ISWS Biennial Conference

Climate-smart Weed Management for Global Food Security

28-30 November, 2024

**VENUE: Banaras Hindu University (BHU)
Varanasi, Uttar Pradesh, India**

Proceedings

Organizers

Indian Society of Weed Science
Banaras Hindu University
ICAR - Directorate of Weed Research
Indian Council of Agricultural Research

Website: http://www.isws.org.in/Conference_2024

Supported by

NABARD

Correct citation of proceedings:
Yadav Ashok, Subramanyam D, Kaur Simerjeet and Dubey RP (Eds.). 2024. *Proceedings of ISWS Biennial Conference on "Climate-smart Weed Management for Global Food Security"*, Banaras Hindu University, Varanasi, India. 363 p.

Correct citation of abstract in proceedings:
Author (s). 2024. Title of the abstract........ P. .... In: *Proceedings of ISWS Biennial Conference on "Climate-smart Weed Management for Global Food Security"*, (Eds. Yadav Ashok, Subramanyam D, Kaur Simerjeet and Dubey RP), Banaras Hindu University, Varanasi, India.

Editors:

Ashok Yadav

D. Subramanyam

Simerjeet Kaur

R.P. Dubey

ISBN Number: 978-81-981439-4-5

9 788198 143945

© 2024 Indian Society of Weed Science (ISWS)

Technical support and Compilation

Gyanendra Pratap Singh

Further information:
Indian Society of Weed Science
ICAR-Directorate of Weed Research
Jabalpur - 482 004, (MP), India
Website: www.isws.org.in
E-mail : iswsjbp@gmail.com
Phone : 91-761-2353138; Fax : 91-761-2353129

Proceedings

ISWS Biennial Conference

on

"Climate-smart Weed Management for Global Food Security"

28-30 November, 2024
Banaras Hindu University, Varanasi, India

ORGANIZED BY
Indian Society of Weed Science, Jabalpur
Banaras Hindu University, Varanasi
ICAR - Directorate of Weed Research, Jabalpur
Indian Council of Agricultural Research, New Delhi

PREFACE

Modern-day agri-food systems across the globe are facing unprecedented challenges of increasing population and climate change. These challenges can be overcome by identifying the constraints and alleviating them through technological innovations in farm sector. Of the biological and physical constraints that need to be alleviated, weeds stand first since the initiation of agriculture by human being, as weeds are pioneers of secondary succession and compete with crops for the resources that are needed for their successful growth and production. In spite of sincere research and extension efforts across the globe and the adoption of weed management technologies by farmers, weeds continue to be the major constraints in agri-food systems.

Climate change has far-reaching impact on crop-weed interactions, weed shifts and herbicide efficacy thus will decide the future course of research and development in weed science. Weed shifts and the development of herbicide resistance in weeds warrant the integration of novel methods of weed management. It is high time to discuss the new happenings in weed science for the development of climate-smart weed management technologies. Indian Society of Weed Science (ISWS) is thus organizing, at this critical time, its Biennial Conference with the theme of "*Climate-smart Weed Management for Global Food Security"* at Banaras Hindu University, Varanasi, India from 28-30 November, 2024. The reputed Weed Scientists from India and abroad will deliberate the issues concerning weed science by presenting their research findings to chalk out future courses of action to meet the current and future challenges posed by the weeds in different ecosystems.

The present publication is a compilation of the abstracts of various presentations being made at the Biennial Conference.

The members of the publication committee have undertaken the voluminous task of compiling, editing and presenting these articles in a systematic manner under the Chairmanship of Dr. Ashok Yadav with Dr. D. Subramanyam as Co-Chairman, Dr. Simerjeet Kaur as the Convener; and Drs. Shobha Sondhia, Narendra Kumar, K.A. Gopinath, P. Prameela, C.M. Parihar, Yogita Gharde, Malay K. Bhowmick, Puja Ray, Dibakar Ghosh, Todar Mal Poonia as members. It is hoped that this publication will be useful to scientists, teachers, students, administrators and policy makers who are concerned with weed management.

We are highly thankful to the herbicide manufacturers, *viz.* Bayer Crop Science Limited, Syngenta, Corteva AgriScience, UPL, ADAMA India Pvt Ltd, BASF, Dhanuka and others for extending financial help to ISWS for organizing the Biennial Conference.

The financial assistance received from the Indian Council of Agricultural Research, New Delhi,| International Rice Research Institute and the National Bank for Agriculture and Rural Development (NABARD) towards this conference is gratefully acknowledged.

28 November, 2024

J.S. Mishra
Convenor, Biennial Conference 2024

R.P. Dubey
Organizing Secretary,
Biennial Conference 2024

and
Publication Committee

ACKNOWLEDGEMENTS

The Publication Committee of the ISWS Biennial Conference is pleased to present the Proceedings containing the ABSTRACTS of various presentations submitted by the Weed Scientists for presentation at the Biennial Conference on *"Climate-smart Weed Management for Global Food Security"* being organized at Banaras Hindu University, Varanasi, India during 28-30 November, 2024. A large number of papers were received covering a wide range of themes from all over India and a few from abroad. These papers were thoroughly reviewed by the members of the committee and others for both technical content and editorial quality.

The Publication Committee noted that though the papers, in general, covered the main theme of the Conference well, the number of papers on weed control in individual field crops far outnumbered than those on other sub-themes. Further, papers on chemical weed control / herbicides usage are many but limited number of papers focused on other control measures and habitat management approaches in integrated cropping/farming systems. The papers on other relevant sub-themes, such as economics, ecology, weed utilization, weed science education, participatory research *etc.* are also comparatively very less. It was noted that large number of papers clearly highlighted the role of weed science in contribution to agricultural productivity.

We thank Dr. J.S. Mishra, President, ISWS and Dr. R.P. Dubey, Secretary, ISWS and Organizing Secretary of this Biennial Conference for giving us this opportunity and providing their guidance and inputs for bringing out this proceedings. The Publication Committee thanks each and every contributing Weed Scientists, who hail from India and abroad, for their sincere efforts in the preparation of the presentation to be made at the Biennial Conference and submitting the "Abstracts" of their Plenary/Lead/Invited oral - presentations/papers, in time for compilation in this publication. Thank you - all the contributing Weeds Scientists.

We appreciate the efforts made by Mr. Gyanendra Pratap Singh, Office Manager, ISWS in processing and formatting of articles, and helping immensely in bringing out the proceedings in a record time.

28 November, 2024

Publication Committee

Ashok Yadav (Chairman)
D. Subramanyam (Co-Chairman)
Simerjeet Kaur (Convener)
Shobha Sondhia
Narendra Kumar
K.A. Gopinath
P. Prameela
C.M. Parihar
Malay K. Bhowmick
Puja Ray
Dibakar Ghosh
Yogita Gharde
Todar Mal Poonia

Contents

ISWS Biennial Conference on "*Climate-smart Weed Management for Global Food Security*", Banaras Hindu University, Varanasi, (India) 28-30 November, 2024.

Keynote lecture

The Future of Weed Science

Robert L. Zimdahl
Professor Emeritus, Colorado State University, Fort Collins, Colorado 80523, USA
Email: R.Zimdahl@colostate.edu
Robertlzimdahl.com

Agricultural scientists, farmers, ranchers, and the agriculture industry remain confident of their basic faith in the possibility of continued increasing production through the intelligent use of ever more efficient agricultural technology and research. Increasing production has been and remains the accepted way to achieve the moral obligation of feeding a growing population. However, many question if the present chemical, capital, and energy-dependent system is sustainable. This brief essay questions if agriculture's moral justification will hold as widespread, rational, scientific, and moral arguments about sustainability, human and environmental harm, public fear of technology, and concern about food quality dominate scientific and public discourse. The future role of the whole agricultural enterprise, weed science, and the ability to feed a growing, demanding world population will be affected.

Promoting the Utilization of Weeds – A Way Forward

Nimal R. Chandrasena
Nature Consulting, 17, Billings Way, Winthrop, WA 6150, Australia
Email: nimal.chandrasena@gmail.com

The utilization of 'weedy' colonizing species for direct human benefits and other practical applications is a much-neglected area within *Weed Science*. It results from an inadequate 'eco-literacy' (i.e. ecological understanding of weeds), which I call 'weed-illiteracy'. Most weed scientists have been brought up hearing a flawed myth that '*all weedy species are bad all the time*', and some may even engulf the world.

Humans present the greatest threat to biodiversity, of which people and weedy species are constituent parts. However unpalatable this message is, it needs to be given much more publicity to achieve a better balance between human greed, the development aspirations of nations, and global biological diversity. A change in attitude and a focus shift are required to redress the issue.

The *Boundary Object* concept provides an opportunity to have meaningful discussions about weedy taxa that have been used as a scapegoat for too long to hide human follies (related to disturbances caused by land-clearing, deforestation, inappropriate forms of agriculture, and excessive population growth). Consensus helps but is not always necessary for cooperation in successfully conducting investigative research. The boundary object approach allows collaborations on investigations of weedy species without always agreeing on divergent viewpoints. These may help ease the tensions and *change our perceptions* of colonizing species. It will also allow weed scientists, trained to think negatively about weeds, to explore the benefits of a positive relationship with a vast array of such taxa and their unique capabilities. Weeds should not be accused as guilty (of harm) until proven innocent!

Colonizing species could assist in achieving the *U.N.'s Sustainable Development Goals* (SDGs) and Millenium Development goals, whose visions have been renewed. These globally-accepted frameworks seek to re-align investments and direct research efforts to improve societal benefits. Seeking ways to derive benefits from weedy taxa should be the basis of their fuller integration into societal needs. Instead of waging an unwinnable war against weeds, there is a convincing case for *living with weeds* for societal and environmental benefits.

Weed Science education must be re-aligned to increase 'weed literacy' by providing a much deeper biological and ecological understanding of weeds among agriculturists and environmentalists. Fast-growing and robust weedy taxa are at the forefront of providing *ecosystem services* in all habitats they occupy. Their ecological roles, including pollination and stabilization of degraded landscapes, are much undervalued within Weed Science.

There is also compelling evidence that calls for broadening the mandate and the direction of *Weed Science* research to include the utilization of colonizing taxa. A 're-think' on how we perceive weeds and weed research should be a priority for everyone concerned about the Planet's future and preserving its biological integrity and diversity.

Plenary lecture -2

Herbicide resistance in weeds and their management under climate change scenario

Samunder Singh
President, International Weed Science Society
Retd. Prof. & Head Agronomy, CCS HAU Hisar, Haryana 125004, India
Email: sam4884@gmail.com

Agriculture was started in India around 9000 BCE and today it is a global powerhouse with the 4th largest producer after China, USA and Brazil; however, a plateau has reached now in increasing further yield per unit area for many commodities and one of the obvious reasons is weeds. Weeds have been associated since we started selective crop cultivation and pose a big challenge in realizing yield potential today. On top of that they usurp significant amount of nutrients, moisture and harbor insects and pests further causing significant increase in the cost of cultivation. Global warming is another threat for enhancing production to India's burgeoning population estimated to be 1.7 bn by 2050. India has already been declared a deficit country when it comes to per capita water availability, and it is projected that water demand will be doubled by 2030 that can reduce country's GDP by 6%. The CO_2 level in the environment has increased from 418.85 to 425.55 ppm from July 2022 to July 2024 and global temperature has increased by 1.5^{O}C from 1980 to 2024 which is a double whammy for India as it will be worst hit by global warming. Increased adoption of HYVs which were highly responsive to higher nutrients and moisture also complicated weed management as they become more competitive and the same is expected with global warming. Herbicides provided great relief for weed management, but their continued use resulted in the evolution of resistant weeds in wheat, rice and soybean making 22 herbicides redundant as the number of resistant weeds increased to 42 and it may further increase if we do not change our management strategy faster than weeds. One method does not work for all the situations if used for long. Herbicide will still form a major part of weed control till they are replaced by robotics or another novel technique like raising indoor crops in total darkness bypassing conventional photosynthesis process. Future weed control recommendations will be field specific taking care of weed based herbicides. Such options could be; crop and herbicide rotations, two or three way mixture of herbicides, sequential application, herbicide rates and timings, water volume, nozzle types, use of surfactants/ efficacy enhancers, precision spray, remote sensing, rapid herbicide resistance detection, drones, in-row robots, use of mulch/straw management, bioherbicides, microbials and MFO's, electric weeders microwave, solar power weeders, nano herbicides, exhausting weed seed germinators/stale seed beds, temperature moderations, herbicide tolerant crops with stack genes, RNAi technology, Bridge RNA with Crispr-CAS9, sterile pollen technology, indoor or vertical farming, hydroponics, agronomic interventions including field preparations and planting methods, seed rate, varietal selection, fertilizer/irrigation scheduling, irrigation automation, integration of micro-irrigation and herbigation/fertigation, bio-stimulants for improving water utilization, plant booster technology, on ground water sensors, climate smart farming, weed biology, use of phenotyping, mechanical tools, sanitation, quarantine, improved spray technology and farmers awareness to name a few.

Lead lecture 1

Impact of global warming on herbicide efficacy and weed control for sustainable food production

Mithila Jugulam
Texas A&M AgriLife Research and Extension Center at Beaumont, TX 77713, USA
Email: m.jugulam@ag.tamu.edu

Global food production needs are steadily rising due to population growth. Significant improvements in food productivity will be essential in the coming decades, particularly in light of global warming. Projections of climate change show increases in season-long mean temperatures and a greater frequency of short-episodes of high temperature during crop growing seasons. These changes will have significant negative impacts not only on the yield of major grain crops but also on weeds. While knowledge on the impacts of season-long high-temperature stress; and the impacts of short-episodes of high-temperature stress on various physiological, growth and yield processes of major crops has increased in the last several decades, such information is still limited in weed species. Changes in global climate factors, including temperature and CO_2 levels can influence agricultural practices including weed control. Invasive plants and weeds can out-perform crops under elevated temperature and CO_2 levels. Temperature is also one of the important factors that can impact post-emergence herbicide efficacy, thereby, weed control. Currently, the evolution of herbicide resistance in weeds poses an increased challenge for weed management across the US. Temperature fluctuation can also alter the level of resistance to herbicides in weeds, and hence, their management. In our lab, we investigated the effect of temperature stress on the efficacy and resistance level of mesotrione, glyphosate, dicamba, and 2,4-D in important weeds of Midwestern agriculture, such as common waterhemp, Palmer amaranth, kochia, giant or common ragweed, and lambsquarters. Our data suggest that warmer temperatures (34/ 20 °C d/n) reduce the control of both 2,4-D-resistant and susceptible common waterhemp, primarily because of the rapid metabolism of 2,4-D at high-temperature stress. Similarly, Palmer amaranth was more sensitive to mesotrione at low (25/15 °C d/n) than high temperatures (40/30 °C d/n), yet again, because of the rapid metabolism of this herbicide at high temperature. Also, at high temperatures, poor control of kochia when treated with dicamba was found, because of reduced translocation of this herbicide. On the other hand, reduced absorption of glyphosate was found to contribute to poor control of kochia at high temperatures. Improved control of common lambsquaters with glyphosate was found when plants were grown at cooler conditions (25/15 °C d/n). In contrast, improved efficacy of 2,4-D or glyphosate occurred at high temperatures (29/ 17 °C d/n) than at low temperatures (20/ 11 °C d/n) regardless of susceptibility or resistance of this weed species to these herbicides. Overall, improved herbicide efficacy and weed (resistant or susceptible) control were found when herbicides were applied at cooler than warmer temperature conditions. These findings imply that future changes in climatic conditions may affect herbicide performance and potentially increase the incidence of herbicide-resistant biotypes.

Lead lecture 2

A new dimension on cost-effective precision weed management strategies in light of climate change

C.R. Chinnamuthu

Emeritus Scientist (ICAR), Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India

Email: crchinnamuthu@yahoo.com

Effective weed control not only increases crop output and quality, but it also reduces competition for resources like water, nutrients, and light. As climate change continues to alter environmental conditions, the dynamics of weed growth and distribution fluctuate, providing new challenges for both farmers and agronomists. Changing weather patterns, which include higher temperatures, changing precipitation regimes, and extreme weather events, have a considerable impact on weed populations. In response to these issues, the implementation of cost-effective precision weed management strategies is becoming increasingly important. These strategies use advanced technology like GPS mapping, remote sensing, and data analytics to optimize weed control efforts. The integration of precision agriculture techniques into weed management not only addresses the immediate challenges posed by climate change but also promotes sustainable practices that can safeguard food security in the long term. Key techniques include Integrated Weed Management (IWM), site-specific herbicide application, and the incorporation of advanced technologies such as drones and sensors. Site-specific herbicide application represents another significant advancement in precision weed management. This technique involves using data-driven insights to apply herbicides selectively based on weed density and distribution within a field. The adoption of precision weed management techniques presents significant cost advantages when compared to traditional weed control methods. Studies have shown that this targeted approach can reduce herbicide use by up to 50%, translating to substantial savings. By embracing these innovative techniques, farmers can not only enhance their operational efficiency but also contribute to a more sustainable and economically viable agricultural landscape. As the agricultural industry seeks more efficient and sustainable methods for weed management, emerging technologies are paving the way for innovative solutions. Notably, machine learning, artificial intelligence (AI), and automated weeding machines are at the forefront of this transformation, offering both promising benefits and significant challenges. AI-driven decision-making tools further enhance precision weed management by providing real-time insights and recommendations. These tools can process data from drones and ground sensors to identify weed infestations with high accuracy. For example, an AI system might suggest the optimal timing and location for herbicide application based on current and forecasted conditions. Automated weeding machines represent another exciting advancement in weed management. These machines utilize robotics and computer vision to differentiate between crops and weeds, allowing for targeted weeding without the use of herbicides. Herbicide performance in tropical environments is frequently erratic and ineffective in weed control. This is especially true for soil-applied herbicides, when high temperatures, heavy rainfall, low soil organic matter, and microbial activity result in rapid breakdown and leaching. In contrast to irrigated conditions, rainfed environments have insufficient soil moisture, which limits herbicide use. Studies have shown that nano-encapsulated herbicides are effective in both rainfed and irrigated areas. For example, nano-encapsulated pendimethalin employing manganese core-hallow shell technology remained unaffected by high temperatures until exposed to rain under rainfed conditions. Nano-encapsulated sulfentrazone and dioclosulam also performed well in rainfed and irrigated conditions. Thus, nano-encapsulated herbicides show greater potential for improving herbicide efficacy in both rainfed as well as irrigated production systems. In conclusion, the climate change continues to alter environmental conditions, the dynamics of weed growth and distribution are increasingly unpredictable. This necessitates a comprehensive reevaluation of existing management practices to adapt to new agricultural challenges.

Closing yield and profitability gaps caused by weeds in smallholder rice production

Virender Kumar
International Rice Research Institute (IRRI), Los Baños, Philippines
Email: virender.kumar@irri.org

Rice is the staple food for over half of the world population, hence crucial crop for global food security. To meet the increasing global rice demand by 2050, an estimated additional 75 million tons of milled rice will be needed. The challenge is that this additional rice must be produced while using fewer resources and adapting to changing climate conditions to ensure food security, and environmental sustainability. Closing yield gaps caused by weeds could help in achieving this target. The drivers such as labor and water scarcity, rising production costs, and climate change are causing shifts in farming practices in Asian smallholder rice systems leading to changes in weed management practices. Farmers are transitioning from puddled transplanted rice (PTR) to more efficient systems like direct-seeded rice (DSR), flooded to alternate wetting and drying (AWD) irrigation system, and from hand-weeding to herbicide-based weed control. Weeds are the biggest constraint in the wide-scale adoption of these new systems (DSR and AWD) and many weed-related issues/challenges have emerged including (1) higher risk of yield losses due to higher weed infestation; (2) evolution of weedy rice which poses a serious threat to DSR sustainability; (3) shifts in weed flora towards difficult-to-control weeds; (4) increased dependence on herbicides resulting in the evolution of herbicide-resistant weeds; and 5) weed management becoming more knowledge-intensive. Additionally, large knowledge and information gaps exist in farmers' current weed management practices. A huge opportunity exists to close yield and profitability gaps of smallholder rice farmers caused by weed competition by (1) developing robust weed reconnaissance systems for monitoring troublesome weeds and characterising farmer's weed management practices at scale for problem targeting and early warning, (2) developing and deploying robust integrated weed management (IWM) programs, and (3) creating enabling environment for wide-scale adoption of IWM. A scalable approach developed by Cereal Systems Initiative for South Asia (CSISA, www.csisa.org) to capture spatial distribution of most common and troublesome weeds infesting smallholder's rice fields and understanding farmers' weed and crop management practices to identify entry points to close yield gaps using a digitally-enabled survey instrument and an efficient crowd-sourcing method based on farmer knowledge will be presented. In addition, novel integrated weed management practices developed to address weed management challenges in direct-seeded rice including soil mulching, weed competitive cultivars, new herbicide molecules to control mixed weed flora, herbicide-tolerant rice technology, use of drone technology for weed control, and managing weed seed bank will be presented.

Lead lecture 4

Climate-smart weed management in pulse crops for sustainable productivity and profitability

Narendra Kumar*, C.P. Nath, K.K. Hazra and Mohammad Hashim
ICAR-Indian Institute of Pulses Research, Kanpur, Uttar Pradesh 208024, India
**Email: nkumar.icar@gmail.com*

Climate change and food and nutritional insecurity are two major challenges of present agricultural production systems. Weeds can impair food production in the agricultural system, diminishing product quality and soil fertility, due to the emulation for the natural resources. On the contrary, weeds can also be looked as the valuable indicators of biodiversity because of their role in delivering ecosystem services and thus, there is a need to carry out an efficient and sustainable weed management action integrating locally feasible control methods (preventive, cultural, chemical, biological and mechanical). Managing weeds has always been placed at the centre of the pulses production systems for obtaining higher yields. Presently, weed management in pulses can be broadly divided into two approaches, first based on widespread use of synthetic chemicals (herbicides) and second widely based on physical, cultural and mechanical methods. Under climate change, it is not possible to rely on one method to control weeds in pulses. Recently during *Kharif* 2024, due to continuous rainfall and cloudy weather in Kanpur, it was not possible to use either herbicide or mechanical method to control weeds in pulses. Therefore, integrated weed management (IWM) strategies need to be developed for efficient weed management in pulses under climate change. Although, it is well acknowledged that climate change will have an effect on the long –term relationship between weeds and crops, the precise nature of these effects is still unknown. Thus, knowledge of weed biology and ecology is utmost important to decide the combinations of weed control measures under IWM. Herbicide is a dominant weed control tool and more effective than other methods in modern agriculture. But, there are several limitations for its use in pulses like limited availability of herbicides (pre- and post-emergence), toxicity of herbicides used in other crops in rotation, weed shift, development of resistant weeds due to use of 1-2 herbicides, etc. The cultural practices usually do not incur extra-cost for weed management. These practices include: competitive crops/crops cultivars, tillage, geometry, time, method, rate and depth of sowing. It also includes the kind, time, method and rate of fertilizers application time, method, and frequency of irrigation, intercropping, stale seedbed, brown manuring, crop rotation. Crop diversification is an important aspect that restrict the weed population but other side increases the weed biodiversity and hence reduces the weed dominance. This kind of observations we have recorded in a long-term conservation agriculture (CA) study at Kanpur. It was also observed that the crop cultivation practices followed in the cropping systems affect the weed population in the pulse crops. Less weed population in chickpea was recorded when it was taken after puddle transplanted rice over DSR. Similarly, growing sesame in *Kharif* season reduces weeds in subsequent *Rabi* season pulse crops. ICAR-IIPR has developed small tools like manual weeder and herbicide applicator suitable for pulses which can be promoted among pulses growers. Following CA practices like ZT, residue retention and crop diversification are the other important aspect which can minimise the weed pressure in pulse crops. Many other practices like use of modern technologies, *viz.* drones, AI based machineries, weed mapping, robot, site specific weed management, biotechnology, etc. need to be integrated in future under IWM for efficient and economical management of weeds for sustainable pulses production.

Lead lecture 5

Role of weed management technologies for farm profitability and sustainability

Makhan Singh Bhullar
Director of Extension Education, PAU, Ludhiana, Punjab 141004, India
Email: bhullarms@pau.edu

Global agricultural production must increase by around 70% to meet the food and nutrition demands of 9.9 billion people by 2050. Weed management technologies help enhance farmers' profitability by directly addressing one of the biggest threats to crop yields and number one pest – weeds. Traditionally, majority of Indian farmers practised manual weeding, for management of weeds. Currently, herbicides have assumed a great significance as a major weed management tool, owing to labor shortage and its rising costs. Chemical weed control tactics play a significant role in modern weed management as it maintains productivity of diverse cropping systems, prevents yield losses by weeds and facilitate conservation tillage systems. However, the evolution of resistance to herbicides in weed populations is a real threat to sustainable food production. In north-west India, farmers are struggling to control resistant populations of *Phalaris minor* and *Rumex dentatus* in rice-wheat cropping system. Herbicides will continue to play a significant role as a major tool of weed control, but weed science must develop and incorporate low-input/low-cost/non-monetary practices to generate integrated weed management (IWM) systems that reduce selection pressure and environmental degradation. The inclusion of herbicides with various non-monetary, low-input, low-cost resource conservation techniques like zero tillage, change in establishment methods, planting pattern, good water and fertilizer management, stale seed bed, mulching, green or brown manuring, timeliness of operations and other cultural methods could be the component of IWM and, are being practised in recent years to reduce herbicide load in the ecosystem. In north-west India, adoption of Happy Seeder, Smart Seeder and Surface Seeder for sowing of wheat could serve as a boon in management of herbicide resistant *P. minor* populations besides other advantages of crop residue mulching. IWM, besides controlling existing weed problems, puts greater emphasis on preventing weed reproduction, establishment and minimizing weed competition with crop. Effective and sustainable weed management involves the combined use of preventive, cultural, mechanical, chemical, and biological weed control techniques in an effective and economical way. Stale seedbed practice has been found very effective in reducing infestation of volunteer rice plants of previous season. Development of non-transgenic herbicide tolerant basmati rice varieties is another step in efficient weed management. The adoption of different weed management technologies leads to increase in crop yields, by reducing crop-weed competition. An integrated approach using knowledge of weed biology, improved agronomic practices, cultural, chemical, and mechanical control methods, sanitation, quarantine, and farmers' awareness are indispensable components for successful weed management. In recent years, more emphasis is on digital agriculture and promoting use of advanced herbicide application technologies, such as drones, and sensor-based precision sprayers which can target weeds precisely and reduces herbicide usage. This will help in reducing input costs and environmental impact, making farming more sustainable. Farmers need to be educated through awareness camps, training programmes, field days and field-scale demonstrations for up-scaling and out-scaling the adoption of practically feasible, economically viable, scalable, and sustainable weed management technologies.

Weed management under conservation agriculture systems

T.K. Das* and Rishi Raj
Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India
**Email: tkdas64@gmail.com*

The land use pattern has huge influence on the composition of weed flora, which is in a continual state of change. The levels of disturbance of a habitat and the changes brought in agronomic practices (tillage, mulching, fire, flooding, drought, *etc*.) towards raising a crop trigger weed dynamics over time. Weeds have a wider ecological amplitude that determines their adaptability and ubiquitousness. Conservation agriculture (CA) is a concept of resource-saving agricultural crop production system that strives to achieve maximum acceptable profits together with high and sustained production levels, while concurrently conserving the environment. It is based on three interlinked principles: continuous no/zero/ minimum mechanical soil disturbance by direct planting, permanent vegetative soil cover or mulch to protect soil surface, and diversification of cropping systems including legumes. It is a paradigm shift from conventional agriculture. The CA-based crop management technologies are said to be more efficient, use less input, improve production and income, and address the emerging problems. Additionally, the secondary drivers, such as: (i) availability of new farm machinery, (ii) availability of new biocide molecules for efficient weed, insect-pests, and diseases control, (iii) ever-decreasing labour force and ever-increasing labour cost, (iv) increasing production costs, energy shortages, erosion losses, pollution hazards and escalating fuel cost, and (v) residue burning, have accelerated a change in thinking of researchers, policy makers and farmers to adopt modified methods for cultivation of crops aimed at improving productivity and resource-use efficiency. Continuous residue cover and no/minimal disturbance of soil under CA provides specific microclimate for weeds in crop fields and herbicide continues to be the sole option for weed control. CA can break productivity barriers and preserve resources, but faces challenges from weeds and weed management remains crucial under zero-till residue-laden conditions. Crop residues, essential for success can harbor pests while herbicide efficacy and availability remain important issues. Shift in weed flora and the small landholding of farming also complicate CA adoption. Preventive weed control is critical in CA to reduce the seed bank. Techniques like stale seed bed, adjusting sowing time, bed plating, residue mulching, and brown manuring, combined with cultivar selection and crop rotation, significantly reduce weed infestation while enhancing productivity and resource efficiency in CA systems. CA highly relies on herbicides having limited weed control options under no/reduced tillage. The “5R Stewardship” approach, choosing the right herbicide, right source, right dose, right time and right method ensure effective weed control while minimizing environmental impact. Herbicides control weeds *albeit* trigger dynamics over time, depending on the nature and spectrum of weed control. Application of higher dose of herbicides, granular formulations, non-selective herbicide during off-season, high volume rate for pre-emergence herbicide application and preferential application of post-emergence herbicides are required to increase the herbicide efficacy under CA. Herbicide tolerant crops (HTCs) that support no till farming by using non-selective herbicides can be a vital component of the weed management programme. An integrated weed management (IWM) practice involving tillage, residue, cover crops, intercrops, herbicides, HTCs would go a long way towards efficient weed management under CA.

Lead lecture 7

Integrated weed management in seed spices

Arvind Verma* and Ruchika Choudhary
Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: arnd_verma@rediffmail.com*

Seed spices such as fenugreek, coriander, fennel, cumin, ajwain, nigella, aniseed, celery, and dill are globally recognized for their culinary and therapeutic uses. They are crucial to agriculture, particularly in India, which is the largest producer and exporter of key spices, including coriander, cumin, fennel, and fenugreek. In 2023-24, the states of Rajasthan, Gujarat, and Madhya Pradesh led India's seed spice production, with Rajasthan and Gujarat accounting for over half of the nation's coriander and cumin output. India's dominance in this sector is underscored by its contribution to around 75% of global seed spice exports, earning it the title "Land of Spices." Seed spices are typically grown in semi-arid and arid regions with dry or cool climates, though they are highly susceptible to weed invasions, especially in early growth stages. Competition with weeds for essential resources such as nutrients, water, and sunlight can result in yield losses of up to 91%. Effective weed management, therefore, becomes essential for sustaining high yields and protecting the economic interests of farmers. Integrated Weed Management (IWM) provides a promising solution, blending cultural, mechanical, physical, and chemical practices to manage weeds sustainably and support robust crop growth. Integrated Weed Management (IWM) is essential for sustainable seed spice cultivation, combining cultural, mechanical, physical, and chemical methods to control weeds and improve crop productivity. Cultural practices lay the groundwork for IWM by creating conditions that favor crop growth and inhibit weed establishment. Techniques such as tillage, optimized planting, timely fertilization, and irrigation support stronger crop development, reducing the competitive edge of weeds. While, cultural methods alone may not completely eliminate weeds, they are highly effective at suppressing them. For example, intercropping fenugreek with 10-20% barley can enhance productivity and reduce weed biomass by 8-45%. In organic coriander systems, fenugreek serves as a natural mulch, effectively suppressing weed growth. Mechanical methods, like hand weeding and hoeing, further support IWM by removing weeds during critical crop growth stages. Research demonstrates that two hand weedings at 20 and 40 days after sowing (DAS) in fenugreek provide effective control, while in nigella, hoeing at 20-25-day intervals is beneficial. Studies reveal that combining these mechanical methods with herbicides, such as pendimethalin or oxadiargyl pre-emergence treatments, improves weed suppression and crop yields, particularly in cumin and coriander. Physical methods, including mulching and soil solarization, also contribute to effective weed control. Mulching involves covering soil with organic or synthetic materials, blocking sunlight to inhibit weed growth while retaining moisture for crops. Soil solarization, which uses heat to sterilize soil during fallow periods, effectively controls annual weeds, though some resilient perennial species like *Cyperus rotundus* and *Cynodon dactylon* may require additional management. Although used sparingly, chemical herbicides remain important in IWM, offering targeted control with minimal environmental impact when used alongside non-chemical methods. For coriander, pre-emergence applications of oxadiazon at 0.5 kg/ha or pendimethalin at 0.75 kg/ha are effective, creating favourable growth conditions. In fennel, pendimethalin at the same rate provides similar control, while in dill, a combination of pendimethalin (500 g/ha) pre-emergence with oxadiargyl (75 g/ha) post-emergence effectively maintains weed-free conditions. In conclusion, IWM in seed spice cultivation promotes sustainable weed control, balancing productivity with ecological health. By integrating diverse management strategies, IWM reduces weed pressure and fosters resilient cropping systems that are vital for India's agricultural sector. As farming practices evolve, adopting IWM will be crucial for securing food security, boosting the economy, and supporting farmers who rely on seed spice cultivation for their livelihoods. This integrated approach ensures a productive, sustainable future for seed spice farming.

Lead lecture 8

Biological control of weeds by using plant pathogens: Now and in the future

Raghavan "Charu" Charudattan
Emeritus Professor of Plant Pathology and Weed Science, University of Florida, USA
President & CEO, BioProdex, Inc., Gainesville, USA
Email: rcharu@ufl.edu

Since the 1980s, there has been sustained interest in exploring plant pathogens as biological control agents of weeds. There are several examples of success in managing terrestrial invasive weeds with non-native, introduced pathogens as classical biocontrol agents, success being defined here as a satisfactory level of control of the target weed with no additional controls needed. Worldwide, of 36 non-native pathogenic fungi introduced against 32 invasive weeds, 11 have produced substantial levels of control of their target weeds in at least one of the counties where they were introduced. Impacts from other introductions have ranged from variable (8), medium (6), slight (5), none (failed to establish [4], and unknown [2]). So, while not all have been successful, nearly half (substantial + medium, 17/36) have achieved their intended purpose. Post-release and post-establishment safety of established agents have confirmed no untoward risks to non-target species. Two outstanding successes are the control of *Acacia saligna* (Port Jackson willow) in South Africa by the gall-forming rust fungus *Uromycladium* morrisii imported from Australia and of *Ageratina riparia* (croftonweed) by the smut fungus *Entyloma ageratinae*. The latter was first introduced from Jamaica into Hawaii and following its success there, was released into South Africa and New Zealand and spread naturally to Australia. It has successfully controlled the weed in all three countries. In theory, the classical biocontrol strategy is unlikely to be effective for agricultural weeds in croplands. For this reason, the bioherbicide approach was developed using native pathogens, mostly fungi. Of the 17 bioherbicides registered since 1981, eight remain registered and two (Di-Bak Parkinsonia [*Lasiodiplodia pseudotheobromae*, *Macrophomina phaseolina*, and *Neoscytalidium novaehollandiae* for *Parkinsonia aculeata*] and SolviNix [Tobacco mild green mosaic tobamovirus Strain U2 for *Solanum viarum*]) are commercially available. They are used for controlling terrestrial non-crop weeds. Controlling weeds in commercial agriculture with bioherbicides has proven a remarkable failure; there is not a single bioherbicide that can be rated "successful" based on the extent (area) of use or volume of sales. While gaining registration is a major step towards success, no bioherbicide has been used as a stand-alone control measure or a significant component of integrated management of a weed problem in crops. Nonetheless, measuring bioherbicide success solely by use and sales numbers would cause us to overlook examples such as Hakatak (*Colletotrichum gloeosporioides* for *Hakea sericea*), SolviNix, and Stumpout (*Cylindrobasidium laeve* for *Accacia mearnsii*) that are serving client needs on an on-demand basis. Looking to the future, the recent success in registering a plant virus as the bioherbicide SolviNix serves as a catalyst for exploring viruses, thus far a neglected group of pathogens, as weed control agents. The viruses themselves as well as virus-elicited cell and plant death should be explored to develop new classes of herbicides and new modes of herbicidal action.

Lead lecture 9

Monitoring herbicide residues under climate change

Shobha Sondhia
ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India
Email: shobhasondia@yahoo.com

Weeds in general cause approximate one third crop yield losses and are more harmful than any other crop pest *viz.* insects, fungi or plant disease in all agro-ecosystems. According to an estimate, approximately 10% yield losses caused by the weeds will be equal to the approximately ~2294 million metric tons. This estimate further warns the future agriculture food production and food demand in coming future. Therefore, to obtain sustainable crop production and to ensure the food security to the increasing population, effective weed management is required throughout the crop growth period. The agriculture practices and agricultural productivity are strongly impacted by the local weather and climate change in larger expect. Due to continuous variation in the pattern of local weather due to changing climate, chemical weed management aspects of farming practices and cropping systems needs to be optimized. Atmospheric CO_2 level has been increasing at an unprecedented rate, reached to 426 parts per million (ppm) in mid-2024 (https://www.co2.earth/daily-co2), and are projected to exceed 700-1000 ppm by the end of the 21st century. Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years. Global climate change mainly increasing temperature and elevated carbon dioxide levels and its associated impact on weed management is one of the greater challenge which is expected to play an important role in the agricultural production systems across the globe. Due to the differential response of C_3 and C_4 weeds and quick dissipation of several currently used herbicides under increasing CO_2 levels and temperature, more frequent and repeated use of herbicides is expected. This may further worsen the development of herbicide resistance in weeds due to strong selective pressures exerted by herbicides. High soil temperatures primarily affect the efficacy, fate and persistence of soil-applied herbicides by decreasing permeability and increasing volatility and microbial breakdown. Reduced efficacy of several pre and post-emergence herbicides of a different mode of action under increasing CO_2 levels and temperature is reported such as, atrazine, acetochlor, bispyribac-sodium, carfentrazone, cyhalofop-butyl, fenoxaprop-p-ethyl, glyphosate, glufosinate, linuron, metsulfuron, paraquat, pinoxaden, penoxsulam, triallate, tribenuron-methyl etc. Higher temperatures in general cause enhanced herbicide metabolism, which consequently decreases herbicidal activity on targeted plants. However, the interaction effect of temperature and genotype on the translocation of some herbicide such as ^{14}C-cyhalofop-butyl was not reported as significant. Less occurrence of herbicides residues is reported due to quicker dissipation under changing climate. Therefore, the use of low volatile herbicides and their mixtures, and slow release herbicide formulation may be useful for effective weed management under predicted climate change. Besides this, an integrated and holistic approach would be imperative to tackle weeds to minimize environmental contamination due to excessive use of herbicides under climate change scenario specifically in response to elevated CO_2 and rising temperature in upcoming future.

Management of *Orobanche* in mustard

R.S. Jat, A Agrawal, S. Kala, Nusrat, R.L. Choudhary, H.V. Singh, J. Kumar and P.K. Rai
ICAR-Directorate of Rapeseed-Mustard Research, Bharatpur, Rajasthan 321303, India
Email: rsjat73@gmail.com

Egyptian broomrape (*Phelipanche aegyptiaca* Pers.) is an obligate holo-root parasitic weed which is most difficult-to-control among all biotic stresses in several crops including oilseed brassica in Asia, Mediterranean, and central and Eastern Europe. Compared with non-parasitic weeds, the control of E. broomrape has been proved to be exceptionally difficult in crops due to its underground location, close association with host plant roots, complex mechanisms of seed dispersal, germination, and seed longevity, and become ‘a peril to farmers’. Because the parasite germinates only in response to the host root exudates, underground development on the host plant for the major part of its life, it is inaccessible to conventional control methods such as tillage and herbicide treatments. When it becomes visible above the ground surface (not necessary), much of the damage has already been done to the host crop, and control measure becomes a futile exercise. Its management is a challenge worldwide because of its bio-physical-genetic connection with the host plants and its ecological affinity. Chemical and non-chemical innovative herbicide formulations (IHF) of different concentrations were developed and evaluated at a pilot scale to control E. broomrape in Indian mustard. These formulations were applied as pre-emergence in Indian mustard with the hypothesis of selective and target-site-herbicide-delivery. Replicated field trials were conducted with host crop ‘Indian mustard’ under semi-arid environment in the hot-spot areas of E. broomrape. The experimental site was located between 26.997-27.032° N latitude and 77.272-77.383° E longitude at 183 m above the mean sea level on the bank of Utangan river. The climate is semi-arid (moisture index: -55 to -45) with a hot summer and a short monsoon (about 700 mm rainfall during July–September). The soils of the location were sandy loam, poor in organic carbon and available N, and medium in available P and K. Results were significantly promising and controlled E. broomrape infestation with the pre-emergence pray of different variants of IHF. Simple and complex formulations like suspension concentrate, suspo emulsion and zumbo combination of chemical and non-chemical herbicides were found quite effective and controlled Orobanche successfully. Results of multiple field trials showed that IHFs significantly reduced Orobanche infestation under hot-spot conditions with an average weed control efficiency of 85% compared to weedy check plots. Also, recorded a lower weed index and higher seed yield under hot spot conditions compared to weed-free plots. The phytotoxicity and residual studies were also conducted and found no significant effects due to IHFs. Thus, IHFs were found as quite effective and instant control measure of E. broomrape in Indian mustard. The repeatability of results in other vegetable and field crops as well as in different ecologies is to be tested in future to selectively eradicate this perilous weed. Commercial application of such novel formulations can also address the problem of herbicide resistance, environmental degradation and ecological disturbances, and can revolutionize the herbicide industry at large. Thus, the development of IHFs by integrating chemical and botanical-based herbicides together should be explored commercially for safe and sustainable weed management in future, especially parasitic weed management.

Invited oral lecture 1

Integration of pre-emergence herbicide with imazethapyr for sustainable weed control in HT rice

Simerjeet Kaur*, Tarundeep Kaur, Manpreet Singh, Pervinder Kaur, Jasvir Singh Gill and M.S. Bhullar

Punjab Agricultural University, Ludhiana, Punjab 141004, India

Email: simer@pau.edu

Weed infestation is the major setback in direct-seeded rice (DSR) which results in yield loss ranging from 15–20%, but in severe cases, it may exceed 50% or even can cause complete failure. Herbicide-tolerant (HT) rice especially, non-transgenic HT rice could be a futuristic option for DSR and an effective and long-term solution for weed management. However, meticulous stewardship guidelines are required for the effective utilization of HT rice in the long run. Burgos *et al.* (2008) has outlined guidelines for HT rice production system in which they stressed upon implementation of an herbicide program which in-cludes herbicides with different mode of action available for rice cultivation in all possible com-binations. Keeping this in view, a field experiment on weed control options in HT rice was planned with 11 treatments during *Kharif* 2024 at PAU, Ludhiana. Treatments comprised of application of imazethapyr 100 g/ha and 125 g/ha as early post-emergence, at 12-15 days after sowing, DAS (Early-PoE); sequential use of imazethapyr 100 g/ha as early-PoE followed by (*fb*) as PoE, at 25-30 DAS; imazethapyr 100 g/ha as pre-emergence, within 2 days of sowing (PE) *fb* imazethapyr 100 g/ha as PoE; pendimethalin 750 g/ha as PRE *fb* imazethapyr 100 g/ha and 125 g/ha as PoE; pendimethalin plus penoxsulam 625 g/ha *fb* imazethapyr 100 g/ha and 125 g/ha as PoE; florpyrauxifen plus cyhalofop 150 g/ha as early-PoE; florpyrauxifen plus penoxsulam 40.63 g/ha as early-PoE and weedy. The experiment was conducted in randomised complete block design with three replications. Application of imazethapyr as PRE was ineffective for controlling grasses such as *Dactyloctenium aegyptium*, *Eleusine indica and Eragrostis japonica* but controlled sedges and broadleaf weeds at 25 DAS. Pendimethalin as PRE controlled grasses, however it was ineffective on sedges, its premix resulted in effective control of all weeds at 25 DAS. The follow-up spray of imazethapyr as PoE after pendimethalin (PE) resulted in 100% control of *Cyperus iria* at 40 DAS. At 40 and 60 DAS, sequential application of imazethapyr as early-PoE and PoE; pendimethalin plus penoxsulam *fb* imazethapyr as PoE was equally effective in controlling all grasses, broadleaf weeds and sedges including *Echinochloa crus-galli, Echinochloa colona, Digitaria sanguinalis, Dactyloctenium aegyptium, Leptochloa chinensis, Eleusine indica, Eragrostis japonica* and *Cyperus iria*. Thus, applying herbicides of different modes of action (according to good weed management practices) in HT rice will help in delaying the evolution of herbicide resistance in weeds and in return will result in sustainable weed control.

Invited oral lecture 2

Weed dynamics in deep water rice in varying land situations along the Brahmaputra river ecotone zone in erstwhile Sibsagar district, Assam

Iswar Ch. Barua*[1], Rashmi Rekha Borah[2] and Animesh Gogoi[2]
[1]*AICRP on Weed Management, Assam Agriculture University, Jorhat, Assam 785013, India*
[2]*Department of Botany, Assam Downtown University, Guwahati, Assam 781026, India*
**Email: iswarbarua0101@gmail.com*

Deepwater rice (DWR) is grown in flooded conditions with water more than 50 cm deep for at least a month and is characterized by its ability to sustain in areas prone to flooding or with high land submergence. DWR is also known for its high nutritional value. Among the states of India, Assam showed the highest percentage of DWR cultivation area which is about 20 per cent representing approximately 1 lakh hectares. To explore the weed dynamics in DWR in the Brahmaputra ecotone of the erstwhile Sibsagar district of Assam the study was conducted by random plotting of 1 square meter quadrats during 2020 to 2024 in the areas along the river Brahmaputra in five distict situations, namely (i) Temporary sandy-silty islands of Dhodang chapori, (ii) Permanent River Islands in Sikoli chaport, (iii) Permanent edges of mainland in Dhodang chapori, (iv) Permanent edges at the mouth of river Dhansiri (a tributary of Brahmaputra) at Chhahala chapori and (v) Perment river banks of mainland at Disangmukh. Soil pH of the area varied from 5.6 to 6.9. The climate experienced in the study area was subtropical with a warm humid summer and cool dry winter with an average annual rainfall of 1900-2100 mm. The results revealed the prevalence of grasses in crop establishment phase (CGS-1) in all the situations starting from 45-47% Importance Value Index in the riverbeds of edges, 54.4% in permanent banks and 70-73.5% in the river islands; that continued to 58-65% in most of the river beds to the crop maturity phase (CGS-3), except the permanent edge along the Brahmaputra (where sedges became dominant to the extent of 47.9%) and the permanent bank with 16.2% dominancy might be due to the effect of stagnation of water for a prolonged period. *Cynodon dactylon* was the most successful weeds in the DWR in the sandy-silty beds irrespective of land situations along the river Brahmaputra, while *Arundo donax* in the mouth of river Dhansiri. Farmers used to utilize monsoon flood in minimising the weed pressure in DWR, which was found to be least effective in the river ecotones than in mainlands along the banks. The dominance spectrum of DWR weeds was changed by monsoon flood from *Cynodon-Alternanthera-Paspalum* complex to *Eichhornia* led aquatic and semi-aquatic weed flora in the river bank situations. Among the prevalent weeds from CGS-1 to CGS-3, *Echinochloa colona* and *Paspalum distichum* showed positive growth in temporary islands, *Eleusine indica* and *Eleocharis geniculata* in permanent islands and *E. geniculata*, *Cynodon dactylon* and *Cyperus halpan* in permanent edges. The Shannon and Wennier Diversity Index has shown an increasing trend in weed flora of both temporary and permanent river islands, whereas, a declining trend in river edges and river bank situations from CGS-1 to CGS-3.

Invited oral lecture 3

Weed management in chickpea through broad spectrum post-emergence herbicides

A.S. Rao* and G. Santosh Kumar

J Farm and PTC (TAFE Unit), ARI, PJTSAU, Rajendranagar, Hyderabad, Telangana 500030, India

Email: atlurisrao@gmail.com

In chickpea (*Cicer arietinum* L.), the non-availability of suitable broad spectrum post-emergence herbicide particularly for the control of broadleaf weeds was identified as one of the research gaps for the last two decades or so. Keeping this in view, a field experiment was conducted for two consecutive years during *Rabi* 2022-23 and 2023-24 at J Farm, Agricultural Research Institute, Rajendranagar, Hyderabad to evaluate the efficacy of different broad spectrum post-emergence herbicides on weed control, yield and economics of chickpea. The experiment was laid out in a randomized block design with three replications comprising of seven treatments viz. imazethapyr at 50 g/ha, topramezone at 15 g/ha, ready mixes of, sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ ha, fomesafen 2.5% + fluazifop-butyl 12.5% at 250 g/ha, imazethapyr 3.75% + propaquizafop 2.5% at 125 g/ha, hand weeding at 15 and 30 DAS (days after sowing) and weedy check. The major weed flora of the experimental plots consisted of *Echinochloa colona, E. crus-galli, Dinebra retroflexa, Dactyloctenium aegyptium, Panicum repens, Leptochloa chinensis, Leersia hexandra* (grasses), *Cyperus rotundus, Fimbrystylis milliacea* (sedges), *Trianthema portulacastrum, Chrozophora rottleri, Celosia argentea, Cleome viscosa, Cynotis axillaris, Parthenium hysterophorus, Alternanthera sessilis, Nicotiana plumbaginifolia, Ageratum conyzoides, Abutilon indicum* (broad leaf weeds). Results indicated that all the post-emergence herbicides applied at 25 DAS significantly reduced weed growth and increased crop growth and yield over weedy check. Among the post-emergence herbicides, the highest weed control efficiency (WCE) of 61.5% and 60% was obtained with application of sodium salt of acifluorfen 16.5% + clodinafop -propargyl 8% at 200 g/ha at 60 DAS and at harvest, respectively. However, all the post- emergence herbicides applied at 25 DAS caused crop injury ranging from 10 to 16% at 14 days after herbicide application but crop gradually recovered later. Among the post-emergence herbicides tested, though the highest yield of 1,012 kg/ha was obtained with application of sodium salt of acifluorfen 16.5% + clodinafop-propargyl 8% at 200 g/ha but it was on par with all other post-emergence herbicides. There was an increased yield of 89% obtained with this treatment compared to weedy check. Higher net monetary returns and benefit cost ratio (BCR) of 1.22 were also obtained with this treatment. The next best treatment was post-emergence application of topramezone at 15 g/ha with seed yield of 1,000 kg/ha, net monetary returns of Rs.32,785/- and BCR of 1.20. Weed competition during the crop growth period due to uncontrolled weed growth caused 60% yield loss in chickpea compared to hand weeding at 15 and 30 DAS which had the highest seed yield (1,326 kg/ha) among all the treatments under study. Thus, it can be concluded that post-emergence application of sodium salt of acifluorfen 16.5%+ clodinafop-propargyl 8% at 200 g/ha was found to be effective and economical compared to other post-emergence herbicides under study. In view of initial crop injury in all the post-emergence herbicides under study, the future research emphasis on the identification of safe and selective broad-spectrum post-emergence herbicides in chickpea should be continued.

Integrated weed management framework for oilseeds: A path towards self-sufficiency

Kulasekaran Ramesh
ICAR-Indian Institute of Oilseeds Research, Hyderabad, Telangana 500030, India
Email: kragronomy@gmail.com

Recent developments in weed management in oilseed crops have strongly focused on screening herbicides for oilseed crops both pre-emergence as well post-emergence as the oilseed crops are highly sensitive to the herbicides. Further, as more than 70% of the oilseed area is concentrated in rainfed ecology, difficulty in mechanical weed management methods, besides, increasing the efficiency of herbicides are the major concerns. To increase the productivity as well as sustainability of the oilseed production system, a paradigm shifts in weed management is the urgent need of the hour: integrated weed management (IWM) with more focus on herbicidal weed management. The framework consists of four pillars: cropping systems approach, crop stand and its establishment, tillage strategies and chemical weed management. Currently, herbicide-based weed management strategies are widely used to control weed populations in oilseed fields, although very sparsely. A study on sesame has reported that imazethapyr 75 g/ha applied as a post-emergence at seedling stage was toxic to sesame and caused adverse effects on sesame. However, a pre-mix product, pendimethalin 30% + imazethapyr 2% EC (750+50) g/ha applied as a pre-emergence herbicide achieved significantly highest sesame yield and 65% weed control efficiency even without any additional hand weeding. Similarly, pyroxasulfone applied at 2 WAP caused up to 25% sesame injury (stunting) but did not result in a yield reduction. However, pyroxasulfone as a pre-emergence herbicide did not cause any injury to sesame and achieved good weed control. There are several questions that emerge here: Whether the crop is sensitive to an herbicide or the stage of the crop or both? The key, of course, is making sense of the results. Many post-emergence herbicides, though effective at controlling weeds, can cause crop phytotoxicity or stunted growth initially and yield loss is imminent. The primary objective of the PoE spray should be to evaluate the post-emergence herbicides designed for season-long weed management in oilseed crops. This sensitivity has limited the development and adoption of integrated weed management strategies that include both PE and PoE herbicides in several oilseed crops. Sensitivity of genotypes to herbicides is yet another area of research which can be integrated with IWM framework, because not much research had been done on the issue. In the recent past, rice fallow oilseeds find a major thrust and the weed management in this ecology is the result of weed dominance in the preceding rice crop also. A literature search for weed management in rice fallow sesame could not show any significant work in that direction. As a rice fallow crop, the sesame crop is vulnerable to weed competition. In Tamil Nadu, Cauvery delta areas of Tiruchirappalli district, rice fallow sesame area has become abysmally low due to severe weed competition from Carpet weed (*Trianthema portulacastrum*). Farmers are forced to postpone first irrigation to sesame crop in the rice fallow season to avoid the proliferation of this weed species. The irrigation is scheduled in such a way that the weed competition period just crosses in four weeks after sesame sowing. No single weed management tactic could help in weed management in oilseed crops. This needs an IWM framework for oilseed crops.

Conservation agriculture practices increases weed problems in rice-wheat system: Myth or reality

U.P. Singh

Department of Agronomy, Institute of Agricultural sciences, Banaras Hindu University,
Varanasi, Uttar Pradesh 221005, India
Email: udaipratap.singh1@gmail.com

Weeds are considered one of the key threats in sustaining the farm productivity and profitability. Excessive tillage, use of poor quality seed, weed contaminated seeds, weed shift, monoculture, unavailability of labour for weeding, inappropriate selection and application of herbicides are key concerns for weed management in prevalent agricultural production. In a conventional rice-wheat system, fields remain fallow for a period of around 75–80 days during summer and Pre-monsoon rains favour common upland rice weeds to germinate and produce large quantities of seeds during this period, thus enrich soil weed seed bank and aggravate the weed problems in succeeding rice. Rising cost of cultivation, declining factor productivity and sustainability in rice–wheat cropping system are forcing the farming community to shift from conventional tillage (CT) practice to conservational tillage (CA) practice for crop cultivation. Despite the numerous advantages of CA practices, major problem of weeds associated with the CA based production system is due to less expertise / management skill in implementation of CA practices. Rational crop rotation is helpful in changing the cycle of the weed which ultimately reduces the weed infestation. Crop residue retention also alters the soil surface temperature and acts as a physical barrier for the weed seed germination, which ultimately help in minimizing weed infestation. There is a myth that weed problem is more under CA. In fact lower weed problem is being noticed with long term CA-based crop management practices/ sustainable intensification. Research results have shown that zero tillage (ZT) combined with retention of crop residue is a potential tool for effective weed management in rice –wheat (RW) cropping system in IGP. CA based practices *i.e.* permanent no-till residue managed beds and double no-till (ZT direct seeded rice- ZT wheat) reduced weed infestation in rice-based cropping systems due to less weed seed bank disturbance in soil and proper cover of soil by the residue. Full CA based practice (ZT-DSR *fb* ZTW *fb* ZT Mungbean residue retained all crops) was found significantly superior over conventional crop establishment method (PTR *fb* CTW) in reducing weed density by 42% in rice and 36% in wheat and enhancing system productivity by 12%. These results provide evidence that full CA practices with sensible diversification/intensification and residue retention can reduce weed problem, especially seasonal weeds and enhance crop productivity in long-run. Recently a decision support web tool *i.e*. Rice Wheat Crop Manager have been developed for optimizing the input use and efficient crop management which helps in indirectly minimizing the weed problems. Hence, it is a myth that weed problem is more in CA system. The promotion of efficient CA practices with skill/expertise may be a potential climate-smart weed management approach for sustainable weed management.

Integrated weed management in millets

K.N. Geetha

AICRP on Weed management, UAS, GKVK, Bangalore, Karnataka 560065, India

Email: gowdageetha200@gmail.com

In recent years, millets have been recognized as nutri-cereals and given much needed impetus for their cultivation by national and international policies. India is the leading millet-producing country with a share of around 80% of Asia's and 20% of the global production. These have amazing nutritional value and are 3 to 5 times more nutritious than rice and wheat in terms of protein, minerals and vitamins. These crops provide food and fodder for millions of resource-poor farmers worldwide. They also have a short growing season (70–80 days), are well suited to multiple cropping systems under both irrigated and rainfed conditions, and can survive in unusually infertile soil. Millets as a group of crops are represented by sorghum (*Sorghum bicolor*), pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), foxtail millet (*Setaria italica*), barnyard millet (*Echinochloa frumentacea*), proso millet (*Panicum miliaceum*), kodo millet (*Paspalum scorbiculatum*) and little millet (*Panicum sumatrense*). Millets are the major crops of the arid and semi-arid regions of the country, and have the potential to contribute substantially for food, fodder and nutritional security. Because of their drought tolerance, millets can be cultivated in areas that are often too hot and dry for other crops to be grown. Millets are cultivated mostly under rainfed conditions and under-nourished soils which makes them more susceptible to weed competition losses.

Low productivity and susceptibility to biotic and abiotic factors are the major reasons for the declining area and productivity of millets in India. As the millets are grown predominantly in the hot and humid rainy season, weeds deprive these crops of vital nutrients and moisture and reduce the yield considerably. Millets grow slowly at first and are relatively poor competitors with weeds during the first few weeks of growth. Planting in wider rows to facilitate inter-row cultivation and/or ditch furrow irrigation worsen the problems. Because the crop canopy forms slowly and provides little shading of weeds between rows until mid-season; by then, most weeds are well established. Weeds compete with millets for light, soil moisture and nutrients and reduce crop yields and quality. Because of wider row spacing and slow initial growth in millets, weeds are more problematic during initial crop growth period, and hence, early control is needed to optimize the yield. Therefore, appropriate weed management approaches are necessary to increase productivity and input use-efficiency of millets.

Invited oral lecture 7

Integrated approaches for safe crop production: Herbicide residue management

T. Ramprakash[1*], Vijaysree Chopde[2] and B. Padmaja[1]
AICRP on Weed Management, PJTSAU, Hyderabad, Telangana 500030, India
**Email: trp.soil@gmail.com*

In today's agriculture, herbicides are essential tools for managing weeds, which compete with crops for light, water, and nutrients and can seriously impact crop yields. Not only do herbicides boost crop productivity, but they also help keep non-crop areas free from unwanted weeds and pests. However, for herbicides to be effective, they need to remain active and in herbicidally active form in the soil long enough to provide effective weed management during the crop growth period. Some herbicides degrade quickly or get adsorbed strongly to the clay particles in the soil, reducing their chances of affecting succeeding crops. However, some herbicides are more persistent, staying active in the environment for longer periods, which can lead to injury/phytotoxicity for subsequent crops and surrounding ecosystems. This persistence underscores the importance of effectively managing herbicide residues for safe crop production. Several strategies have been developed to manage these residues and minimize their impact while promoting sustainability. Some methods aimed at reducing the herbicide load in the soil system include integrated weed management (IWM), tilling and cultivating the land, incorporating herbicides into the soil, rotating crops, growing herbicide-tolerant varieties, and applying light irrigation after herbicide use. Precision technologies, such as site-specific applications using variable rate applicators, are also employed to target herbicide use more effectively. Additionally, techniques like bio-stimulation (by adding electron acceptors, electron donors, or nutrients) and bioaugmentation help enhance the soil's natural microbial populations to increase herbicide degradation. Other approaches include adding organic matter, using non-toxic oils, surfactants, adsorbents, protectants, and antidotes to the soil. Practices like incorporating biochar, using safeners, reducing and optimizing herbicide doses, splitting applications, and timing the applications carefully all help manage herbicide residues effectively. Bio-stimulation—adding the right mix of water, nutrients, and oxygen—can be highly effective in encouraging microbial activity in the soil, which helps break down herbicides faster. Soil organic carbon is also beneficial, as it helps speed up herbicide degradation. Organic amendments, like farmyard manure (FYM), aid in reducing toxicity by binding to herbicides, while tillage can bring herbicide residues from deeper layers closer to the surface, where they can naturally degrade due to more exposure to sunlight and other environmental factors. Using tools like disc ploughs or inter-cultivators can help spread the herbicide across a larger soil volume, effectively diluting its concentration. Activated charcoal, with a large surface area, is also effective in minimizing herbicide toxicity. Additionally, light irrigation after applying herbicides keeps soil moisture levels optimal, promoting microbial activity and helping the herbicide degrade faster. In cases where herbicides are water-soluble, frequent irrigation can help leach these residues away, reducing their levels in the soil. Bio-stimulation enhances the activity of natural microbial degraders in the soil. Supplementing with additional nutrients can further encourage the breakdown of harmful substances. Studies show that adding a mix of microbial strains can enhance the breakdown of certain herbicides, like atrazine, effectively. Research also shows that biochar, when added to agricultural soils, increases water retention, improves soil organic matter, aids nutrient cycling, lowers soil bulk density, and provides a habitat for beneficial microorganisms, including bacteria and mycorrhizal fungi. Nanomaterials, such as graphene, have been shown to increase pesticide adsorption significantly. Furthermore, nanocrystalline metal oxides work well in removing a range of pesticides due to their high adsorption capacity, quick reaction times, and greater number of surface reaction sites. A combination of cultural practices, biological control, chemical alternatives, monitoring can contribute to more sustainable herbicide residue management for a safe crop production system. It is essential to continuously evaluate and refine these strategies to address emerging challenges and ensure the long-term health of our ecosystems and natural resources. Integrating mechanical and cultural management practices with herbicides for managing weeds is a viable option for safe crop production.

Importance of quarantine laws for restricting expansion of weed seeds

M.C. Singh*, Dhruv Singh, S. Gnansambandan[1] and V.C. Chalam

ICAR-National Bureau of Plant Genetic Resources, New Delhi 110012, India

[1]Directorate of Plant Protection, Quarantine & Storage, NH-IV, Faridabad 121001, India

**Email: mchsingh@gmail.com*

Plants are damaged by more than 10,000 spp. of insects, 30,000 spp. of weeds, 100,000 pathogens and 1000 spp. of nematodes in the world. Some new exotic pests were introduced and caused extensive damage in India. To prevent the introduction of exotic pests, from other countries or within the country, legal restrictions are enforced commonly known as Quarantine. Plant Quarantine regulatory measures are taken at the national level as well as international level. At the same time, quarantine agencies are tasked with minimizing the risk of introducing exotic pests along with imported plant material, with the goal to protect domestic agriculture and native fauna and flora. **Inspection and identification of weeds:** In order to prevent the introduction of serious exotic weeds, all imported plant/plant materials are subjected to critical examinations. Samples are examined for weed seeds by sieving through sieves of different pore sizes. **Visual examination:** Working samples are spread in a thin uniform layer on a clean white drawing sheet or in a white enamel tray and examined with the help of an illuminated magnifier and all weed seeds are collected. Weed seeds are segregated into different types on the basis of their shape, size, colour, texture and the presence of any attachment. **Microscopic examination:** Seeds are placed in a glass Petri dish and examined under a stereoscopic binocular microscope and weed seeds are segregated from the crop seeds with the help of forceps or camel hair brush. **Identification of weed seeds:** i) On the basis of morphological character ii) by Grow Out test.

Invited oral lecture 9

Integrated weed management in plantation crops

P. Prameela
AICRP on Weed management, Kerala Agricultural University, Thrissur, Kerala 680656, India
Email: weedsvka@kau.in

Weed management in plantation crops presents unique challenges compared to annual field crops. Plantation crops, being perennial and long-term, create environments conducive to shade-tolerant weeds that adapt to lower light levels under dense canopies. These weeds, including climbers, aroids, and shade-tolerant dicots, often exhibit rapid multiplication and resilience against control measures, making them competitive and difficult to manage. Weed infestation is particularly problematic during the initial stages of crop establishment and in systematically planted large estates, where broader spacing promotes weed growth. Diverse set of strategies are applied to manage weeds effectively and sustainably in plantations. These include integrated approaches combining cultural, manual, mechanical, biological, and chemical methods. Cultural practices, such as poly cropping, intercropping, and cover cropping, help suppress weeds naturally while enhancing soil health, reducing erosion, and providing secondary income. Cover crops such as *Pueraria phaseoloides* and *Mucuna bracteata* are common in rubber and coffee plantations, serving as natural mulches that reduce weed growth and improve soil fertility. Mechanical methods, like using weed cutters, and manual weeding, offer cost-effective solutions with minimal soil disturbance. However, these are often labor-intensive and less feasible for large-scale operations. Herbicidal management, utilizing glyphosate and other broad-spectrum herbicides, is widely employed due to its effectiveness and efficiency in mature plantations. Nevertheless, the repetitive use of herbicides can lead to environmental risks, residue accumulation, and herbicide resistance, necessitating careful herbicide rotation and limited application frequencies. Biological control methods have seen limited success, with a few agents introduced to control some invasive weeds. Consequently, an integrated weed management approach tailored to specific crop types, climates, and topographies is recommended for sustainable plantation agriculture. By combining diverse strategies, weed suppression in plantation crops can be achieved to improve productivity, and support ecological balance, paving the way for a resilient and sustainable plantation sector in India.

Invited oral lecture 10

Phytoremediation: aquatic weed-based technology for water quality improvement in peri-urban areas of India

P.J. Khankhane*[1] and R.P. Dubey[2]

[1] *Regional Centre, National Bureau of Soil Survey and Land Use Planning (ICAR) & Executive Member, Indigenous Federation of Commerce and Industries Delhi, India*

[2] *ICAR-Directorate of Weed Research Jabalpur, Madhya Pradesh 482004, India*

**Email: pjkhankhane@yahoo.com.ph*

The main concerns with water quality are the merging of untreated waste water emanated from residential, dairy and industrial sources which have impacts on human health, on the cost of drinking water treatment, and on ecosystems. To find extent of application of aquatic weed based constructed wetlands for protection of surface water bodies, maintenance of sanitation and use of treated water for various purposes, the literature survey was carried out. Published case studies of phyto-based waste water treatment systems in hydroponics, surface and sub-surface constructed wetlands in nine Indian states including Madhya Pradesh, Maharashtra, Uttar Pradesh, Orissa, Punjab, Delhi, Karnataka, Telangana (A.P.), Tamil Nadu was reviewed for assessing the performance of aquatic plant-based wetland units for water quality improvement. Among macrophyte based treatment, *Phragmites karka, Typha latifolia, Arundo donax, Vetiveria zizinoides, Canna indica* as emergent and *Eichhornia crassipes, Pistia stratiotes* as floating aquatic plants were found largely used for water treatment in decentralized sub-surface and surface constructed wetlands (CW) respectively. Due to easy availability *Canna indica* was used at larger number of wetland sites. However, lower performance of *Canna indica* was observed in reduction of water quality parameters including biological oxygen demand (BOD), chemical oxygen demand (COD) as compared with aquatic weeds, *Typha* and *Phragmites*, *Eichhornia* in southern part of India. In addition, various possible opportunities related to implementation of phyto-technologies for development of entrepreneurship for water quality monitoring, establishment of constructed wetland (CW)/effluent treatment plant (ETP) treatment facilities, supply chain for providing porous media, wetland nursery plants and supply of treated water to different stake holders are also discussed.

Weed management in herbicide-tolerant rice under dry direct-seeded rice with special reference to weedy rice

V.K. Choudhary* and J.S. Mishra

ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India

**Email: ind_vc@rediffmail.com<*

Rice is an important cereal food crop for more than half of the world's population. The total rice is being grown in about 167 million ha with a total production of 782 million tones. Out of these, 90% is being produced and consumed in South Asia. Rice is being grown in different crop establishment methods and transplanting of seedlings (TPR) and direct-seeded rice (DSR) are common. Transplanting has numerous advantages *i.e.* retention of water, fewer weeds, more yields, *etc*. while DSR has several advantages of saving water, labour and energy, better soil structures, shorter duration crops, *etc*. but DSR has some constraints such as severe weed problems. In DSR, concurrent emergence of weeds and crops, absence of a thin water layer, no seedling head advantages, and multiple flushes of weeds pose serious problems and can cause yield loss between 30-90%. However, scarcity of labour and higher wages makes weeding a daunting task. Therefore, herbicide-based weed management is considered to be a smart and viable option. Recently weed management has been further improved by developing herbicide-tolerant rice through mutagenesis against the imidazolinone (IMI) group of herbicides. However, the dose and application timing of these herbicides for effective weed management have not been standardized. Therefore, the present study was conducted on weed management in herbicide-tolerant rice under dry DSR conditions at ICAR-Directorate of Weed Research, Jabalpur during the rainy season of 2021 and 2022. The results revealed that the sequential application of imazethapyr at 100 g/ha as early and late post-emergence (at 14 and 28 DAS) provided broad-spectrum weed control with the least population and biomass of major weeds. However, it was comparable to imazethapyr at 125 g/ha at 14 and 28 DAS and hand weeding at 20 and 40 DAS. The highest grain and straw yield was recorded under the sequential application of imazethapyr 100 g/ha, which was followed by the sequential application of imazethapyr 125 g/ha. Unweeded check witnessed with the highest density and biomass of weed and harvested with the lowest grain yield followed by bispyribac-sodium at 25 g/ha. Weedy rice is an emerging problem in DSR and none of the rice herbicides are effective against it. As of date, it can be managed by manual weeding but a lot of escapes have been observed due to morphological similarity. However, the application of imazethapyr at 75-200 g/ha either single application or in sequence provided complete control on weedy rice. Based on the findings, sequential application of imazethapyr 100 g/ha at 14 and 28 DAS provided higher weed control including weedy rice, grain, and straw yield, and profitable over other weed management practices in dry DSR.

Understanding temporal emergence and competition between weeds and crops for sustainable weed management

Ram Kumar Singh[1] and Pawan Kumar Verma[2]

[1]*Binod Bihari Mahato Koylanchal University, Dhanbad, Jharkhand 826004, India*

[2]*Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*

**Email: profrksinghagronomybhu@gmail.com*

Weeds are the largest competitors of crop plants for moisture, nutrients, light, and space, thereby depriving the crop of its vital input. This becomes a serious problem because of the smothering effect, which is more prevalent when weeds emerge earlier than crops. The loss in yield depends on various factors such as weed species and density, time of emergence, crop cultivar, planting density, soil and environment. The emergence of weed seedlings at different times after crop emergence may differ in terms of growth and fecundity, and these differences are assumed to be induced by conditions during early development. Weed seedlings that emerged earlier in the growing season produced significantly more biomass and more seeds than those emerging later in the season because late-emerging weeds face more shading and competition effects from the crop for nutrients and soil moisture compared to early-emerging weeds. Various agricultural scientists have reported that not all emerged weed seedlings resulted in established plants; some of seedlings died after emergence. Similarly, emergence generally decreases with the advancement of crop growth, restricting the transmission of light through the canopy for weed emergence. In such cases, the seeds of weed species that require light for germination did not add to the emergence count. Therefore, understanding weed-crop interference is critical for designing successful, integrated and sustainable weed-management programs. This can be achieved by making appropriate and sound decisions based on the principles of biological and ecological weed management, which can significantly limit the use of herbicides. Detailed knowledge of weed biology and competitive ability can help determine weed management decisions for particular species. An investigation into the competitive characteristics of coexisting weeds and crop plants is important not only for explaining the mechanisms of interaction but also for the identification of suitable measures for weed control.

Oral lecture 3

Direct-seeded rice as an alternate establishment method of rice: Lessons learnt from two decades of studies in Haryana on weed dynamics to herbicide tolerant rice

Dharam Bir Yadav*[1], Ankur Chaudhary[1], Ashok Yadav[2], Virender Kumar[3], R.K. Malik[4] and Gurjeet Gill[5]

[1,2]*Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125004, India*
[3]*International Rice Research Institute, Los Baños, Philippines*
[4]*Consultant, CIMMYT-Cereal Systems Initiative for South Asia, Hub, New Delhi 110012, India*
[5]*School of Agriculture, Food and Wine, University of Adelaide, Adelaide, Australia*
**Email: dbyadav@gmail.com*

Direct seeded rice (DSR) is being proposed as an alternative to conventional puddled transplanted rice to reduce accelerated ground water depletion, address the issue of labour scarcity and improve profitability. However, weed management remains quite challenging in DSR because of absence of continuous flooding. The initial studies during 2007-2009 indicated that weed dynamics changed rapidly after the adoption of DSR. Aerobic grass weeds such as *Leptochloa chinensis*, *Eragrostis* spp. and *Dactyloctenium aegyptium* which were minor weeds in transplanted rice became major weeds in DSR. In contrast, *Echinochloa crus-galli* still remained the dominant weed under puddle transplanted rice with little or no infestation of other grass weeds. Sedges like *Cyperus rotundus* also increased under DSR. Integrated weed management strategies based on herbicides, stale-bed technique and some hand-rogueing were found essential for achieving high yields in DSR. Stale seedbed technique not only proved effective in reducing weed density in DSR, it also controlled volunteer rice plants. Bispyribac-sodium 25 g/ha as PoE was quite effective against barnyard grass and some broadleaf weed species in DSR. PRE application of pendimethalin 1000 g/ha or oxadiargyl 100 g/ha could be used to effectively control aerobic grass weeds. Metsulfuron + chlorimuron 4 g/ha, ethoxysulfuron 18.75 g/ha, 2, 4-D Ester/Amine 500 g/ha, azimsulfuron 20 g/ha or pyrazosulfuron 25 g/ha as tank-mix with bispyribac 25 g/ha as PoE provided effective control of broadleaf weeds (BLW) and sedges. However, there is need for tailor-made solutions based on the infestation of weeds in the field. There is need felt for PoE herbicides for grass weeds other than *Echinochloa*. *Cyhalofop-butyl* and *fenoxaprop-methyl* (with safener) could be the options as PoE herbicides for control of aerobic grass weeds; however, fenoxaprop has some phyto-toxicity issues with the crop/specific varieties. Compatibility issues are also there with bispyribac as tank-mix with fenoxaprop and as sequencial with cyhalofop with low efficacy of the later herbicide in sequence. Triafamone + ethoxysulfuron 67.5 g/ha, penoxsulam + cyhalofop 135 g/ha, florpyrauxifen + cyhalofop (RM) 150 g/ha were found other potential herbicides in DSR. In recent years, the development of herbicide tolerant (HT) rice cultivars has opened a new window to tackle the challenges of weeds under DSR in India. Sequential application of imazethapyr *fb* imazethapyr (PRE *fb* PoE) 100 + 100 g/ha was found effective for management of diverse weed flora in Imidazolinone tolerant DSR. Alternatively, inclusion of pendimethalin as PRE herbicide with IMI herbicides as PoE was also advisable. In Provisia Rice System, quizalofop 120 g/ha provided effective control against grasses like *E. crus-galli, D. aegyptium, L. chinensis.* Sequential application of herbicides (EPoE *fb* PoE), *viz*. quizalofop 120 g/ha *fb* florpyrauxifen + cyhalofop (RM) 150 g/ha; triafamone+ ethoxysulfuron (RM) 67.5 g/ha *fb* quizalofop 120 g/ha and quizalofop 120 g/ha *fb* bispyribac + pyrazosulfuron (TM) 20+20 g/ha resulted in effective control of all type of weeds. The long-term studies at CCSHAU, RRS, Karnal indicated that DSR produced grain yield similar to conventional puddle transplant rice, with more economic returns due to saving of $100/ha in labour, diesel and nursery cost. The grain yield of succeeding wheat crop was more by about 0.3-0.5 t/ha thus resulting in more system productivity, and economically viable DSR based rice-wheat system. In addition, there has also been about 25-30% saving of water. Weedy rice is not an issue till now in north-western India, but it has to be monitored regularly so that it may not become a serious problem in future.

Oral lecture 4

Effect of planting pattern and intercropping systems on weed dynamics and partitioning of nutrients among weeds and pigeonpea

I.B. Pandey*, R.S. Singh, Sunil Kumar and Rajendra Prasad
Tirhut College of Agriculture, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India
**Email: indubhushanpandey@gmail.com*

An experiment was conducted at research farm of Tirhut College of Agriculture, Dholi (25o 98'N 850 76'E and at an altitude of 51.3 m above mean sea level) a campus of Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar for four consecutive years during rainy season of 2012-14 to 2016-17. The soil of the experimental plot was sandy loam in texture, low in organic carbon (0.33%), low in available nitrogen (163.8 kg/ha), low in available phosphorus (12.2 kg/ha) and medium in available potassium (152.8 kg/ha) with pH 8.1. The treatment comprised of three intercropping systems with two planting patterns *viz*, pigeonpea (60cm) + urdbean (1:1), pigeonpea (60 cm) + sesame (1:1), pigeonpea (60cm) + sorghum (1:1), pigeonpea paired (45cm) + urdbean (2:2), pigeonpea paired (45cm) + sesame and pigeonpea paired (45 cm) + sorghum (2:2) along with sole pigeonpea. The experiment was fertilized with recommended dose of fertilizer of pigeonpea along with 75, 100 and 125% RDF of intercrops. All quantities of fertilizers were applied at the time of sowing. The plant-to-plant distance of 20 cm in sole as well as in intercropped pigeonpea was maintained by thinning in third week of sowing. Weed density and weed dry biomass were recorded from an area enclosed in quadrate of 0.25 square meter randomly selected at two places in each plot at 60 and 90 DAS. The original weed data were subjected to square root transformation "x+ 0.5 before statistical analysis. All the intercropping systems in normal as well as in paired row planting of pigeonpea significantly reduced the weed density and weed dry- biomass than sole pigeonpea except pigeonpea + sorghum in both the planting patterns. The extent of reduction in weed density and weed dry-biomass were greater under paired row planting of pigeonpea and intercrops in 2:2 row ratios than their normal planting pattern in 1:1 row ratio. Paired row planting of pigeonpea (45cm) + urdbean (2:2) recorded lowest weed count, weed dry biomass and higher weed control efficiency followed by Paired row planting of pigeonpea (45 cm) + sesame (2:2). It also enhanced pigeonpea equivalent yield, water-use efficiency, production efficiency (in terms of kg/ha/day and Rs. /ha/day), Land equivalent ratio (LER), NPK- uptake by pigeonpea, net return, benefit: cost ratio and reduced NPK- depletion by weeds than the other pigeonpea based intercropping system and sole cropping. The reduction in weed density and weed dry mass in pigeonpea + urdbean intercropping system might be that urdbean emerged earlier, develop their canopy in short period of time and cover the ground which curtail the movement of light below their canopy cover and suppress the weed. The weed dry biomass and NPK- depletion by weed increased with subsequent increase in fertilizer levels of intercrops and recorded maximum at 125% RDF.

Oral lecture 5

Manoeuvring tolerant cultivars for weed management in direct-seeded rice

Malay K. Bhowmick*[1], Indrani Dana[1], Sunil Kumar[2], Panneerselvam Peramaiyan[2], Virender Kumar[3] and Sudhanshu Singh[2]

[1]*Rice Research Station, Chinsurah (R.S.), West Bengal 712102, India*

[2]*International Rice Research Institute-South Asia Regional Centre, Varanasi, Uttar Pradesh 221106, India*

[3]*International Rice Research Institute, Los Baños, Laguna 4031, Philippines*

**Email: bhowmickmk@gmail.com*

Direct-seeded rice (DSR) has been regaining its popularity as a climate-resilient, resource-efficient, and cost-effective alternative to puddled transplanted rice (PTR). Despite numerous benefits, the sustainability of DSR-based systems has been questioned due to certain risks and challenges, including early season flooding, poor seed germination, uneven crop stand, severe weed menace, nutrient deficiencies, nematode problems, yield decline, *etc*. Among these, weeds are one of the major impediments, which inhibit rice cultivars in exhibiting their full genetic potentials under DSR systems. High-yielding weed-tolerant cultivars need to be screened and manoeuvred with their best bet agronomy, taking into account of related trade-offs, in order to make the DSR precise and customized. Rice cultivars with early seedling emergence and vigour, faster canopy cover, tall stature, prolific tillering ability, drooping leaves, efficient root systems, *etc*. are more weed-competitive and also weed-suppressive during early growth phases due to a smothering effect of the crop that has an edge over the weeds. Efforts have been undertaken at the Rice Research Station, Chinsurah (Hooghly) in collaboration with the International Rice Research Institute (IRRI) to identify region-specific suitable cultivars for dry- and wet-DSR conditions across different landscapes in West Bengal. A recent study under wet-DSR systems in West Bengal revealed that the hybrids displayed 28-49 and 17-62% yield superiority over the inbreds under weed-free and partial-weedy conditions during wet (*Kharif*) and dry (boro) seasons, respectively. Moreover, rice cultivars of short- to medium-duration groups performed better than the long-duration cultivars under direct-seeded condition, while hybrids were more productive not only for their heterosis, but also for their better tolerance to the weed pressure. In DSR systems, crop-weed competition can further be manipulated by adjusting/optimizing seeding rate, seeding depth and crop geometry, including row spacing and planting pattern, which can aid crop plants to better compete with the weeds. Crop competitiveness is increased under narrow row spacing through rapid canopy cover, better light interception, higher leaf area index, and less light penetration for developing weeds. Although the adjustment or optimization in seeding parameters and planting patterns alone is insufficient to completely suppress weeds, it can help reduce the need for herbicide use and the associated environmental trade-offs. The potential benefits of using early flooding to eliminate initial weeds are limited in dry-DSR. But it can be leveraged through introgression of QTLs for anaerobic germination and tolerance to early submergence under wet-DSR. Rice morphological traits for enhanced nutrient uptake and better weed suppression are associated with weed tolerance. Hence, the cultivars suitable for direct seeding should have the right combination of traits, depending on the growing environments, cropping seasons, and crop establishment methods. These traits include anaerobic germination (AG) tolerance, seed longevity (tolerance to seed ageing), early uniform emergence, early seedling vigor and establishment, weed tolerance, herbicide tolerance, lodging resistance, modified panicle architecture, efficient root architecture, drought tolerance, early crop maturity, nutrient responsiveness, nematode resistance, good environmental adaptation, and higher yield potentials. These potential cultivars would substantially contribute to the climate-smart interventions for sound weed management under direct-seeded conditions.

Oral lecture 6

Modelling geographic distribution of *Echinochloa colona* and *Cyperus rotundus* under current and future climate scenarios

Yogita Gharde*, P.K. Singh, R.P. Dubey, A. Jamaludheen and J.S. Mishra
ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India
**Email: yogita.gharde@icar.gov.in*

Weeds are considered as the major biotic constraints significantly affecting the agricultural production, agrobiodiversity and natural water bodies. They can negatively affect the crops by competing for resources, *viz*. water, sunlight and space and also by sheltering crop pests, interfering with water management, reducing the yield and quality and subsequently increasing the cost of the production. Similarly, climate change is expected to affect the distribution and occurrence of the weeds and their interaction with crops in future. Climate change may affect the geographic distribution of a native species or invasion of crops by a new weed species. To minimize the effect of weed success favoured by climate change, there is need to predict the potential geographical distribution of species accurately. Keeping in view, the harmful effects caused by *Echinochloa colona* and *Cyperus rotundus* in agriculture ecosystem, it was felt necessary to explore the expansion risk of these weeds in India. Therefore, in the present study habitat suitability of *E. colona* and *C. rotundus* was modelled and projected under current as well as future climatic scenarios with the help of MaxEnt program. The findings of the study revealed that in current climatic conditions, central part of India including eastern states, *viz*. West Bengal and Odisha showing high suitability for *E. colona*. However, in future climate, this species will be benefited in most of the parts of India due to the presence of highly suitable conditions. In case of *C. rotundus*, most of the parts of India (excluding western Himalaya region, parts of Rajasthan, few places of central plains and western and southern plateau and hills) were found to be moderately suitable for the species, however, a significant decrease in these areas were found under RCP 4.5 & 8.5 for both the years 2050 and 2070. Very high and high suitable areas are found to be increased under RCP 4.5 for both the years with slight decrease in 2070 as compared to 2050. In addition, Indo-Gangetic plains were found to be highly suitable for the species including very few parts of the country. Jackknife test revealed that two bioclimatic variables bio1 (Annual Mean Temperature) and bio10 (Mean Temperature of Warmest Quarter) provided higher test gain in case of *E. colona*, however, bio6 (Min Temperature of Coldest Month) and elevation are found to be affecting the distribution of *C. rotundus* significantly. Higher suitable conditions for *E. colona* are characterized by annual mean temperature (bio1) at 23°C. In case of *C. rotundus*, minimum temperature of coldest month (bio6) >22°C is found to be suitable for the species which indicates its tendency to tolerate the high temperature. Test revealed that at lower temperature (<18°C) species favourability decreases. Elevation was also observed as significant factor affecting the distribution of the species. The generated information on future distribution of the species will not only help to make informed decisions on the matter related to agriculture, biodiversity, public health and the economy but it will also help in early detection of the species to enable speedy actions to reduce the management cost which otherwise would become more expensive and sometimes impossible at the later stages.

Conservation tillage and in-situ rice residue driven weed dynamics, soil temperature fluctuation, nutrient status and wheat productivity under aberrant climate nexus in north-western Indo-Gangetic Plain

Ankur Chaudhary*[1], Todar Mal Poonia[1], Dharam Bir Yadav[1], Roohi[2] and Naveen Kumar[2]

[1]Department of Agronomy, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125004, India

[2]Regional Research Station, Chaudhary Charan Singh Haryana Agricultural University, Uchani, Karnal, Haryana 132001 India

**Email: ankurchaudhary292@gmail.com*

Combine harvester as fully automated machine are being employed to harvest coarse rice which leads to the presence of both anchored stubbles and loose residue (6-8 t/ha). Farmers generally burn rice residue in-situ for timely sowing of succeeding crop. Timely sowing of wheat under rice residue load has become possible with the help of efficient seeding machineries. Therefore, an experiment was conducted at CCS HAU Regional Research Station, Karnal with the objectives to study the effect of tillage and residue management practices on weed dynamics, soil temperature and crop productivity under rice-wheat cropping system during *Kharif* 2018 to *Rabi* 2021-22. The experiment consisted of five tillage and residue management options (main plots) as conventional till wheat (CTW), zero till (ZT) sowing in anchored stubble, ZT with partial residue, ZT wheat full residue with and without waste decomposer. The weed management options (sub plots) were recommended herbicides, integrated weed management and weedy check. Summer mungbean variety MH 421 with seed rate 30 kg/ha was sown after wheat harvest under zero till conditions uniformly in all treatments and incorporated before puddling of rice at green pod stage during 2020 and 2021. The infestation of *Phalaris minor* was reduced under zero tillage as compared to conventional till wheat CTW over the years. Overall, *P. minor* infestation was found higher under CTW as compared to zero till scenario, while reverse was the case for broad leaved weeds (*Rumex dentatus* and *Medicago denticulata*). ZT (mean of temperature recorded under different zero tillage scenario) reduced afternoon soil temperature to the tune of 1.8-3.59^{o}C and 0.88-4.66^{o}C as compared to CTW from 5 to 13th standard meteorological weeks during *Rabi* 2020-21 and *Rabi* 2021-22 (heat stress year), respectively compared to CTW without residue from 5 to 14th standard meteorological weeks. Further, this congenial environment improved yield as zero till full rice residue retention with (4891-5238 kg/ha) and without waste decomposer (4950-5264 kg/ha) resulted in higher grain yields as compared to CTW (3740-4244 kg/ha). *Rabi* 2021-22 was the abnormal year in terms of high atmospheric temperature (25.6 – 38.4^{o}C) starting from March 2022 onwards and having 16 days with maximum temperature > 31^{o}C during grain filling and dough stage. Zero till wheat under different residue level significantly reduced soil pH, but increased soil organic carbon content as compared to CTW. The results revealed that seeding of wheat under residual soil moisture (irrigation to be applied 10-14 days before super straw management based combine harvesting of rice) and surface retained residue driven reduction in soil temperature may facilitate early sowing (an escape mechanism) and thermo-moderating soil temperature against terminal heat stress in wheat, besides, saving of pre-sowing irrigation and reducing *P. minor* infestation.

Oral lecture 8

Exploring the molecular basis of imazethapyr resistance in *Commelina* spp. and *Echinochloa colona*

Deepak Pawar Vishwanath*, D. Sreekanth, C.R. Chethan, Shobha Sondhia and P.K. Singh
ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India
**Email: pawardv1@gmail.com*

This research aimed to elucidate the molecular mechanisms of imazethapyr resistance in two biotypes of weed species, *C. benghalensis* and *C. communis*, utilizing de novo transcriptome analysis through RNA sequencing. Both studies generated approximately 72 million paired-end raw reads from leaf tissues, which were processed to yield around 70 million clean reads for further analysis. In the *C. benghalensis* study, denovo assembly using Trinity software produced 580,040 unigenes and 767,750 transcripts with a GC content of 40.19%. Differential expression analysis revealed that 30,170 genes were down-regulated and 10,344 genes up-regulated in the resistant biotype following herbicide treatment. In comparison, the susceptible biotype exhibited 17,614 down-regulated and 21,419 up-regulated genes. Gene Ontology (GO) enrichment highlighted over-expressed genes associated with DNA-binding, protein phosphorylation, and various metabolic pathways in the resistant biotype. Pathway enrichment analysis further indicated significant upregulation of genes involved in purine metabolism, protein glycosylation, and lipid metabolism. Notably, a non-synonymous mutation (isoleucine to proline) at the 178^{th} amino acid position in the ALS (acetolactate synthase) protein was identified, resulting in conformational changes in the enzyme's structure. Similarly, in the *C. communis* study, denovo assembly predicted 442,326 unigenes and 651,613 transcripts with a GC content of 40.62%. Differential expression analysis in this biotype revealed 21,076 genes down-regulated and 19,996 genes up-regulated under herbicide treatment in the resistant biotype, compared to 10,526 down-regulated and 13,089 up-regulated genes in the susceptible biotype. GO enrichment analysis indicated significant overexpression of genes related to DNA-binding transcription factor activity, ATP hydrolysis, and protein kinase activity in the resistant biotype, especially those involved in ATP binding. Pathway enrichment analyses highlighted the overexpression of genes implicated in purine metabolism, protein glycosylation, and lipid metabolism. Additionally, four mutations were identified in the ALS protein of *C. communis*, leading to amino acid substitutions that contributed to differences in the conformational structure of the resistant and susceptible isoforms. These studies enhance the understanding of the genetic responses to imazethapyr treatment in both *C. benghalensis* and *C. communis*, providing valuable insights into the complex mechanisms of herbicide resistance and informing potential management strategies. The amplification and sequencing of the *ALS* gene from Imazethapyr resistant and susceptible biotypes of *E. colona* was carried out using the gene-specific primers. Gene prediction, sequence alignment and protein structure analysis of the *ALS* gene revealed that both resistant and susceptible *ALS* enzyme isoforms contained about 642 amino acids. The one resistant biotype had one amino acid substitution at the 122^{th} position in the *ALS* protein. The other resistant biotype had two amino acid substitutions at 122th and 165th positions in the *ALS* protein.

Weed management and yield improvement of green gram through climate resilience management practices

K. Shashidhar*[1], Samuel Jeberson[2], N. Premaradhya[3], S. Bhuvaneswari[4] and A.K. Mishra[5]

[1]*Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*

[2]*ARS, Agriculture University, Jodhpur, Rajastan 342304, India*

[3]*MTTM, CoA, Phasighat, Central Agricultural University, Arunachal Pradesh 795004, India*

[4]*ICAR-Indian Institute of Vegetable Research, Varanasi, Uttar Pradesh 221005, India*

[5]*Central Agricultural University, Imphal, Manipur 795004, India*

**Email: shashi81@bhu.ac.in*

Greengram, is one of the important short duration pulse crops which is rich in proteins play a major role in augmenting the income of small and marginal farmers besides giving food and nutritional security. The main reason behind its low productivity is lack of appropriate planting techniques and weed management practices in particularly high rainfall areas. Thus, identifying appropriate land configuration and weed control regimes would help to increase the productivity. A field experiment on ”Weed management and yield improvement of green gram (*Vigna radiata* (L.) R. Wilczek) through climate resilience management practices” was conducted at C.A.U. research farm, Andro, Imphal East of CAU, Manipur during *Kharif* season 2019 and 2020. It was laid out in strip plot design with 2 land configurations in main plots *viz* Flatbed method (fb) and Ridge method (RM) and 4 weed management regimes in subplots *viz* weedy check pre-emergent application of pendimethalin 30 EC 1.0 kg/ha, post emergent application of imazethapyr 10% SL 55 g/ha at 20 DAS and W1 + imazethapyr 55 g/ha with four replications. The major weed species identified in the experimental field were broad leaved weeds like; *Amaranthus viridis, Physallis minima, Phyllanthus niruri, Celosia argentia, Euphorbia hirta* and *Datura strumonium* grasses like; *Cynodon dactylon, Sorghum halepense, Dactyloctenium aegyptium* and *Cyperus rotundus* among sedges. The ridges and furrow method (966 kg/ha) of planting recorded significantly higher seed yield of 10.6% in mungbean compared to flatbed method (873 kg/ha) over two years. Application of pendimethalin 30 EC at 1.0 kg/ha as pre-emergent spray *fb* imazethapyr 10% SL at 20 DAS as post emergent spray recorded significant reduction in weed count, weed dry matter, weed control efficiency (74%) and increase in seed yield (1141 kg/ha) up to 120% over weedy check. Significantly higher number of pods per plant, seed and stover yield and growth attributes like plant height and no. of branches per plant, total dry matter accumulation per pant recorded with the same treatment. The higher net returns and B:C was recorded with the ridges and furrow method with the Application of pendimethalin 30 EC at 1.0 kg a. i. per ha as pre-emergent spray *fb* imazethapyr 10% SL at 20 DAS as post emergent spray. The climate resilient practices like ridge and furrow method of planting along with pre-emergent application of ready mixture of pendimethalin 30 EC at 1.0 kg/ha + imazethapyr 2 EC at 55 g/ha is most effective in controlling weeds in greengram crop under acidic soils of Manipur.

Oral lecture 10

Climate smart weed management in pearlmillet under custard apple based agri-horticulture system in Eatern Plain Zone

Raj Kuldeep, Pratik Sanodiya* and Riju Pratap Singh
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: prsanodiya10@gmail.com*

Millets, known as Shri-Anna, are multi-nutritional, climate-resilient crops that require fewer inputs and can withstand harsh climatic conditions, making them ideal for climate-smart agriculture. This aligns with the global food security goals highlighted by the International Year of Millets 2023. Among ten millet crops pearl millet share 90% of 78 million ha area proving its importance in the globe. Continuous shrinkage of agricultural land area and the bourgeoning population brings the aspect of integrating pearl millet with agri-horticulture to surge in productivity per unit area. Weed infestation remains a significant factor reducing productivity in millet-based agri-horticulture systems. Yield and income losses due to weeds range from 30% to 60% and 25% to 50%, respectively. Managing weeds in an agri-horticulture system involving pearl millet and custard apple presents unique challenges, requiring a sustainable approach. However conventional weed management practices proved to be unsustainable impacting soil, water, envisaged greenhouse emissions, herbicide resistance along with ill effects on environment. To counter these challenges a wide scale adoption of climate smart weed management practices are needed with an aim in improving system adaptive capacity, sustaining food security, reducing the environmental footprints and can influence weed density and dry weight in an agri-horticulture system. The field experiment was conducted at Rajeev Gandhi South Campus, Banaras Hindu University, Barkachha, Uttar Pradesh in year 2023, to evaluate the effect of pre- and post-emergence herbicides on pearl millet variety ‘MPMH 17’ in a custard apple-based agri-horticulture system. The experiment utilized a randomized block design, comprising ten treatments with three replications. Weed density and dry weight were recorded at 30, 45, and 60 DAS, using a 100 cm x 100 cm quadrat to measure two randomly selected spots within the net plot area. The major weeds encountered included, *Commelina benghalensis, Cynodon dactylon*, and *Cyperus rotundus*. At 30, 45, and 60 DAS. (atrazine 1.0 kg/ha *fb* one hand weeding at 25 DAS) recorded stastically lesser weed density and dry weight as compared to T2 (pendimethalin 1.0 kg/ha *fb* 1 HW at 25 DAS), T3 (atrazine 1.0 kg/ha *fb* tembotrione 100 g/ha at 25 DAS), T4 (pendimethalin 1.0 kg/ha *fb* tembotrione 100 g/ ha at 25 DAS), T5 (atrazine 1.0 kg/ha *fb* 2,4-D 0.75 kg/ha at 25 DAS), T6 (pendimethalin 1.0 kg/ha *fb* 2,4-D 0.75 kg/ha at 25 DAS), T7 (atrazine 0.5 kg/ha + pendimethalin 0.5 kg/ha *fb* 1 HW at 25 DAS) and T8 (atrazine 0.5 kg/ha + pendimethalin 0.5 kg/ha *fb* tembotrione 100 g/ha at 25 DAS) but was statistically at par with T2 and T7. Similar trend of higher weed control efficiency (WCE) of 98.72%, 99.14%, and 98.07% at 30, 45 and 60 DAS, respectively, with a lower weed index (WI) (56.25%) and lesser cost of cultivation (Rs. 22,751/ha) were observed in T1. This, in turn, recorded a yield of 2.8 t/ha in pearl millet and an impressive benefit-cost ratio (B: C) of 1.8 in contrast to other treatments. However, T3 found more remunerative (2.86) under present climate change conditions of eastern parts of Uttar Pradesh.

Oral lecture 11

Research evidences of climate smart weed management in root and tuber crops

N.V. Mhaskar*, M. Nedunchezhiyan and Deo Shankar
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri,
Karjat, Maharashtra 415712, India
**Email: namdev_mhaskar@rediffmail.com*

Root and tuber crops have played significant role as a survival food because of their high nutritive value and high energy production. Major tropical tuber crops viz., Cassava, Sweet potato, Yams (Lesser yam, greater yam, aerial yam and white yam), Aroids (Taro, Xanthosoma and elephant foot yam) are widely grown in India for use as secondary staple food, animal feed and as raw material for industries. Weeds as an average cause 37% of total crop loss, besides deteriorating quality of the produce and creating favourable conditions for attack of insect - pests and diseases. In India, weeding is predominantly done by the use of manual labour and to a limited extent through mechanical means. Cassava tuber yield losses due to weeds may go up to 95%. Among the different weed species *Cyperus rotundus, Cynodon dactylon, Panicum repens* were the dominant weed species recorded at different locations. Suppression of weed growth during initial growth period is important for cassava production. The four hand weeding at 1, 2, 3 and 4 MAP were reported the highest tuber yield as well as highest WCE and low weed index. The draught animals which were commonly used for intercultural operations in cassava along with gorru (7 tynes/9 tynes) in Andhra Pradesh previously. Research results revealed that the pre-emergence herbicides, oxyflourfen, alachlor, butachlor *etc*. and the post-emergence herbicides, paraquat and glyphosate in combination with hand weeding was effective in weed control of cassava in various agro-climatic conditions of India. Inclusion of intercropping systems with pulses or oilseeds, maize, vegetable crops appears to be effective control of weeds. The extent of sweet potato loss depends on weed intensity, composition, duration of weed – crop competition and fertility of soil. Weed growth beyond 45 days significantly reduces sweet potato yield. The weed species belonging to families *Amaranthaceae, Asteraceae, Capparidaceae, Cyperaceae, Euphorbiaceae, Poaceae appeared* immediately after planting of sweet potato. The most dominant species in large numbers are *Celosia argetia, Digitaria sangunalis, Cleame viscosa, Ageratum conizoides* and *Cyperus rotundus* in sweet potato. Weeding and earthing up at 15th and 30 DAP recorded highest tuber yield in sweet potato. Weeds are one of the major constraints for the growth of yams and frequent and effective weeding is essential for yam cultivation. Yield reduction was greater (77%) in unstaked yams than in staked yams (36%). Broad leaved weeds dominated grasses and sedges while large number of weeds belonging to *Poaceae*, *Cyperaceae* and *Papilionaceae*. Application of pre–emergence herbicide like diuron 3.0 – 3.5 kg/ha effectively controlled weeds. Three hand weedings were recorded the highest tuber yield in lesser yam. Research conducted at Dapoli, Maharashtra location reported that application of oxadiargyl 0.1 kg a. i./ha (Pre-emergence) + 1 Hand weeding (30 DAP) was effective weed control measures in lesser yam. Aroids are also grown as intercrops in tropical plantations such as coconut and rubber. Newly planted aroids are most susceptible to weed competition during initial 3 to 4 months. Initial slow growth and development of aroids coupled with wider spacing make conditions favourable for the early establishment of weeds in the field. The critical period of weed – crop competition is between 4 to 7 months. Black polythene or paddy straw mulching has been practiced to control weeds and conserve moisture in taro. Pre-emergence application of isoproturon 1.0 kg/ha was found effective in taro weed management. While in Xanthosoma, a Linuron or Simazine or ametryn + paraquat or glyphosate were recommended in different situations. In Elephant foot yam, straw mulch at the time of planting and application of pre-emergence herbicides pedimethalin and oxyfluorofen 1 kg/ha and post-emergence herbicide glyphosate were effectively reduce weed population as well as dry weed mass as compared to control at different locations. The use of herbicides is expected to grow further in the near future due to non-availability of labours and draught animals for weeding. Mulching using weed control ground cover and diesel operated power weeder are highly suitable for weeding in widely spaced root and tuber crops. Hence, depending upon agro-ecosystem and socio-economic conditions, farmers can adopt for any combination of weed control methods for effective management of weeds in root and tuber crops.

Oral lecture 12

Optimizing weed management and irrigation regime on spring maize performance amidst climate variability under Tarai region

Munny Chinyo*, Tej Pratap, Subhash Chandra, V.K. Singh, Navneet Pareek, S.P. Singh and V.C. Dhyani

College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology Pantnagar, Udham Singh Nagar, Uttarakhand 263145, India

**Email: munnychinyo57@gmail.com*

The optimization of irrigation and weed management is of paramount importance in the context of climate change, as shifting weather patterns and increased occurrences of moisture stress can profoundly influence weed dynamics and herbicide efficacy. Field experiments conducted during the spring seasons of 2022 and 2023 at the Norman E. Borlaug Crop Research Centre, GBPUAT, Pantnagar, sought to evaluate the effects of varying irrigation levels and weed management strategies on the performance of the spring maize hybrid 'P-1899' grown in sandy loam soil. The study was structured using a Split-Plot Design, with two irrigation levels (IW/CPE ratios of 0.8 and 1.2) allocated to the main plots, while eight weed management treatments were assigned to the subplots, each replicated thrice. The weed management treatments consisted of atrazine at 1000 g/ha, tembotrione at 120 g/ha, topramezone at 25.2 g/ha, atrazine at 1000 g/ha followed by hand-weeding at 35 days after sowing (DAS), atrazine at 25.2 g/ha followed by tembotrione at 120 g/ha, atrazine at 1000 g/ha followed by topramezone at 25.2 g/ha, a weed-free control, and a weedy check. Notably, the total rainfall during the experimental period was 98.6 mm in 2022 and 223.0 mm in 2023. The predominant weed species observed were *Digitaria sanguinalis*, *Eleusine indica*, and *Sorghum halepense* (grasses), *Cyperus rotundus* (sedge) and *Alternanthera sessilis* (broadleaf). The results revealed a positive correlation between maize plant height and weed control efficiency (r = 0.66 and r = 0.62), while chlorophyll content exhibited a negative correlation with weed density (r = -0.44 and r = -0.45) at 60 DAS. Increased weed density in the weedy check plot reduced chlorophyll content by 25% in 2022 and 35% in 2023 compared to the weed-free plot. Furthermore, weed control efficiency (WCE) demonstrated a strong correlation with grain yield (r = 0.84 and r = 0.80), leading to a 43.91% and 41.47% increase in grain yield with the application of atrazine at 1000 g/ha followed by topramezone at 25.2 g/ha compared to the weedy check in 2022 and 2023, respectively. In addition, maize yield attributes showed significant positive correlations with grain yield. Irrigation water-use efficiency (IWUE) improved by 5.23% and 24.88% under IW/CPE 0.8, whereas proline content decreased by 27.09% and 20.68% in well-irrigated plots (IW/CPE 1.2) during the two-year study. The findings of this two-year investigation suggest that the most effective strategy for maximizing weed control and maize productivity in the Tarai region of Uttarakhand is the pre-emergence application of atrazine at 1000 g/ha followed by post-emergence topramezone at 25.2 g/ha, in conjunction with irrigation at an IW/CPE ratio of 1.2. Moreover, the integration of resistant cultivars with optimized weed management and irrigation practices can enhance maize resilience to fluctuating environmental conditions, thus ensuring sustainable yields and economic viability.

Performance of different *Phalaris minor* Retz. biotypes growing with and without wheat in relation to different herbicides

Sangam* and U.S. Walia
Department of Agronomy, School of Agriculture, Lovely Professional University, Phagwara, Punjab 144411, India
**Email: Sangam8100@gmail.com*

The field experiment was conducted at experimental farm of the Department of Agronomy, Lovely Professional University Phagwara, Punjab during *Rabi* season of 2022-23 and 2023-24. To check the effectiveness of prominent herbicides *viz.* Axial 5EC (pinoxaden) 50 g/ha, Leader 75WG (sulfosulfuron) 25 g/ha, Total 75WG (sulfosulfuron + metsulfuron) 30 g/ha and ACM-9 29WG (metribuzin + clodinofop) 174 g/ha on the resistant population of *Phalaris minor* collected from different districts of Punjab. The experiment was laid out in Split Plot Design having five main plots and four sub plots with four replications. Two experiments were conducted separately, *Phalaris minor* growing with and without wheat (Triticum aestivum L). Herbicides were applied at their recommended dose in main plots and four biotypes *viz.* B1- Ferozepur, B2- Ropar, B3- Fazilka, B4- Ludhiana in sub plots in both the experiments. Herbicides were applied as post-emergence at 35 days after sowing. In the experiment, *Phalaris minor* growing with wheat, the result revealed that higher grain yield of wheat was found in ACM-9 treated plots which was 5.7 t/ha during 2022-23 and 5.16 t/ha during 2023-24 which was significantly higher than all other herbicide treated plots. However, significantly less grain yield was found in unsprayed (control) which was 4.22 t/ha and 3.64 t/ha during both the years respectively. Among the biotypes, significantly higher grain yield was found in Fazilka biotype which was 5.56 t/ha and 5.98 t/ha, respectively during both the years and significantly lowest grain yield was found in Ferozepur biotype which was 4.48 t/ha during 2022-23 and 3.15 t/ha during 2023-24. Significantly higher mortality percentage of *P. minor* was found in ACM-9 (92.6% and 97.2%) treated plots during 2022-23 and 2023-24. Among the biotypes, Fazilka biotype shows significantly higher mortality percentage (62.1% during 2022-23 and 70.1% during 2023-24). However, significantly less mortality percentage was found in ferozepur biotype which was 24.5% and 24.0% during both the years respectively. In second experiment, which was association of *Phalaris minor* without wheat. In this experiment, the results shown highest mortality percentage was observed in ACM-9 sprayed plots which was 75.0 and 72.0 percent significantly higher than all other treatments during both the years and significantly less mortality percentage was found in Axial (27.1%) during 2022-23 and during 2023-24. Significantly less dry matter was found in ACM-9 treated plots and among the biotypes, lowest dry matter was observed in Fazilka and significantly highest dry matter was found in Ludhiana biotype followed by Ferozepur biotype.

A novel herbicide delivery method to increase efficacy and weed management in transplanted rice ecosystem

P. Murali Arthanari* and R. Sabarivasan
Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India
**Email: agronmurali@tnau.ac.in*

Weed management is a major bottleneck in transplanted rice which leads to the reduced productivity or profitability of the rice ecosystem. Herbicidal weed management is one of the important, economical approach for effective weed management. This method of involves more skills and need to apply without any drift for easy absorption and translocation of herbicides to reach site of action. Further, it has to be eco-friendly ways to deliver herbicides in the environment. This paper reveals at four ways of herbicide delivery methods that aim to improve accuracy, cut down on environmental harm, and save costs. Hydrogel-based delivery systems use water-absorbing materials that release herbicides in response to changes in the environment, like moisture or temperature. This helps control weeds more effectively while keeping the soil moist, which benefits both weed control and soil management. Next, nano-drone swarms bring a new level of precision to farming. These tiny, biodegradable drones, guided by smart AI and sensors, find weeds and apply small amounts of herbicide directly to them. This reduces overall herbicide use and allows for real-time data collection on field conditions, improving the delivery of herbicides. Thirdly, Biodegradable mulch infused with herbicides offers both physical and chemical weed control. As the mulch breaks down, it releases herbicides into the soil, targeting weeds while adding organic matter to the soil. This approach reduces herbicide runoff and makes it a good option for sustainable and organic farming. Finally, herbicide-filled gelatin capsules offer a controlled release, allowing herbicides to be applied in exact amounts, which means fewer, easy application can be achieved. This not only lowers chemical runoff but also improves soil health and reduces labour costs. Field experiment conducted at Tamil Nadu Agricultural University during February – June 2024 reveals that, capsule-based herbicide application, especially with the higher dose of bensulfuron-methyl 0.6% + pretilachlor 6% GR, offers a promising and cost-effective method for controlling weeds, enhancing rice growth, and improving economic outcomes in transplanted rice ecosystems. Capsules filled with 150% of the recommended dose of bensulfuron-methyl 0.6% + pretilachlor 6% GR were the most economically beneficial, providing the highest gross return, net return, and benefit-cost ratio. In contrast, capsules filled with 50% of the recommended dose of triafamone 20% + ethoxysulfuron 10% WG had the poorest economic performance. These new herbicide delivery methods provide practical and scalable solutions that make weed management more efficient, environmentally friendly, and cost-effective. The loss of herbicides through drift, application time and application cost *etc*., can be minimised. These methods favour way for using less herbicide, improving soil health, and making better use of resources, these technologies offer significant improvements in herbicidal weed management in crop production.

Does weed diversity influence yield losses in dry direct-seeded rice?

B. Duary*[1] and Virender Kumar[2]

[1]*Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal 731236, India*

[2]*International Rice Research Institute, Los Banos, Philippines*

**Email: bduary@yahoo.co.in*

Field experiment was conducted in the Agricultural Farm of the Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal, India to study the impact of competition by single and diverse categories of weed on yield of direct seeded rice (DSR). Eight treatments comprised of grass only, broadleaved only, sedge only, grass + broadleaved, grass + sedge, broadleaved + sedge, grass + broadleaved + sedge and weed-free were assigned in a randomized block design with three replications. Number of weeds under each category was maintained as per treatment with a total population of 60 /m^2. In case of single category of weed, population was maintained by removing additional weeds of the same category as well as all other emerged weeds under different categories from 12 DAS onwards. Where combinations of two categories of weeds were kept, the number was maintained as 30 each with a total of 60/m^2. Similarly in the treatment grass + broadleaved + sedges, 20 weeds under each category was maintained keeping total as 60. *Echinochloa colona, Digitaria sanguinalis* under the grasses, *Ludwigia parviflora* and *Malvastrum coromandelianum* under broad-leaved and *Cyperus iria* under the sedges were the weed species present in the experimental field. The reduction of biomass of broadleaved weed at 60 DAS from its sole 100% population to one third in presence of grass and sedges was 75.77%. Whereas for grass and sedge the same was to the tune of 84.29 and 81.13%, respectively indicating greater competitive ability of broadleaved weed in mixed flora composition as compared to grass and sedge. The biomass of weed under sedge only at 60 DAS was significantly lower than that of broadleaved only and grass only. Total weed biomass was significantly lower under grass + broadleaved + sedge as compared to either sole category of weed or equal proportion of any two categories of weeds indicating reduced impact of weed competition when maintained more diversity of different categories of weeds in equal proportion. Reduction of total weed biomass under grass + broadleaved + sedge was in the range of 33.46-44.95% over single category of weed with 100% population and 7.38 -28.29% over the treatments of two categories of weeds with 50:50 population. The grain yield of DSR was significantly lower under broad-leaved only than sedge only and was on par with grass only. Higher grain yield of rice was registered under the treatments grass + broadleaved + sedge, grass + sedge and sedge only and were on par with each other. The reduction in grain yield was the highest (55.84%) under broadleaved only which was followed by grass only (52.26%), combination of broad-leaved + sedge (50.65%), grass + broadleaved (48.05%), sedge only (44.83%), grass + sedge (43.51%) and was the lowest (38.98%) under grass + broad-leaved + sedge. When single category of weed was present comprising 100% population alone the reduction of grain yield was more (44.83-55.84%) than the combination of any two with equal proportion (43.51-50.65%) and combination of three with equal proportion (38.98%) indicating lower impact of diverse weed categories than single category of weed in dry direct seeded rice.

Oral lecture 16

Weed management in rice-wheat-sesbania cropping system under conservation agriculture

Tej Pratap*, S.P. Singh, Vineeta Rathore, Vishal Vikram Singh and Dharmendra Kumar
Department of Agronomy, College of Agriculture Govind Ballabh Pant University of Agriculture and Technology Pantnagar, Udham Singh Nagar, Uttarakhand 263145, India
**Email: drtpsingh2010@gmail.com*

A field experiment was conducted at G. B. Pant University of Agriculture and Technology, Uttarakhand, India during the *Rabi* season of 2021-22 and *Kharif* season of 2022 to develop an appropriate establishment method for rice-wheat cropping system along with weed management treatment under irrigated ecosystem. The experiment was laid out in split plot design with six establishment methods in main plot, viz. Rice (TPR)-Wheat (CTW), Rice (TPR) + RC- Wheat (CTW)+RC-Sesbania (inc), Rice (TPR) + RC- Wheat (ZTW)+RR-Sesbania (inc), Rice (DSR) -Wheat (CTW), Rice (DSR) + RC-Wheat (CTW)+RC-Sesbania (inc), Rice (DSR) + RC- Wheat (ZTW)+RR-Sesbania (inc) and three weed control methods were in sub plot *viz.* recommended herbicide (clodinafop propargyl 15% + metsulfuron-methyl 1% WP 60+4 g/ha post-emergence), IWM (recommended herbicide *fb* one hand weeding at 60 DAS/DAT) and unweeded check in wheat with three replications. Wheat variety HD-2967 and rice variety Pant Dhan-18 was sown under zero and conventional till system respectively. In rice weed control treatments were recommended herbicide penoxsulam 1.02% w/w + cyhalofop–butyl 5.1% w/w OD 135 g/ha (15-20 DAS/DAT), IWM (recommended herbicide *fb* one hand weeding at 45 DAS/DAT) and unweeded check with three replications. Herbicides were applied with knapsack sprayer fitted with flat-fan boom nozzle using 500 liter water/ha. Among establishment methods, Rice (DSR) + RC- Wheat (ZTW)+RR-Sesbania (inc) and Rice (TPR) + RC- Wheat (ZTW)+RR-Sesbania (inc) recorded the lowest weed density and dry weight of grassy and broad leaf weeds respectively whereas IWM (clodinafop propargyl 15% + metsulfuron-methyl 1% WP 60+4 g/ha post-emergence *fb* one hand weeding at 60 DAS) recorded significantly lowest total weed density and dry weight of grassy and broad-leaf weeds over recommended herbicide and weedy check. The interaction effect of establishment methods and weed management practices on total weed density of grassy and broad leaf weeds has been found significant at 60 DAS. Combination of IWM (recommended herbicide *fb* one hand weeding at 60 DAS/DAT) with all the establishment methods resulted in complete elimination of grassy weeds and recorded lowest density of total weed and dry matter accumulation of broad-leaf weeds. Combination of recommended herbicide (clodinafop-propargyl 15% + metsulfuron-methyl 1% WP 60+4 g/ha post-emergence with all the establishment methods except Rice (TPR) (CT)-Wheat (CT), Rice (TPR) + RC- Wheat (CT)+RC-Sesbania (inc) and Rice (TPR) + RC- Wheat (ZT)+RR-Sesbania (inc) resulted in complete elimination of grassy weeds. Total density and weed dry weight of grassy and non-grassy weeds was significantly influenced by different tillage and weed management practices at 60 DAS/DAT. Significantly lowest total weed density and dry weight of grassy weed was observed with Rice (TPR) + RC- Wheat (ZT)+RR-Sesbania (inc). Among weed management treatments, IWM (penoxsulam 1.02% w/w + cyhalofop–butyl 5.1% w/w OD 135 g/ha *fb* one hand weeding at 45 DAS/DAT recorded highest yield attributes and yield over recommended herbicide and unweeded check.

Crop establishment and weed management techniques for enhancing productivity of rice fallow greengram

P.L. Sahithi, K. Srinivasulu*, S. Prathibhasree and G. Vijay Kumar
Agricultural College, Bapatla, Andhra Pradesh 522101, India
**Email: srinivasulukatragadda@yahoo.co.in*

Rice-greengram is the most extensive and traditional cropping system in Krishna zone of Andhra Pradesh. There is a need to evaluate new generation post-emergence herbicidal mixtures for broad spectrum weed control and suitable crop establishment method in rice fallow greengram and hence the present investigation was made. The field trial was conducted at the Agricultural college farm, Bapatla during *Rabi* season of 2021-22 on sandy loam soil. The experimental site was neutral in reaction, low in available nitrogen, medium in available phosphorus and potassium. The experiment was laid out in split plot design replicated thrice. The treatments consisted of three crop establishment methods, *viz*. Sowing by broadcasting 4 to 5 days before harvesting of paddy (M1), Sowing with seed drill under zero tillage (M2), Sowing with seed drill under conventional tillage (M3), as main plot treatments, five weed management treatments, *viz*. Weedy check (S1), HW at 20 and 40 DAS (S2), pendimethalin 1.0 kg/ha as PE *fb* imazethapyr 50 g/ha as PoE (S3), pendimethalin 1.0 kg/ha as PE *fb* acifluorfen Na + clodinafop propargyl 160+80 g/ha as PoE (S4), pendimethalin 1.0 kg/ha as PE *fb* fomesafen + fluzifop-p-butyl 110+110 g/ha as PoE (S5) as sub plot treatments. Pendimethalin was applied as pre-emergence by mixing with 20 kg sand/ ha (SMA) and broadcasted after removing paddy sheaves on moist soil surface for main plot treatment with broadcasting greengram seeds in standing rice crop followed by water spray. post-emergence application of herbicides were applied at 20 DAS. The highest seed yield and haulm yield was found with sowing with seed drill under conventional tillage which is higher than other crop establishment methods. In conventional tillage, better environmental and eco-physiological conditions prevailed by less crop- weed competition for moisture and light and made better availability of nutrients for proper development of crop dry matter and yield attributing characters viz., pods/plant and seeds/pod which resulted in increased grain yield of greengram. Among weed management practices the higher seed yield and haulm yield was found with Hand weeding treatment which was statistically on par with pendimethalin 1.0 kg/ha as PE *fb* fomesafen + fluzifop-p-butyl 110 + 110 g/ha as PoE and superior over all other treatments studied. Among the crop establishment techniques, sowing with seed drill under conventional tillage recorded higher gross returns which was at par with sowing with seed drill under zero tillage. Among the weed management techniques, highest gross returns were obtained with hand weeding at 20 and 40 DAS. Among the herbicidal treatments, the highest gross returns were obtained with pendimethalin 1.0 kg/ha *fb* fomesafen + fluazifop-butyl 110 + 110 g/ha as PoE. Sowing with seed drill under conventional tillage produced markedly higher net returns and among the weed management practices pendimethalin 1.0 kg/ha *fb* fomesafen + fluazifop-butyl 110 +110 g/ha as PoE recorded higher net returns which were comparable with pendimethalin 1.0 kg/ ha *fb* acifluorfen Na + clodinafop propargyl 160+80 g/ha as PoE and hand weeding at 20 and 40 DAS as well. Highest benefit cost ratio was observed with broadcasting 4 to 5 days before harvesting of paddy and this might be due to low cost involved in broadcasting method compared to other methods. Based on the results obtained from the experiment, sowing with seed drill under conventional tillage along with pendimethalin 1.0 kg/ha as PE *fb* fomesafen + fluazifop-butyl 110 +110 g/ha as PoE resulted in higher seed yield and net returns in rice fallow greengram over other methods studied.

Bio-efficacy evaluation of new herbicide molecule penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG against weed complex in transplanted rice

N. Ananda* B.K. Desai, Y.M. Ramesh, A.G. Sreenivas, Mahadevaswamy, S.N. Bhat and Vineetha

AICRP on Linseed, University of Agricultural Sciences, Raichur, Karnataka 584104, India

**Email: clkananda@gmai;.com*

A field experiment was conducted during *Kharif* 2020 and 2021, on medium black cotton soil of Agriculture Research Station, Dhadesugar, coming under Northern Dry Zone of Karnataka, University of Agricultural Sciences, Raichur. The study was conducted to assess the bio- efficacy of penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG against weed complex in transplanted rice. Experiment consist of 8 treatments *viz*., penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG as pre emergence (PE) at 260 ml/ha, penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG as PE at 300 ml/ha, penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG as PE at 340 ml/ha pyrazosulfuron 10% WP as PE at 200 ml/ha penoxsulam 21.7% SC as PE at 115 l/ha Penoxsulam 0.97% + Butachlor 38.8% SE as PE at 2062 ml/ha Weed free check and Weedy check which were replicated thrice in a randomized complete block design using crop variety: RNR-15048. Pooled data of 2020 and 2021 revealed that, significantly higher plant height (84.99 cm), number of panicles per hill (11.73), number of grains per panicle (122.30), panicle length (24.78 cm), panicle weight (3.82 g), 1000 seed weight (21.59 g), grain yield (5.203 t/ha), straw yield (8.055 t/ha) and lower number of chaffy grains per panicle (9.35) were recorded in treatment with application of penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG at 340 g/ha as PE and it was followed by penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG at 300 g/ ha as PE . This could be possibly due to reduction in weed growth with the herbicide application which allowed the crop to get adequate nutrient supply resulting in higher leaf-area index and thus more production and assimilation of photosynthates contributing to higher grain and straw yield (Shan *et al.* 2012). Similar results were recorded by Bhargavi *et al.* (2024) in rice. The economics of different herbicides was calculated and among the herbicide treatments, application of penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG at 300 g/ ha as PE significantly recorded the higher BC ratio (1.99) followed by application of penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG at 340 g/ ha as PE (1.98) which might be because of higher yield Lower growth and grain yield was observed in weedy check due to higher weed density and biomass which compete with the crop for nutrients, light and space and in turn decreases the yield components.

Oral lecture 19

Weed management in rice: A need for sustainable food security in Chhattisgarh, India

Veenapani Dubey
Dept of Botany, CMD College Bilaspur, Chhattisgarh 495004, India
Email: dubey.veenapani@gmail.com

Agricultural achievement in India during its 77 years of independence have changed country's image from food importer to potential exporter. India's population is growing at the rate of 1.9% annually and may reach up to 1.4 billion by the year 2025. The challenge to sustain food security is to develop production technologies for rainfed areas. Rain fed agricultural production plays an important role in meeting the demand of food in the future. Rice is a rainfed crop. Increasing population urbanization and industrialization and have been exerting stress on croplands. To meet the demands of increased population it is necessary that the productivity of croplands should be very high. Because of limited arable land, agriculture management has assumed new dimensions in the form of technology to cope up with situation. Solution of the present problem lies in reducing the gap between actual production and potential production of crop by eradicating crop weeds using low-cost inputs. To keep pace with the present rate of population growth and consumption patterns, the food requirements must reach 246 million tons by year 2025. Production of 'green revolution' crops (wheat and rice) has declined at the rate of 2.46% since 1991. To compensate the decline in productivity there is need to reduce crop loss from pests, diseases and weeds. Moreover, to sustain food security the challenge is to develop food production technologies for rain fed areas because the rain fed agricultural production plays an important role in meeting the demand of food in future. Rice is one of this. Apart from the other factors weeds are serious impediments to crop growth and productivity. Therefore, solution of present problem lies in reducing the gap between actual production and potential production of crop by eradicating crop weeds using low-cost inputs in general and rice in particular. To manage the rice field weeds in Chhattisgarh the knowledge on ecology and taxonomy of weeds is a prerequisite. unless one knows, proper identification of a weed, a very successful strategy to control them cannot be evolved. A very less data is available on ecology of weeds and their interrelationship with other plant communities. In present study, some of these aspects have been discussed particularly with reference to paddy field weeds.

Effects of tillage and herbicide on weed interference and crop yield in a direct-seeded rice-wheat-greengram system in eastern Indo-Gangetic Plains

Sonaka Ghosh*, Kirti Saurabh, Ved Prakash, Rachana Dubey, Saurabh Kumar, Rohan Kumar Raman, Rakesh Kumar, Ashutosh Upadhyaya and Anup Das

ICAR Research Complex for Eastern Region, Patna, Bihar 800014, India

**Email: sonakaghosh@gmail.com*

Weed infestation is a continuous and recurrent problem and dynamic in nature for crop production, which envisages continuous research need to be undertaken towards developing new tools for weed management. Conservation agriculture (CA) involving minimum mechanical soil disturbance, permanent soil cover with crop residue mulch and diversified crop rotation, plays a crucial role in sustainable crop production. However, weeds pose the most serious threat to CA. A field study was conducted during 2021-24 at ICAR Research Complex for Eastern Region, Patna in eastern Indo-Gangetic Plains (EIGP) to evaluate different tillage and crop establishment systems supplemented with weed management practices in a direct seeded rice-wheat-greengram system on weed interference and crop productivity. The experiment was conducted in a split plot design with 3 main plots and 4 sub plots and with 3 replications. The treatments comprised of different tillage and crop establishment practices as main plot treatments and weed management practices as subplot treatments. Results of the study revealed that CA-based practice comprising zero till direct seeded rice (ZTDSR) - zero till wheat (ZTW) - zero till greengram (ZTG) combined with efficient herbicide application led to higher weed control efficiency and increased cropping system productivity than conventional tillage practice comprising line puddled transplanted rice (LPTPR) - conventional till (CT) wheat - CT greengram. Adoption of the practice comprising ZTDSR-ZTW-ZTG also led to 35.9% higher soil organic carbon concentration at 0-7.5 cm soil layer and 33.5% reduction in global warming potential. There was variation in weed emergence under CT and CA-based plots showing differential soil moisture and temperature. The grassy weed density and diversity were more prominent in rice than broad-leaf weeds and sedges irrespective of tillage practices. Among weed management practices, pre-emergence application of pyrazosulfuron-ethyl (25 g/ha) followed by *(fb)* post-emergence application of cyhalofop butyl + penoxsulam (100 + 25) g/ha (tank-mix) at 20 days after sowing (DAS) led to significant reduction of weed density as well as biomass in rice and achieved 89.4% weed control efficiency. PCA analysis revealed that emergence of grassy weeds was more prevalent under CT wheat, whereas broad-leaf weed species were found more dominant under ZTW. Post-emergence application of clodinafop-propargyl + metsulfuron-methyl (60 + 5) g/ha (tank-mix) at 25 DAS in wheat recorded 93.2% weed control index. In case of greengram, application of pendimethalin (1000 g/ha) as pre-emergence *fb* post-emergence application of imazethapyr (100 g/ha) at 20 DAS led to 78.1% weed control efficiency. These herbicides also led to higher herbicide efficiency index. Thus, the integrated effects of crop residue retention and herbicides could prove to be an integrated weed management strategy for sustainable intensification of rice-wheat-greengram system under CA in EIGP.

Assessment of weed diversity and critical crop-weed competition impact on upland rice using spatial techniques in the mid-hills of Meghalaya

N. Premaradhya*[1], Vishram Ram, Santosh Korav and K.S. Shashidhar[4]

[1]*College of Agriculture, Pasighat, Arunachal Pradesh 791102, India*

[2]*SNRM, College of PG Studies in Agril., Scienes, Umiam, Meghalaya 793103, India*

[3]*School of Agriculture, Lovely Professional University, Jalandhar, Punjab 144411, India*

[4]*Banaras Hindu University, Mirzapur, Uttar Pradesh 231001, India*

**Email: premaradhya@gmail.com*

Rice is a dominant crop for ensuring nutritional security across many countries in the Asia-Pacific region. However, traditional cultivation practices must be modified to address the impacts of climate change. A key strategy in this shift is moving from submerged rice cultivation to aerobic systems. A significant challenge in upland rice cultivation is weed infestation, which can reduce yields by up to 90%. Cost-effective and efficient weed management techniques, particularly during critical stages of crop development, are crucial for sustainable production. The response of weed species to different management practices also influences biodiversity and potential yield, necessitating detailed studies. A field experiment was conducted in the mid-hills of Meghalaya at ICAR-NEH to assess the critical period for weed competition (CPWC) and the resource acquisition patterns of weed species in upland rice. The experiment was laid out in a Randomized Block Design (RBD) with 10 treatment combinations of weedy and weed-free competition periods at different intervals, replicated thrice. The study identified 22 weed species, with broadleaf weeds being the most dominant. Key species, including Spermacoce latifolia (27.2), *Ambrosia artemisiifolia* (25.1), *Bidens pilosa* (24.8), *Galinsoga parviflora* (22.0), and *Echinochloa* spp. (23.4), emerged throughout the crop's growth cycle, showing the highest Importance Value Index scores. Diversity indices such as the Shannon-Weiner (2.86) and Pielou's index (0.99) showed maximum values in weed-free conditions up to 42 days after sowing (DAS). In contrast, lower evenness and diversity were observed in weedy conditions. The estimated CPWC for preventing a 5% relative yield loss was between 15–66 DAS, and between 21–62 DAS for a 10% relative yield loss. This corresponded to growing degree days (GDD) of 199.5°C days at 5% relative yield loss and 289.55°C days at 10% relative yield loss. Weed-free competition for 42 DAS was statistically similar, showing a positive correlation with plant height, biomass accumulation, number of effective tillers, panicle length, panicle weight, filled grains per panicle, grain yield, and 1000-grain weight. Conversely, a negative correlation was found between weed biomass and tiller number, panicle development, number of grains, sterility percentage, and grain yield, highlighting the adverse effects of weeds on crop productivity. A spatial analysis of the weed flora in Ri-Bhoi district, Meghalaya, using Remote Sensing and GIS techniques, revealed medium to high weed density in Umling and Upper Umsning blocks. The weed species diversity ranged from 3 to 10 species per square meter. The Shannon diversity index (H') ranged from 0.69 to 2.08, while the Simpson's index varied from 0.01 to 0.9. Weed species were more evenly distributed in lowland areas compared to upland sites. Although Umling had moderate to high weed diversity, no new species were observed compared to other blocks. This study highlights the importance of identifying CPWC and monitoring weed diversity to develop long-term management strategies for weed control, especially in the context of precision agriculture.

Integrated weed management in semi-dry rice

Y. Sreeja*, R. Babu, P.P. Mahendran, and K. Sujatha
Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, Tamil Nadu 625104, India
**Email: sreerani26@gmail.com*

The field experiment was conducted in Agricultural Research Station, TNAU, Paramakudi, during 2017-18 and 2018-19 to study the influence of irrigation and weed management practices on the growth performance and yield of semi-dry rice. The experimental site is situated at 9°21' N latitude and 78°22' E longitude with an altitude of 39.83 m above mean sea level. The experiment was set up in a split plot design with eighteen treatment combinations and replicated thrice. The main plot treatments were, *viz.* Irrigation when water level drops to at 10 cm below soil surface (I10), Irrigation when water level drops to at 15 cm below soil surface (I15), Irrigation when water level drops to at 20 cm below soil surface (I20), and sub plot treatments were pre-emergence (PE) pendimethalin at 1.0 kg/ha at 3 days after soaking rain (DAS) *fb* (followed by) one hand weeding at 30 DAS (W1), Early post-emergence (EPoE) bispyribac-sodium 25 g/ha at 15 DAS *fb* one hand weeding at 30 DAS (W2), PE pendimethalin at 1.0 kg/ha at 3 DAS *fb* Star weeder at 30 DAS (W3), EPoE bispyribac-sodium 25 g/ha at 15 DAS *fb* Star weeder at 30 DAS (W4), PE pendimethalin at1.0 kg/ha at 3 DAS *fb* EPoE bispyribac-sodium 25 g/ha at 15 DAS (W5), and Two Hand weeding at 20 and 40 DAS (W6). Irrigation when water level drops to 10 cm below soil surface recorded significantly higher growth parameter, yield parameter, crop nutrient uptake and B:C in rice then other irrigation levels. Among the weed management practices pendimethalin 1 kg/ha followed by bispyribac-sodium 25 g/ha favorably responded to crop growth and yield. Considering weed management at 15 DAS PE application of pendimethalin at 1.0 kg/ha followed by one hand weeding at 30 DAS had significantly influenced the different weed parameters. However, at 30 and 45 DAS, pendimethalin 1 kg/ha followed by bispyribac-sodium 25 g/ha given best performance on weed control. At 15 DAS, irrigation when water level drops to 10 cm below soil surface and pendimethalin at 1.0 kg/ha followed by one hand weeding recorded greater WCE 90.34% and 90.67% Whereas, at 30 and 45 DAS, irrigation when water level drops to 10 cm below soil surface along with pendimethalin 1 kg/ha followed by bispyribac-sodium at 25 g/ha recorded high weed control efficiency. Among the weed management practices, significantly higher grain yield of 3,980 and 3,810 kg/ha was recorded with PE pendimethalin at 1.0 kg/ha followed by bispyribac-sodium 25 g/ha during 2017-18 and 2018-19, respectively. During both the years of experimentation, irrigation when water level drops to 10 cm below soil surface + pre-emergence application of pendimethalin 1.0 kg/ha on 3 DAS followed by early post-emergence application of bispyribac-sodium 25 g/ha on 15 DAS registered higher grain yield of 4,363 and 4,172 during 2017 and 2018 respectively. Similarly lower grain yield of 2,487 and 2,347 kg/ha was recorded in irrigation when water level drops to 20 cm below soil surface + PE pendimethalin at1.0 kg/ha on 3 DAS *fb* operating star weeder on 30 DAS.

Impact of crop establishment methods, nutrient levels and weed management practices on weed suppression and yield optimization in hybrid rice

Abhinandan Singh*, I.B. Pandey and Amit Kumar Singh
Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh 224229, India
**Email: agabhi92@gmail.com*

Efficient nutrient management strategies (NL) and appropriate crop establishment methods (CEM), and use of sound weed management practices are the key factors for sustained rice yield and plays an important role in the nation economy. However, the impact of crop CEM, NL and WMP on weed suppression and yield of hybrid rice were not elaborately studied. In order to assess its performance, we used a split-plot design to evaluate a field study. The experiment had the combination of 9 main-plot treatments viz, 3 CEM (puddled transplanting (PT), un-puddled transplanting (UPT), and dry direct seeding rice (DDSR) and 3 NL (75%RDF, 100%RDF, e.g. 120:60:40 kg NPK/ha and 125%RDF) and 4 sub-plot treatments viz, WMP weedy-check (WC), two hand-weeding at 20 and 40 DAS/T (HW), bispyribac-sodium 20 g/ha + pyrozosulfuron 20 g/ha at 20 DAS/T (CW), and brown manuring (BM). Among the crop establishment methods lowest weed density, weed dry biomass, weed growth rate and nutrient depletion by weed were recorded in PT, which was significantly lower than UPT and DDSR. However, the lowest weed density, weed dry biomass, weed growth rate, nutrient depletion by weed and higher weed control efficiency were associated with 75% RDF. Likewise, all the WMP significantly reduced the weed density, weed dry biomass, weed growth rate and NPK- depletion by weed than weedy check and enhanced weed control efficiency. Among weed management practices, significantly lower weed density, weed dry biomass, weed growth rate and NPK- depletion by weed were recorded in HW twice, followed by combined application of bispyribac-sodium + pyrazosulfuron than BM. The observed data revealed that puddled transplanting correspondingly produced higher grain yield (56.71 and 58.47 q/ha), straw yield (80.10 and 81.24 q/ha), harvest index (41.43 and 41.80) and grain: straw ratio (0.708 and 0.719) than unpuddled transplanting and dry direct seeded rice. Application of 125% RDF registered maximum yields though remained statistically comparable with 100% RDF and both proved significant superiority over 75% RDF. Weed management practices significantly differed among themselves irrespective grain yield, straw yield and harvest index. However, two hand weeding recorded the maximum yield but not proved remunerative than combined application of bispyribac-sodium + pyrazosulfuron.

Geospatial analysis of impact of weed management practices in rice crop of Chhattisgarh plains

Nitish Tiwari, Manju Tiwari* and Shrikant Chitale
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India
**Email: manju2022iirs@gmail.com*

The present investigation entitled "Geospatial Analysis of Impact of Weed Management Practices in Rice Crop of Chhattisgarh Plains" is an analysis of the effect of using weed management practices on crop productivity in various districts of plains of Chhattisgarh (C.G.). The survey was initially carried out during the *Kharif* season (2022) for the Rice crop. The position and location of various fields having different types of weeds were collected along with details of species of weed, weed elimination techniques, use of herbicides, *etc*. This data was visualized using QGIS to get its district-wise spatial distribution. The data imported from QGIS was further analyzed using Numpy and Matplotlib libraries of Python. It is evident from the nature of the plot that the use of weed management practices and herbicides can greatly increase the per-hectare yield of Rice crop.

Weed flora and their diversity under the non-chemical weed management in direct-seeded rice

Mona Nagargade[1,2]*, Manoj Kumar Singh[2], Vishal Tyagi[1] and Pravin Upadhyay[1]
[1]Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India
[2]Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Uttar Pradesh, Varanasi 221005, India
**Email: monanagargade@gmail.com*

The journey of direct seeded rice (DSR) started with weed interference as a bottleneck obstacle for it. While herbicides have traditionally been the primary means of controlling weeds, their application often carries environmental costs. Therefore, shifting towards non-chemical alternatives presents a more sustainable solution that can positively impact weed diversity and promote long-term ecological balance. Adopting practices such as selecting appropriate planting geometry, utilizing competitive cultivars, and implementing other cultural techniques can yield non-monetary benefits in terms of effective weed management. Therefore, a field experiment was carried out with a focus on non-chemical weed management, We observed the prevalence of various weed types, including grasses, sedges, and broad-leaved weeds. Among the grasses, *Cynodon dactylon* (L.) Pers, *Echinochloa colona* (L.) Link, and *Echinochloa crusgalli* (L.) Beauv emerged as the most dominant species. In the sedge category, the predominant weeds were *Cyperus difformis* (L.), *Cyperus iria* (L.), and *Fimbristylis miliacea* (L.) Vahl. Meanwhile, the broad-leaved weeds that stood out included *Ammannia baccifera* (L.), *Caesulia axillaris* (L.) Rottb, and *Phyllanthus fraternus* (L.) Webster. The data demonstrated a significant impact of planting geometry, cultivar selection, and non-chemical weed management strategies on the composition of weed flora. Analysis of the relative composition of different weed types at various growth stages revealed that *Cynodon dactylon* and *Echinochloa colona* consistently ranked as the most dominant weeds throughout all growth stages. Additionally, *Cyperus difformis* and *Caesulia axillaris* were notable contributors at 25 days after sowing (DAS), while *Fimbristylis miliacea* and *Caesulia axillaris* were significantly higher at 60 DAS. By 90 DAS, *Fimbristylis miliacea* and *Ammannia baccifera* also played major roles within the overall weed community. Weed diversity indices—such as dominance, evenness, and Shannon–Wiener diversity—were not significantly affected by planting geometry or cultivar, nor by their interaction. However, non-chemical weed management practices had a significant influence on these indices at 25 and 60 DAS. The combination of hand hoeing at 12 DAS followed by *Sesbania aculeata* co-culture at 45 DAS (with mulching) resulted in the lowest Shannon–Wiener and evenness indices but the highest dominance index, indicating superior weed control. Evenness values close to 1 reflected uniform weed species distribution across treatments. The hand hoeing and *Sesbania* co-culture combination had notably lower evenness and Shannon–Wiener values, but higher dominance values. In terms of effective weed management, the Arize 6444 cultivar, square planting geometry, and hoeing followed by hand weeding performed best. However, the high cost and labor scarcity associated with manual weeding remain challenges. Alternatively, using Arize 6444, square planting geometry, and hoeing at 12 DAS followed by *Sesbania* co-culture and mulching at 45 DAS proved to be superior in terms of enhancing crop productivity and profitability, while markedly reducing weed density in DSR in Eastern India.

Crop establishment methods and weed management practices influence weed dynamics, system productivity and profitability in rice-chickpea-greengram cropping system

M.P. Sahu*, Vikash Singh, Alpana Kumhare, Narendra Kumar and V.K. Choudhary

ICAR- Directorate of Weed Research, Maharajpur, Jabalpur, Madhya Pradesh 482004, India

**Email: munipratapag@gmail.com*

Weeds pose a major threat to crop production by competing with above (light, space and CO_2) and below-groundresources (nutrients and water). The weed severity further increased under a direct-seeded rice (DSR) based system mainly due to the absence of a thin water layer and congenial environment for weeds to grow and establish. This may cause yield loss up to the extent of 90%. Subsequently, growing chickpea and greengram in the system are also severely infested with weeds. Management of weeds including various methods in the system mode may reduce the weed severity and future weed problem. Therefore, the present study was undertaken to ascertain the effect of crop establishment methods and weed management practices on weed dynamics, productivity and profitability in the rice-chickpea-greengram cropping system at the ICAR-Directorate of Weed Research, Jabalpur (M.P.). Under the study, conventional tillage (CT)-CT-CT and zero tillage coupled with previous crop residues (ZTR)-ZTR-ZTR were the crop establishment methods assigned to the main plots, while weed management [weedy check, recommended herbicide (RH), integrated weed management (IWM), and herbicide rotation (HR)] were assigned to sub-plots under split design and replicated thrice. Major weed flora during *Kharif*in rice was *Echinochloa colona, Dinebra retroflexa, Digitaria sanguinalis* and *Eleusine indica* among grasses, *Alternanthera sessilis* among broad-leaf weeds and *Cyperus iria* was only sedge, while during *Rabi* in chickpea, *Avena ludoviciana* was grass, *Medicago denticulata, Convolvulus arvensis, Sonchus oleraceus, Lathyrus aphaca, Chenopodium album* and *Trifolium pretense* among broadleaf weeds and *Cyperus rotundas* was only sedges, during summer in greengram, *Dinebra retroflexa, Digiteria sanguinalis, Echinochloa colona, Eleusineindica, Dichanthium annulatum* among grassy, *Convolvulus arvensis, Alternanthera sessilis, Physalis minima* among broad-leaf weeds and *Cyperus iria* was only sedge present. In the long-term study during 2022-23 system, result revealed that among crop establishment methods, ZTR-ZTR-ZTR system recorded with 14.5% higher weed density and 17.5% higher weed biomass than that of CT-CT-CT system in rice. While in chickpea, ZTR recorded with 8.9% less weed density and 21.3% lower weed biomass over CT. Similarly, in summer, ZTR was obtained with a reduction in weed density by 16% and biomass by 16.7% over CT. Among weed management practices, IWM significantly controlled the weeds in the system and reduced the weed density by 75.2-90.6%, and biomass by 86.2-94.3% over weedy check, while it was comparable to HR. Higher weed flora under ZTR in rice and chickpea marginally reduced the crop yields 3.5% in rice and 4.7% in chickpea, whereas greengram has out yielded over CT by 2.2%. Likewise, IWM (pretilachlor + pyrazosulfuron 615 g/ha (PE) followed by *(fb)* bispyribac-sodium 25 g/ha (PoE) *fb* hand weeding (HW) at 45 DAS in rice, pendimethalin + imazethapyr 1000g/ha (PE) *fb* HW at 30 DAS in chickpea and pendimethalin 678 g/ha *fb* HW at 30 DAS in greengram achieved the highest system productivity and profitability in rice-chickpea-greengram followed by Herbicide rotation.

ISWS Biennial Conference on "*Climate-smart Weed Management for Global Food Security*", Banaras Hindu University, Varanasi, (India) 28-30 November, 2024.

Oral lecture 27

Comparative study of weed control methods on weed dynamics and productivity in transplanted rice in Eastern Uttar Pradesh

Abhishek Mishra*, Vaibhav Pandey and Prashant Dwivedi

Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Email: abhiagro0549@gmail.com*

A field experiment titled "Effect of weed control methods on weed dynamics and productivity of transplanted rice in Eastern Uttar Pradesh" was conducted during the *Kharif* season of 2021 at the Agronomy Research Farm, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh. The study aimed to evaluate the influence of various weed control methods on weed dynamics, growth parameters, and productivity of transplanted rice. The experiment was laid out in a Randomized Block Design (RBD) with three replications and eight treatments, combining chemical and manual weed control techniques. The treatments included: (1) pretilachlor 1000 g/ha as pre-emergence (PE), (2) pretilachlor 1000 g/ha (PE) + bispyribac-sodium 25 g/ha as post-emergence (PoE), (3) pretilachlor 1000 g/ha (PE) + one hand weeding at 35 days after transplanting (DAT), (4) Bispyribac-sodium 25 g/ha as PoE, (5) bispyribac-sodium 25 g/ha early PoE (25 DAT) + one hand weeding at 45 DAT, (6) two hand weeding at 20 and 40 DAT, (7) weed-free up to 60 days, and (8) weedy check. These treatments aimed to compare the effectiveness of different herbicides and manual weeding schedules for optimum weed control in rice. The results indicated that all the growth parameters and yield attributes were significantly influenced by the various weed control treatments. Among the methods, the weed-free up to 60 days treatment recorded the highest growth and yield performance. This treatment had the tallest plant height, the highest number of tillers, and the greatest panicle weight and grain yield, demonstrating the importance of keeping the field free from weeds during the critical early growth stages of the crop. The two-hand weeding treatment at 20 and 40 DAT followed in terms of performance, showing strong growth and yield as well. Among herbicide-based treatments, pretilachlor 1000 g/ha (PE) + one hand weeding at 35 DAT emerged as the most effective, significantly enhancing growth and yield compared to other herbicide treatments. This combination provided good weed control during the initial and mid-growth stages, allowing the rice crop to utilize nutrients, water, and light optimally. The economic analysis revealed considerable differences in the cost of cultivation, gross returns, net returns, and benefit-cost ratio among treatments. The highest cost of cultivation (Rs. 1,04,141/ha) was incurred by the weed-free up to 60 days treatment, primarily due to increased labour costs. The two-hand weeding treatment followed with a cost of Rs. 82,611/ha. Despite the high cost of cultivation, the weed-free treatment produced the highest gross returns (Rs. 1,37,509.2/ha) due to its superior yield. However, the most profitable treatment was Pretilachlor 1000 g/ha (PE) + bispyribac-sodium 25 g/ha (PoE), which recorded the highest net return of ^{1} 80,800 per ha. This treatment also had the highest benefit-cost ratio of 1.88, making it the most cost-effective and financially viable weed control strategy.

Weed management through conservation agriculture practices under rice–wheat system

Kajal Verma*, U.P. Singh, N.K. Singh, Anurag Upadhyay and Sitesh Jha
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: vermakajal.bhu@gmail.com*

Rice–wheat system is one of the most widely practiced agricultural systems, occupying approximately 13.5 million hectares in South Asia and is lifeline for billions of people. This system is considered backbone of India's food security, accounts for nearly 75% of the nation's food supply. This system is of immense importance for food security, employment, income and livelihood. However, Intensive tillage practices and monocropping used in this system has created favorable conditions for weed germination and proliferation, whereas heavy reliance on herbicides for weed control has further exacerbated the issue. Weeds are the major problematic issue and alone can cause loss of up to 40% in agricultural production. As, manual weeding is increasingly becoming difficult task due to labor shortage at the peak period and higher wages. Weed control using herbicides, though easy, effective and economical however, its timing and dose of application is very crucial. Otherwise it may result in development of herbicide resistant weeds and adversely affect the management of weeds. Therefore, it's high time to search for some viable and potential options for effective management of weeds. In response to these challenges, Conservation Agriculture (CA) practices are gaining attention as a sustainable solution. CA, with its principles of minimum soil disturbance, permanent soil cover, and sensible crop diversification, offers a unique approach in managing weeds while also improving soil health and reducing the environmental footprint of farming. By minimizing tillage, CA disrupts the germination of many weed species, while crop residue retention and diverse crop rotations create unfavorable conditions for weed growth. The presence of residue on the soil surface also influence soil temperature and moisture regimes which affect weed seed germination and emergence patterns. Research trial conducted at Agricultural research farm, BHU, Varanasi for assessing the impact of CA based crop establishment options on weeds under rice-wheat system. Result indicated that full CA based practices *i.e.* Zero till (ZT) direct-seeded rice- ZT wheat- ZT mungbean + along with anchored residue retention of all three crops helped in reducing weed infestation (weed density) 22.12% in rice and 28.43% in wheat and enhancing system productivity (14.5%) over conventional system particularly seasonal annual weeds as compared to conventional tilled (CT) rice–CT wheat. Hence, Efforts should be more focused to generate viable CA based practices along with appropriate weed management measures including new herbicidal molecules and its sensible rotation to address the issues of weed resistance and resource degradation under rice-wheat system.

Oral lecture 29

Evaluation of the bio-efficacy of bispyribac-sodium 9.1% + metsulfuron-methyl 1.2% + chlorimuron-ethyl 1.2% SC w/v against weeds in transplanted paddy

Sameer Shrivastava*, Chandra Bhushan, Sunil Kumar Verma and Mohammad Vaheed
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: sameer03152@gmail.com*

Rice (*Oryza sativa* L.) is the primary staple food for over half of the global population, particularly in regions with high population density and rapid growth, contributing approximately 21 percent of the world's calorie intake. Despite increased production through high-yielding varieties, full yield potential remains unrealized due to inadequate weed management. Effective weed control is critical for maximizing rice yields as unchecked weed growth in transplanted rice can reduce grain yields by 30-36 percent. Weeds compete directly with rice for essential resources like nutrients, moisture, light and space underscoring the need for efficient weed management to optimize rice production. This study evaluated various herbicidal weed management strategies in transplanted rice focusing on weed control efficacy, crop safety, and the effects of herbicide mixtures. The experimental design was randomized complete block design replicated thrice with ten herbicidal treatments *viz*. bispyribac-sodium 9.1% + metsulfuron-methyl 1.2% + chlorimuron-ethyl 1.2% SC w/v at 200 mL/ha, 250 mL/ha, 270 mL/ha; bispyribac-sodium 10% SC at 250 mL/ha; metsulfuron-methyl 20% WG at 20 g/ha; chlorimuron-ethyl 25% WP at 24 g/ha; metsulfuron-methyl 10% + chlorimuron-ethyl 10% WP at 20 g/ha; penoxsulam 21.7% SC at 93.7 mL/ha; hand weeding (twice) and untreated control. The field experiment was conducted during rainy (*Kharif*) season of 2018-19 to evaluate the effect of different rates of bispyribac-sodium 9.1% + metsulfuron-methyl 1.2% + chlorimuron-ethyl 1.2% SC w/v in transplanted paddy and its effect on succeeding crop. The pH of the soil is approximately neutral (7.31) and the texture experiment was sandy clay loam in texture. The soil was low in organic carbon (0.35%) and nitrogen (121.10 kg/ha) and medium in phosphorus (19.98 kg/ha) and potassium (182.85 kg/ha). The results reveals that the application of bispyribac-sodium 9.1% + metsulfuron-methyl 1.2% + chlorimuron-ethyl 1.2% SC w/v applied 270 mL/ha and 250 mL/ha were effective for the control of weed flora and subsequently increasing the crop growth and yield of transplanted paddy. No adverse effect of these herbicides on the soil properties and no phytotoxicity on transplanted paddy crop was observed. Further, no adverse effect of the treatments on succeeding wheat crop. Thus, for the effective control of weeds, use of bispyribac-sodium 9.1% + metsulfuron-methyl 1.2% + chlorimuron-ethyl 1.2% SC w/v at 250 mL/ ha as post-emergence is recommended for higher yield and profitability of transplanted paddy crop.

Oral lecture 30

Evaluation of weed competitive ability of rice cultivars in dry direct-seeded rice under changing climate

Anamika Pandey*[1], P.K. Mukherjee[2], V.K. Choudhary[3], Namrata Jain[4] and Sonali Singh[5]
[1,4]*Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh 482004, India*
[2,3]*ICAR, Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*
[5]*Rajmata Vijayaraje Scindia Krishi Vishwavidhyalay, Gwalior, Madhya Pradesh 474011, India*
**Email: pandey.ana22@gmail.com*

Field experiment was conducted at the ICAR-Directorate of Weed Research, Jabalpur, during the *Kharif* season of 2023-24 under ICAR-IRRI collaborative project with the objective to evaluate weed competitive ability of rice cultivars under different levels of weed pressure in dry direct-seeded rice (DSR) under upland ecology. The weed pressure treatments included: low weed pressure [pendimethalin 678 g/ha as pre-emergence (PE) followed by cyhalofop-butyl + penoxsulam 135 g/ha as post-emergence (PoE)], medium weed pressure (pendimethalin 678 g/ha as PE), and high weed pressure (weedy control). Under high weed pressure, dominant weed flora was *Dinebra retroflexa* and *Echinochloa colona* among grasses, *Cyperus iria* among sedges, and *Alternanthera paronychioides*, *Physalis minima*, and *Phyllanthus simplex* among broad-leaf weeds. All varieties showed higher weed control index under both medium and low weed pressure. Among them, Purna, Abhishek, Sadabahar, and IR64-Drt1 performed exceptionally well and registered lower values of weed dry weight and higher weed control index (weed control index values were 77.7, 78.0, 77.7 and 76.7% at 90 DAS, respectively) under low weed pressure. The short duration variety Purna (98-101 days maturity) was recorded as high weed competitive variety with the yield reduction of 14 to 21% in high weed pressure (grain yield 3.8 t/ha) compared with medium weed pressure (grain yield 4.4 t/ha) and low weed pressure (grain yield 4.8 t/ha). Early seedling emergence, tallness stature and early maturity were the important characters for attributing weed competiveness trait in Purna. Purna registered the highest yield of 4.8 t/ha with a higher net return of Rs. 68,034/ha and B:C of 2.75 followed by IR64-Drt1 (grain yield 4.4 t/ha, net returns Rs. 70,652/ha and B:C 1.90), Abhishek (4.1 t/ha, net returns Rs. 64,882 /ha and B:C 1.94), and Sadabahar (3.3 t/ha, net returns Rs. 47,996 /ha and B:C 1.58) under low weed pressure. Varieties Purna (98-101 days maturity), Sadabahar (96-98 days maturity), IR-64 Drt 1 (113-118 days maturity) and Abhishek (108-112 days maturity) performed well in dry DSR under the condition of early withdrawal of monsoon, whereas moisture stress at grain filling stage resulted in significant yield losses (Average yield <2.2 t/ha in low weed pressure) of other high yielding cultivars CR Dhan 205, CR Dhan 206, CRR-808-1, Tej Gold (Hybrid), JR-206, Arize 6129 Gold (Hybrid), XRA 27936 (Hybrid), Kranti (more than 120 days maturity) evaluated in the experiment.

Effect of integrated weed management practices in transplanted rice in Indo-Gangetic plain

Mausmi Rastogi*[1], Shikhar Verma[2] and Vivek[3]

[1,3]Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh 250110, India

[2]Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208002, India

**Email: Mausmisony@gmail.com*

Rice (*Oryza sativa* L.) holds an indispensable position as the most important staple food crop worldwide, serving as the primary food source for nearly 60% of the global population. Weeds are a major hindrance to rice cultivation, especially in the critical growth stages when they compete with rice for essential resources like nutrients, light, and space. Uncontrolled weed growth can lead to yield losses ranging from 12 to 51%, depending on the severity of the infestation and the control methods employed. In transplanted rice, heavy weed infestations are especially problematic, as weeds emerge simultaneously with rice seedlings, exacerbating the competition for nutrients and other growth factors. Weeds contribute to 45% of the total annual agricultural production losses in India, surpassing other agricultural pests like insects and diseases. The critical period for rice-weed competition typically occurs during the vegetative phase of rice, and effective weed management during this time is crucial for maximizing rice productivity. Traditional mechanical methods, such as hand weeding, while effective, are labor-intensive and costly, making them less feasible for large-scale operations. Chemical weed control, particularly the use of herbicides, offers a more practical and cost-effective solution for managing weed infestations, especially in transplanted rice systems. integrated weed management (IWM) strategies that combine cultural, mechanical, and chemical methods to achieve sustainable weed control. IWM not only reduces dependency on herbicides but also promotes eco-friendly practices, ensuring long-term productivity and environmental health.

Effect of weed control practices on growth attributes and yield of direct-seeded rice

Ruchi Rajpoot*[1], M.L. Kewat[2], Lalit Kumar Mainway[3] and Ankush Raj[1]

[1]*Department of Agronomy, Rani Lakshmibai Central Agricultural University, Jhansi, Madhya Pradesh 284003, India*

[2]*Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[3]*Department of Agronomy, Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: ruchiji0143@gmail.com*

Numerous biotic and abiotic factors influence crop growth and yield, Weeds being widely acknowledged as the most significant biotic factor impacting crop production. Weeds account for the highest loss in crop yield, causing up to 30% reduction, surpassing the impact of other biotic and abiotic factors. Rice is the most crucial food crop globally and plays a vital role in ensuring food security worldwide. Rice (*Oryza sativa* L.) is a primary food crop grown widely over 161 million hectares in more than 100 countries of the world It has been reported that weed competition in direct-seeded rice (DSR) can result in yield losses of approximately 35% due to presence of monocot weed such as (*Echinochloa Colona, Leptochloa chinensis, Cyperus rotundus, Fimbristylis miliacea*), and dicot weed such as (*Celosia argentea*). A field experiment was conducted at the College of Agriculture, JNKVV, Jabalpur during *Kharif* session of 2022 in randomised block design (RBD) having seven treatments which are pre-sowing application of glyphosate(T1), pre-sowing application of glyphosate along with 1 hand weeding at 30 days after sowing (DAS) (T2), post-emergence application of bispyribac-Na salt (T3), post-emergence application of bispyribac-Na salt along with 1 hand weeding at 45 DAS (T4), hand weeding at 30 DAS(T5), and hand weeding twice at 30 and 45 DAS(T6), weedy check plot (T7)). The key parameter which was recorded are weed control efficiency (WCE) weed index (WI), crop growth rate and relative growth rate at 60 DAS. Observations indicate that integrating herbicides with cultural methods offers the most effective control and minimizes the risk of herbicide resistance. It is concluded that T2 having higher WCE, CGR, RGR (98.98%, 12.05 g/m^2/day, 0.043 g/g/day) followed by T6 (95.63%, 12.00 g/m^2/day, 0.036 g/g/day) over the other weed control practices. Weed index was highest in T7 where weed were not treated at all. (56.60%) and lowest in T2 (0.00%) followed by T6 (9.23%).

Can remotely piloted aerial application systems do a broadcast aerial herbicide application in rice cultivation?

Reuben Senyo Kudiabor*[1,3], Navjot Singh[1], Zhou Xin-Gen[1], Daniel Martin[2], Muthukumar Bagavathiannan[1], Amit Srivastava[3] and Vikas Dugesar[3]

[1]*Texas A&M University*

[2]*474 Olsen Blvd, College Station, TX 77845, UDSA- Agriculture Research Services*

[3]*IRRI-South Asia Regional Centre*

**Email: rskudiabor@tamu.edu*

Remotely Piloted Aerial Application Systems (RPAAS) present a promising innovation in precision agriculture, particularly for rice cultivation. Traditional methods for herbicide application in rice involve ground-based machinery or manned aircraft, both of which have limitations in accessibility, efficiency, cost, and environmental safety. RPAAS offers a high degree of precision, efficiency, and accessibility enabling targeted applications that minimize herbicide waste. A study was conducted at the David Wintermann Rice Research Station at Eagle Lake in Texas, USA to evaluate the feasibility of using RPAAS for broadcast herbicide applications in rice fields focusing on target area coverage, herbicide deposition, and weed control efficacy. A comparative analysis of RPAAS and backpack application methods of herbicide application was conducted by modeling the spray volume and flight speed interactions and cross-validated these parameters to predict target area coverage, droplet density, and weed control at mid-post. The Hylio AG-210 spray drone equipped with the Tejeet XR 110015 nozzle was used for aerial herbicide application. The drone was calibrated to operate at a pressure of 40 PSI, maintaining a flight altitude of 3.05 meters. The CO2 backpack sprayer used was calibrated to apply 140.31 L/ha at 40 PSI using the same Tejeet XR 110015 nozzle. A quadratic regression model was applied to examine the relationship between spray volume, target coverage, and weed control. Higher spray volumes were simulated using random normal variables to predict the average coverage and weed control based on the fitted model. The results showed that 100% of the plot area received the herbicide treatment with an even distribution within the plots. Short wind gusts caused some herbicide displacement from the intended target, but no significant differences in weed control efficacy were found between imazethapyr and propanil when applied by drone. The ranges of the droplet sizes were between 0.2-0.7µm, decreasing with low spray volume and high-flying speed combinations. The spray drone had a weed control efficacy of 40-100% compared to 80-100% for backpack applications. Under the current drone application parameters, target coverage increased as the spray volume increased from 18.71L/ha to 37.42L/ha and spray volume of 28.06L/ha provided optimal weed control for both broad-leaf weeds and grasses, regardless of the herbicide chemistry. The quadratic regression model with an adjusted R2 of 0.33% showed a significantly positive relationship between spray volume and weed control efficacy. The simulation results indicated that target area coverage increased as spray volume was increased from 18.71L/ha to 37.42L/ha, then declined exponentially between 46.77L/ha and 93.54 L/ha. Additionally, weed control improved with increasing spray volumes. Therefore, RPAAS demonstrates significant potential for broadcast aerial application in rice cultivation, providing total target coverage, and higher weed control. However, uniform herbicide distribution across the field remains a challenge. Future research will focus on validating these findings and assessing the efficacy of spray drones by testing different nozzle types and herbicide tank mixes at different growth stages.

Integrated weed management in soybean with new generation ready mix pre emergence herbicides

S.S. Nooli, B.T. Nadagouda* and K.R. Gajendra

College of Agriculture, University of Agricultural Sciences, Dharwad, Vijayapura, Karnataka 580005, india

**Email: btnadagouda@gmail.com*

A field experiment was conducted to study the effect of integrated weed management with new generation ready-mix herbicide molecules on weed dynamics, growth and yield of soybean at Agricultural Research Station, Hukkeri, Belagavi, during *Kharif*, 2022. The experiment was laid out in randomized complete block design with three replications. The experiment consisted of 10 treatments consisting of 8 pre-emergence (PE) herbicides, *viz*. sulfentrazone 28% + clomazone 30% WP (350 + 375 g/ha) ready-mix (RM) 1250 g/ha as pre-emergence (PE), sulfentrazone 12% + metolachlor 37.5% EC (1237.5 g/ha) RM 2500 mL/ha as PE, metolachlor 50% EC (1000 mL/ha) 2000 mL/ha as PE, metribuzin 70% WP (0.35 kg/ha) 500 g/ha as PE, pendimethalin 30% EC + imazethapyr 2% EC (900 + 600 g/ha) RM 3 l/ha as PE, flumioxazin 50% SC (125 g/ha) 250 mL/ha as PE, pendimethalin 30% EC (1 kg/ha) 3.3 l/ha as PE, diclosulam 84% WDG (26 g/ha) 31 g/ha as PE. All of the treatments were tested along with one intercultivation operation at 35 days after sowing. Significantly lower total dry weight of weeds, higher weed control efficiency and lower weed index was recorded with application of sulfentrazone 28% + clomazone 30% WP (350 + 375 g/ha) RM 1250 g/ha as PE followed by one inter cultivation 35 DAS compared to all other treatments. PE application of sulfentrazone 28% + clomazone 30% WP (350 + 375 g/ha) RM 1250 g/ha followed by one inter cultivation at 35 DAS recorded significantly lower weed density (2.27/m^2), dry weight of weeds (2.42 g/m^2) and higher weed control efficiency (88%) for total weeds at 15 days after herbicide application (DAHA) with lower weed index (5.30%). It also recorded higher plant height (53.89 cm), number of branches (7.75/plant), total dry matter production (16.80 g/plant), seed yield (2413 kg/ha), haulm yield (2696 kg/ha), gross returns (Rs. 1,15,824/ha), net returns (Rs. 70,887/ha) and benefit cost ratio (2.58). The lower seed yield, net returns and benefit cost ratio was recorded with metribuzin 70% WP (0.35 kg/ha) 500 g/ha as PE followed by one inter cultivation at 35 DAS due to phytotoxicity of metribuzin on soybean. Seed quality was not influenced by herbicidal treatments.

Weed management in sesame using pre- and post-emergence herbicides

Madhumati Hosakeri and J.A. Hosmath*

Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Dharwad, Karnataka 580005, India

**Email: hosmathja@uasd.in*

In India, sesame (*Sesamum indicum* L) productivity is low (474 kg/ha) on account its cultivation in marginal and sub-marginal soils under rainfed environment. Weed infestation is the one of the major constraints for lower sesame productivity. In view of above reasons, a field experiment was conducted at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad (Karnataka State) during *Kharif* season of 2021-22 to screen the application of pre (PE) and post-emergence (PoE) herbicides in order to impart season long weed control in sesame under rainfed ecosystem. The experiment was replicated thrice in Randomized Complete Block Design on vertisols comprising nine treatments. Results of the investigation indicated that PE/POE herbicides application controlled the weeds effectively in sesame ecosystem compared to weedy check. Among PE and PoE herbicides application, PE herbicides application followed by one hand weeding (HW) at 30 days after sowing (DAS) proved effective in imparting season long weed control in soybean under rainfed ecosystem compared to PoE herbicides application at 20 DAS. Significantly higher sesame seed yield and weed control efficiency at 60 DAS recorded with the PE application of oxyfluorfen 30 EC 75 g/ha and pendimethalin 30% EC 750 g/ha followed by one hand weeding at 30 DAS in comparison to PE application of pendimethalin 30 EC 750 g/ha, oxyfluorfen 30 EC 75 g/ha and PoE application of propaquizafop 10% EC 50 g/ha and quizalofop-p-ethyl 5 EC 50 g/ha at 20 days after sowing only. Growth and yield attributing traits of sesame followed the similar trend. Significantly lower total weed density, total weed dry matter and lower weed index and the economic analysis (gross/net returns and B:C) also followed the similar trend with respect to the above-mentioned treatments. Higher B:C (2.21) recorded with herbicides application in comparison to farmers practices (1.99). Greater labour costs led to higher cultivation costs in farmers practices, however herbicide applications registered lower cultivation costs. The outcome of the present investigation proved that weed management in sesame with the PE application of oxyfluorfen 30 EC 75 g/ha and pendimethalin 30% EC 750 g/ha followed by one hand weeding at 30 DAS is economically viable and practically feasible as compared to hand weeding practice alone.

Chemical weed management in blackgram for enhancing productivity

S. Sreenivasulu*, V. Divya and T. Ramu Kumar
RASS – Krishi Vigyan Kendra, Vanasthali, Karakambadi Post, Renigunta mandal, Tirupati dt, Andhra Pradesh 517501, India
**Email: nivassakamuri@gmail.com*

In Chittoor district, blackgram is grown in an area of 684 ha with a production of 586 tonnes and with an average yield of 857 kg/ha. The productivity of blackgram in Chittoor district is little higher than India's average (596 kg/ha) but, very low when compared to Andhra Pradesh state average (1249 kg/ha). There is lot of scope to increase the productivity in blackgram in the district by adopting improved package of practices. Weeds are the major problem among different constraints during *Rabi* season because of North East monsoon coincides with vegetative stage of the crop. In addition, slow initial growth, compact and early maturing habit of blackgram varieties hinder to attain higher yields. The traditional weed control methods like hand weeding and inter-cultivation are expensive due to high labour cost and also delays weeding due to non-availability of labour in time. Further, North East monsoon rains during initial crop growth stages hinder the hand weeding or inter-cultivation. Hence an On Farm Trial was conducted by Rashtriya Seva Samithi (RASS) – Krishi Vigyan Kendra, Tirupati during *Rabi* 2020 and 2021 seasons at Agaram Peta village, Nindra mandal, Chittoor district, Andhra Pradesh to assess the performance of pre- and post-emergence herbicides on productivity of blackgram. The results revealed that pre-emergence application of pendimethalin, 2.5 L/ha followed by post-emergence application of-sodium acifluorfen + clodinafop propargyl, 1.0l t/ha at 15-20 Days After Sowing (DAS) proved to be effective in suppressing weed density (23.30 and 8.80) and weed dry matter (8.95 g/m^2 and 8.35g/m^2) resulted in high weed control efficiency (71.33% and 27.37%) over farmer's practice, hand weeding at 25-30 DAS in blackgram. Average plant height (31.6 cm), average number of pods per plant (52.8) and average grain yield (1020 kg/ha) were significantly high in the case of trial when compared to farmers practice. The results also revealed that trial recorded significantly higher net returns (Rs.41825/ha) and benefit cost ratio (2.59) with low cost of cultivation (Rs.24877/ha) over farmer's practice. The low weed density and weed dry matter and high weed control efficiency and, increased economic yield in the trial was mainly due to effective weed control at critical stages helps in better crop growth and development which lead to more number of pods and ultimately yield by using pre- and post-emergence herbicides. So, it can be concluded that the pre-emergence application of pendimethalin, 2.5 L/ha at 3 DAS followed by post-emergence application of-sodium acifluorfen + clodinafop propargyl, 1.0 L/ha at 15-20 DAS results in efficient control of weeds in blackgram with significant improvement in growth, yield and economics compared to farmer's practice.

Oral lecture 37

Efficacy of herbicides against diverse weed flora of Indian mustard

Dinesh Sah*, Stuti Maurya and G.S. Panwar
Department of Agronomy, College of Agriculture, Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India
**Email: dr.d.sah@gmail.com*

Mustard (*Brassica juncea*) is one of the most important oilseed crops in many part of the world. This is an important winter season oil seed crop of Bundelkhand region of Uttar Pradesh, India. The productivity of mustard in the region is low due to various biotic and abiotic stresses. Among the various biotic stresses, weeds are the major one which are the salient competitors of natural resources like nutrients, water and light. Experiment conducted at Banda University of Agriculture and Technology, Banda during *Rabi* season of 2022-23 and 2023-24. Experiment was laid out following RBD design with nine treatment combinations and replicated thrice. Seed of mustard variety Giriraj was sown by following standard agronomic practices for mustard crop cultivation and management. The spray of herbicide was done as per treatments with the help of knap-sack sprayer fitted with flat-fan nozzle. The weed population, dry matter, crop growth parameters, yield attributes and yield were recorded as per standard protocol. Economic analysis was done by following the methods as suggested by DWR, Jabalpur. The experimental field of mustard was infested with several grassy, broad-leaved and sedge weeds. The major species were *Chenopodium album*, *Anagallis arvensis, Rumex crispus, Spergula arvensis, Cynodon dactylon*, *Cyperus rotundus. etc*. At 20 DAS only sedge and few grassy weeds were observed, while a greater number of BLWs along with sedge and grassy weeds were observed at 45 and 75 DAS. Significant reduction in weed population observed with application of oxadiargyl 6 EC 90 g/ha (PE) *fb* propaquizafop 10% EC 100 g/ha POE. Application of pendimethalin 30 EC (PE) 750 g/ha *fb* propaquizafop 5% + oxyfluofen 12% w/w EC ready-mix (PoE) 43.75 g + 105 g/ha significantly reduced the weed dry weight at most of the stages and gave maximum weed control efficiency. Under various weed management practices plant stand at 25 DAS remains unaffected, while at 45 DAS it was observed variable. Highest reduction (21%) in was noticed when treatment pendimethalin 30 EC (PE) 750 g/ha *fb* propaquizafop 5% + oxyfluofen 12% w/w EC ready-mix (PoE) 43.75 g + 105 g/ha applied. Among herbicidal treatments maximum values of yield attributes, yield and harvest index was observed with pendimethalin 30 EC (PE) 750 g/ha *fb* propaquizafop 5% + pxyfluofen 12% w/w EC ready-mix (PoE) 43.75 g + 105 g/ha. Due to application of same treatment the yield loss was only 13.2%, whereas, with weedy check it was 27.5%. Application of pendimethalin 30 EC (PE) 750 g/ha *fb* propaquizafop 5% + oxyfluofen 12% w/w EC ready-mix (PoE) 43.75 g + 105 g/ha recorded BCR value > 2 and additional benefit due to weed management of Rs. 12170/ha over weedy check.

Integrated weed management in Indian mustard (*Brassica juncea* L.) under NEH region

Devendra Kumar Dadhich[1], Rajvir Sharma*[1], Kapila Shekhawat[1] and Jayanta Layek[2]

[1]*Division of Agronomy, ICAR-indian agricultural research institute, New Delhi 110012, India*

[2]*ICAR -Research Complex for North East region, Umiam, Meghalaya 793103, India*

**Email: drrajvirsharma63@gmail.com*

The present investigation was conducted during *Rabi* season of 2022-23 at the experimental farm of ICAR -Research Complex for North East Hill region (ICAR-RC-NEH) for suggesting viable and economical integrated weed management options in mustard in hilly areas. The experiment was laid out in randomized block design and replicated thrice. The application of pendimethalin at 0.75 kg/ha as pre-emergence followed by one hand weeding at 30 DAS was found very effective in controlling all major weeds such as *Ageratum conyzoides, Alternanthera sessilis, Panicum repens* and *Cynodon dactylon* found in the field. This treatment produced 44.03% higher seed yield of Indian mustard over weedy check. After this, pre-emergence application of oxadiargyl at 45 g/ha followed by one hand weeding at 30 DAS found effective in reducing weed density, dry weight, nutrient uptake by composite weed species and increasing nutrient uptake by crop and enhanced crop growth parameters. Highest yield attributes like primary and secondary branches, silique/plant, seeds/siliqua were observed with the pre-emergence application of pendimethalin at 0.75 kg/ha followed by one hand weeding at 30 DAS. Season long weed free conditions recorded 57.57% increase in seed yield of Indian mustard as compared to season long weed competition. Different weed management options provided yield advantages in between the range of 6.06 to 44.03% over weedy check. The highest net return was obtained under pendimethalin at 0.75 kg/ha as pre-emergence followed by one hand weeding at 30 DAS which was closely followed by oxadiargyl at 45 g/ha as pre-emergence followed by one hand weeding at 30 DAS. The B:C was highest in pendimethalin 0.75 kg/ha as pre-emergence followed by one hand weeding at 30 DAS owing to high gross return as compared to cost of cultivation than other treatments, which was comparable to oxadiargyl application at 45 g/ha as pre-emergence followed by one hand weeding at 30 DAS. It may be concluded that either of pre-emergence application of pendimethalin at 0.75 kg/ha supplemented with one hand weeding at 30 days after sowing or oxadiargyl application at 45 g/ha as pre-emergence followed by one hand weeding at 30 DAS may be practiced as most viable weed management options in Indian mustard in North-Eastern Hilly Region.

Impact of post-emergence herbicides on weed management, yield performance and economic viability in greengram cultivation

M.L. Mehriya* and Rameti Jangir
Dr. B. R. Choudhary Agricultural Research Station, Mandor Agriculture University, Jodhpur, Rajasthan 342304, India
**Email: mlmehriya@gmail.com*

The experiment was conducted to determine the most effective post-emergence herbicides for managing weeds in mungbean, aiming to enhance crop growth, yield and economic returns. Weed competition is a significant constraint in mungbean cultivation, particularly in early stages, as it reduces yield by competing for resources such as light, nutrients, and water. By testing different herbicide treatments and their combinations, the study aimed to find treatments that would reduce weed pressure without adversely affecting the crop, ultimately increasing profitability and sustainability for farmers. The experiment was conducted at Dr. B.R. Choudhary ARS, Mandor, Jodhpur, Rajasthan during two consecutive *Kharif* season of 2021 and 2022. The experiment was laid out in Randomized Block Design (RBD) comprising eight (8) treatments with three replications. This study assessed the efficacy of post-emergence herbicides on the growth, yield, weed control, and economic returns of mungbean, based on two years of pooled data. Significant reductions in weed density and dry matter were observed across all herbicidal treatments compared to the un-weeded control, with the highest weed control efficiency (WCE) noted under the weed-free treatment (100%), followed by manual weeding (89.4%) and fomesafen + fluzifop-p-butyl 220 g/ha at 20 DAS (ready mix) as post-emergence (77.5%). Herbicidal treatments also showed a marked improvement in growth and yield attributes, such as branches/plant, seeds/pod, and test weight. fomesafen + fluzifop-p-butyl 220 g/ha at 20 DAS (ready mix) as post emergence resulted in maximum branches/plant (6.6), seed/pod (27.2) test weight (27.2 g) along with the highest seed yield (1.17 t/ha), net returns (Rs. 62,851/ha), and benefit-cost ratio (3.44), indicating its economic superiority over the other herbicidal treatments. This treatment was statistically comparable to other herbicides except application of fluzifop-p-butyl 13.4% W/w at 250 g/ha 20 DAS as post-emergence but offered enhanced returns, making it a highly effective strategy for weed management in mungbean cultivation.

Integrated weed management in chickpea under irrigated conditions

D.D. Chaudhari*, V.J. Patel, H.K. Patel and P.H. Rathod
AICRP-Weed Management, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat 388110, India
**Email: ddcsms@aau.in*

Application of a broad-spectrum post-emergence herbicide is a promising weed management option for chickpea but there was no any post-emergence herbicide available to manage complex weed flora in chickpea. So, the goal of this experiment was to find out bio-efficacy of topramezone on weeds and phytotoxicity on chickpea as early post-emergence and post-emergence application with 15 and 20 g/ha in comparison to pre-emergence application of herbicides under irrigated conditions. The experiment was designed in RBD of ten treatments and three replications at AICRP-WM farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *Rabi* season of the year 2022-23 on loamy sand soil. The experiment consisted of pendimethalin 30% EC 750 g/ha PE *fb* HW at 30 DAS, oxyfluorfen 23.5% EC 188 g/ha PE *fb* HW at 30 DAS, pendimethalin 30% EC 500 g/ha + oxyfluorfen 23.5% EC 120 g/ha PE (tank mix) *fb* HW at 40 DAS, pendimethalin 30% + imazethapyr 2% EC 480 g/ha PE (PM) *fb* HW at 40 DAS, topramezone 336 g/L w/v SC 15 g/ha EPoE *fb* HW at 30 DAS, topramezone 336 g/L w/v SC 20 g/ha EPoE *fb* HW at 30 DAS, topramezone 336 g/L w/v SC 15 g/ha PoE *fb* HW at 40 DAS, topramezone 336 g/L w/v SC 20 g/ha PoE *fb* HW at 40 DAS, IC *fb* HW at 20 and 40 DAS and weedy check. All recommended package of practices except weed control treatments were followed for raising the crop. Herbicides were applied as per the treatment with knapsack sprayer fitted with flat fan nozzle. Application of topramezone as early-PoE (15 DAS) had some phytotoxicity on crop (rating 1) but recovered after one week. Results indicated that significantly lower density and dry biomass of monocot, dicot and total weeds at harvest, higher seed yield, gross returns, net returns and benefit cost ratio was obtained under application of topramezone 336 g/L w/v SC 15 g/ha PoE *fb* HW at 40 DAS which was closely followed by application of topramezone 336 g/L w/v SC 15 g/ha EPoE *fb* HW at 30 DAS, pendimethalin 30% EC 500 g/ha + oxyfluorfen 23.5% EC 120 g/ha PE (TM) *fb* HW at 40 DAS, topramezone 336 g/L w/v SC 20 g/ha EPoE *fb* HW at 30 DAS, topramezone 336 g/L w/v SC 20 g/ha PoE *fb* HW at 40 DAS, IC *fb* HW at 20 and 40 DAS and oxyfluorfen 23.5% EC 188 g/ha PE *fb* HW at 30 DAS.

Improving the productivity and weed control in groundnut through ready-mix post-emergence herbicides

S.S. Nooli, B.S. Yenagi* and Sourabh Munnoli

University of Agricultural Sciences, Dharwad, Karnataka 580005, India

**Email: yenagibs@uasd.in*

A field experiment was conducted at the Agriculture Research Station in Hukkeri, during the *Kharif* 2022 and 2023 to evaluate new generation ready mix herbicides against weeds in groundnut and its effect on succeeding chickpea crop. The experiment was laid out in randomized complete block design with three replications. There were total of 9 treatments which encompassed 7 different post-emergence herbicides, *viz*. imazethapyr 35% + imazamox 35% WG (70 g/ha) ready mix 100 g/ha as post-emergence, propaquizafop 2.5% + imazethapyr 3.75% w/w ME (50+75 g/ha) ready mix 2000 g/ha as post-emergence,-sodium aciflourofen 16.5% + clodinafop-propargyl 8% EC (80 + 165 g/ha) ready mix 1000 mL/ha as post-emergence, fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL250 g/ha ready mix 1000 g/ha as post-emergence, fomesafen 175 + clethodium 125 EC 1250 g/ha ready mix as post-emergence, imazethapyr 10% SL + surfactant (2 mL/L) (100 g/ha) 1000 g/ha as post-emergence, quizalofop-p-ethyl 5 EC (50 g/ha) 1000 g/ha as post-emergence, weed free check and weedy check . groundnut cultivar Dh-256 was sown with 30 cm row spacing and 10 cm between plants. Pooled data indicated that, among the various heribicide treatments, significantly higher level of weed control efficiency at 10,25 and 40 days after herbicide application and the lower weed index, weed count and dry weight at 10,25 and 40 days after herbicide application were observed in the imazethapyr 35% + imazamox 35% WG (70 g/ha) ready mix 100 g/ha as post-emergence and fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL 250 g/ha ready mix 1000 g/ha as post-emergence which were on par with each other. Similarly, imazethapyr 35% + imazamox 35% WG (70 g/ha) ready mix 100 g/ha as post-emergence recorded significantly higher ground nut pod yield (2,603 kg/ha), kernel yield (1,753 kg/ha), net returns (Rs. 1,04,743/ha) and benefit cost ratio (3.04) which was on par with fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL 250 g/ha ready mix 1000 g/ha as post-emergence, which recorded ground nut pod yield (2,461 kg/ha), kernel yield (1,657 kg/ha), net returns (Rs. 97,011/ha) and benefit cost ratio (2.92). There was no influence of herbicides on soil dehydrogenase enzyme activity at 45 days after sowing and at harvest and also herbicides did not show any phytotoxic effect on groundnut as well as succeeding chickpea crop in *Rabi* season.

Oral lecture 42

Yield maximisation in soybean through use of ready-mix post-emergence herbicides in rainy season

S.S. Nooli*[1], Sourabh Munnoli[2] and G. Somanagouda[3]
ARS, Sankeshwar, University of Agricultural Sciences, Dharwad, Karnataka 580005, India
**Email: ssnooli@gmail.com*

A field experiment was conducted at the Agriculture Research Station in Hukkeri, during the *Kharif* 2021 and 2022 to evaluate new generation ready mix herbicides against weed flora in soybean and its effect on succeeding chickpea crop. The experiment was laid out in randomized complete block design with three replications. There were total of 7 treatments which encompassed 5 different post-emergence herbicides, *viz*. propaquizafop 2.5%+ imazethapyr 3.75% W/W ME (50+75 g/ha) ready mix 2000 g/ha as post-emergence, sodium-aceflourofen 16.5% + clodinafop-propargyl 8% EC (80 + 165 /ha) ready mix 1000 mL/ha as post-emergence, fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL (250 g/ha) ready-mix 1000 g/ha as post-emergence, imazethapyr 35% + imazamox 35% WG (70 g/ha) ready mix 100 g/ha as post-emergence, chlorimuron-ethyl 25% WP (9 g/ha) 36 g/ha as early post-emergence, weedy check, weed free check. The cultivar of soybean used was Dsb-34. The row spacing was 30 cm and plant spacing was 10 cm. Knap sack sprayer fitted with flood jet or flat fan nozzle was used for the spraying the herbicide solution. Standard spray volume of 500 liters/ha was used. Farm yard manure 6 t/ha, 40:80:25 kg N: P: K/ha, ZnSO4 12.5 kg/ha was applied. Pooled data indicated that, among the various herbicide treatments, significantly higher of weed control efficiency at 15 and 30 days after herbicide application and the lower weed index, weed count and dry weight of various weed species (*Digera arvensis*, *Commelina benghalensis*, *Parthenium hysterophorus*, *Euphorbia hirta*, *Portulaca oleracea, Tridax procumbens, Amaranthus* spp. and *Cynodon dactylon*) at 15 and 30 days after herbicide application were observed in the fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL (250 g/ha) ready mix 1000 g/ha as post-emergence. Similarly, fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL (250 g/ha) ready mix 1000 g/ha as post-emergence recorded significantly higher soybean yield (2,489 kg/ha), net returns (Rs. 1,00,673/ha) and benefit cost ratio (3.3). There was no influence of herbicides on soil dehydrogenase enzyme activity at 60 days after sowing and at harvest and also the herbicides did not show any phytotoxic effect on soybean crop as well as succeeding chickpea crop in *Rabi* season.

Oral lecture 43

Efficient weed management in chickpea through new generation herbicides

Lokesh Kumar Jain
Agricultural Research Station, Sriganganagar, Rajasthan 335001, India
Email: jainlokesh74@gmail.com

An experiment was conducted on sandy loam soil of western irrigated plain zone of Rajasthan to find out the most efficient weed management practice to manage the weeds in chickpea using pre- and post-emergence herbicides. The experiment comprised of 15 treatments and replicated thrice in randomized block design using test varity GNG 2171. The chickpea is a major *Rabi* crop of the zone cultivated on around 3 lac ha and severely affected by major weeds like Chenopodium album, Rumex sp. and Spergula arvensis, Melilotus indica. The humid environment and low temperature during December and January restrict the growth of crop while favour the growth of weeds. Thus, a study was conducted to keep the crop weed free for extended period of time. The treatment was applied as per schedule using flat fan nozzle. The treatments are oxyfluorfen 150 g/ha (PE), oxyfluorfen 250 g/ha (PE), quizalofop-ethyl 100 g/ha at 15-20 DAS (PoE), propaquizafop 100 g/ha at 15-20 DAS (PoE), topramezone 20.6 g/ha at 14 DAS (PoE), topramezone 20.6 g/ha at 21 DAS (PoE), topramezone 20.6 g/ha at 30-31 DAS (PoE), topramezone 25.7 g/ha at 21 DAS (PoE), pendimethalin 750 g/ha (PE), oxyfluorfen 150 g/ha *fb* quizalofop-ethyl 100 g/ha at 15-20 DAS (PE+PoE), oxyfluorfen 150 g/ha *fb* propaquizafop 100 g/ha at 15-20 DAS (PE+PoE), oxyfluorfen 150 g /ha *fb* topramezone 20.6 g/ha at 14-21 DAS (PE+PoE), pendimethalin 750 g/ha *fb* topramezone 20.6 g/ha at 30-35 DAS (PE+PoE), weedy check and Weed free check. The mean of two years data reveals that the mean maximum seed yield of chickpea of recorded in treatments pendimethalin 38.7 EC 750 g/ha (PE) (1.89 t/ha) followed by oxyfluorfen 150 g/ha *fb* quizalofop-p-ethyl 100 g/ha at 15- 20 DAS (1.88 t/ha) as against the weedy check (1.20 t/ha). However, the treatment pendimethalin 38.7 EC 750 g/ha (PE) recorded highest mean B:C of 2.1 followed by 1.9 in the treatment oxyfluorfen 150 g/ha *fb* quizalofop-p-ethyl 100 g/ha at 15- 20 DAS. The application of topramezone at various concentrations and at different growth stage caused a severe toxicity as alone as well as in sequence with pre-emergence herbicides. However, topramezone recorded maximum weed control efficiency for an extended period of time but initial toxicity on crop followed by low yields and reduced plant growth and yield attributes besides higher cost of cultivation make it unfit for farmers, However further research is required for a meaningful recommendation.

Oral lecture 44

Deciphering the post-emergence herbicide tolerance in major pulse crops based on phytotoxic, morpho-physiological and yield variability

C.P. Nath*, Narendra Kumar, Asik Dutta, K.K. Hazra and Namrata Laskar
ICAR Indian Institute of Pulses Research, Kanpur, Uttar Pradesh 208024, India
**Email: cpnath4@gmail.com*

Weeds create a serious problem in cultivation of pulses and reduce the yield up to 90%. To control weeds in pulses, use of post-emergence (PoE) herbicides becomes important. But, no post-emergence herbicide is available for controlling broad-leaved weeds in pulses. Therefore, there is an urgent need to identify and evaluate the post-emergence herbicide to control broad-spectrum weeds in pulses for effective weed control and to obtain better crop yield. The objective was to assess the phytotoxic, morpho-and yield variability and efficacy of POST herbicides in pulses. Genotypes tolerance and crop selectivity were tested in chickpea, fieldpea, lentil in winter season and mungbean, urdbean in rainy season. The PoE herbicides targeted in winter pulses were topramezone 20.6, 25.7 and 30.9 g/ha (pigment synthesis inhibitor), halosulfuron-methyl 70, 105 g/ha (ALS/AHAS inhibitor), imazethapyr 75, 100, 112.5 g/ha (ALS/AHAS inhibitor), carfentrazone-ethyl 20, 30 g/ha (protoporphyrinogen oxidase inhibitor). The targeted herbicides in rainy season pulses were clodinafop-propargyl + Na-acifluorfen (CPNaA) 122.5, 187.5, 245 g/ha (lipid synthesis/protoporphyrinogen oxidase inhibitor) and halosulfuron-methyl. The 150 genotypes of urdbean, 360 genotypes of chickpea, 330 genotypes of fieldpea, and 30 genotypes of lentil were screened. Three lines of each genotype was grown with treated and non-treated condition. Crop phytotoxicity score (0-10 scale: 0= complete tolerance; 10 = susceptible), crop phenological shift (delay in maturity), and yield difference were recorded against each herbicide. Based on phytoxicity scale and yield variability, a significant genotypic variability was observed. A range of phytotoxicity 0 to 10 was observed across doses. Yield variability against halosulfuron-methyl was 29% to –100% at 75 g/ha and -2 to -100% at 105 g/ha. The higher yield was obtained in IPU 2022-129 and IPU 2022-93 genotypes (treated condition) with the lowest phytotoxicity (scale 2.3 at higher dose) in urdbean. The genotypic tolerance of 27 lentil genotypes were tested against imazethapyr 75 and 112.5 g/ha. The yield reduction of EC 248330, ILL 6540B, ILL 5900, IPL 329 were minimal under treated condition than non-treated condition (2-5%). In fieldpea, genotypes IP2K-99, PMR-6, I-163, and ET-5120 tolerant against topramezone (3-8% yield reduction). Chickpea genotyp tolerance (lowest yield reduction) included: IPC 20-38, IPC 20-115, JP18-186 for imazethapyr and IPC 20-155, IPC 20-194, ICCV 97105 for carfentrazone ethyl. A metribuzin tolerant fieldpea genotype (‘P 637’) was registered in fieldpea at 500 g/ha dose. One chickpea genotype (‘ICC 121315’) tolerant to imazethapyr at 150 g/ha dose was screened/identified and registered for herbicide-tolerance. Clodinafop-propargyl + Na-acifluorfen 183.5 g/ha significantly reduced the weed density and dry weight without any phytotoxicity on mungbean with higher grain yield. Topramezone 20.6 g/ha at 14 days after sowing resulted in higher weed control (toxicity scale of 7–10) without chickpea phytotoxicity (in large number of chickpea genotypes). Many promising lines are being developed that can be used for breeding programme and for sustainable weed management.

Efficient weed management in lentil through new generation herbicides

Anju Kanwar Khangarot*, Shweta Gupta, Seema Sharma, Pratibha Singh and Kavita Bhadu
Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan 302018, India
Sri Karan Narendra Agriculture University, Jobner, Rajasthan 303329, India
**Email: anju.agro@sknau.ac.in*

A field experiment entitled "Efficient weed management in lentil through new generation herbicides" was conducted at experimental farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur during *Rabi* 2022-23 and 2023-24. It is comprised of 10 weed management treatment including pendimethalin 750 g/ha (PE), imazethapyr 50 g/ha (PE), pendimethalin 750 g/ha - quizalofop-p-ethyl 100 g/ha at 20 DAS (PE+PoE), oxyfluorfen 150 g/ha *fb* propaquizafop 100 g/ha at 20 DAS (PE *fb* PoE), imazethapyr 50 g/ha at 20 DAS (PoE), quizalofop-p-ethyl 100 g/ha 20 DAS (PoE), propaquizafop 100 g/ha 20 DAS (PoE), pendimethalin + imazethapyr (RM) 800 g ai/ha (PE), unweeded control and two hand weeding (20 and 40 DAS). The experiment was performed in randomized block design which was replicated thrice time. The major weed flora found was *Chenopodium album, Rumex dentatus, Verbesina encelioides, Anagallis arvensis, Argemone maxicana, Solanum nigrum, Cyperus rotundus, Paspalum vaginatum, Digitaria sanguinalis* and *Cynodon dactylon*. The minimum weed density at 60 DAS was found under two hand weeding treatment and therafter followed by pendimethalin + imazethapyr (RM) 800 g/ha (PE). The maximum WCE (93.05%), seed (2.40 t/ha) and straw (4.02 t/ha) yield were recorded under two hand weeding treatment which was closely followed by pendimethalin + imazethapyr (RM) 800 g/ha (PE).

Oral lecture 46

Tillage and weed management practices influence weed prevalence, system crop and energy productivity, and environmental footprints of maize-wheat-greengram

Narendra Kumar*[1,2], V.K. Choudhary[2], D.S. Sasode[1], M.P. Sahu[2], Vikash Singh[2], Mrinali Gajbhiye[3], Alpana Kumhare[1,2] and Sonali Singh[1,2]

[1]*Department of Agronomy, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya Gwalior, Madhya Pradesh 474002, India*

[2]*ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[3]*Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwavidyalaya Jabalpur, Madhya Pradesh 482004, India*

Email: narendrakumarpatidar222@gmail.com

In context to current scenario, extreme climatic events and increasing greenhouse gas (GHG) emissions contribute to global warming by shifting natural crop environment. carbon footprint represents exclusive emissions of total GHG in terms of CO_2 equivalent directly or indirectly caused by anthropogenic activities. Moreover, increasing cost per unit energy invested requires an energy efficient technology for crop production by lowering energy consumption thereby ensuring higher economic profitability of the cropping system. Inclusion of crop residue could help to supress the weeds beside improving the soil health. Hence, research was carried out to study the tillage and weed management practices influence weed prevalence, system crop and energy productivity, and environmental footprints of maize-wheat-greengram at ICAR-Directorate of Weed Research, Jabalpur (M.P.) during 2021-23. Eight treatment combinations were laid out in split-plot design with three replications. The main plots were assigned two crop establishment methods, *viz*. conventional tillage [CT (maize)-CT (wheat)-CT (greengram)] and conservation tillage [ZT+R (maize)-ZT+R (wheat)-ZT+R (greengram)] and four weed management practices, *viz*. weedy check, recommended herbicide (RH), integrated weed management (IWM) and herbicide rotation (HR) in sub-plot. The results revealed that the weed density and biomass were supressed under ZT+R sown crop. Among the weed management practices, HR *i.e.* atrazine + topramezone at 500 + 25.2 g/ha (PoE) (1st year)/atrazine + tembotrione at 500 + 120 g/ha (PoE) (2nd year) in maize while IWM *i.e.* clodinafop + metsulfuron at 60 + 4 g/ha (PoE) *fb* HW at 45 DAS in wheat and pendimethalin 678 g/ha (PE) *fb* HW at 30 DAS in greengram. The carbon footprints were more under CT and IWM. The system productivity and production efficiency in terms of MEY were maximum under ZT+R and IWM. The energy requirement was reduced under ZT+R and weedy check plots in maize, wheat and greengram while energy output was maximum under ZT+R and HR in maize while in wheat and greengram under IWM. The soil chemical properties were improved under ZT+R and IWM although soil biological properties were improved under ZT+R and IWM thus, improving the soil health. The economic yield of maize (6.67 and 5.76 t/ha, respectively), wheat (4.37 and 3.89 t/ha, respectively) and greengram (0.90 and 0.99 t/ha, respectively) were maximum under ZT+R. Among the weed management practices, maximum economic yield was recorded in HR in maize (7.81 and 7.83 t/ha) while in wheat (4.76 and 4.39 t/ha, respectively) and greengram (1.12 and 1.20 t/ha, respectively). The crop sown under ZT+R coupled with HR in maize while ZT+R coupled with IWM in wheat and greengram was found to be remunerative as it fetched maximum B: C. The study concludes that CA with IWM practices could a help to supress weeds and earning profit with sustainable production.

Effect of dose and time of imazethapyr on weed and yield in summer season blackgram

Lalchand Kumawat[1] and A.P. Singh*[2]

[1]*Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313004, India*

[2]*Deapartment of Agronomy, School of Agricultural Science, Nagaland University, Nagaland 797106, India*

**Email: Kumawatlalchand522@gmail.com*

A field experiment was carried out in the summer of 2022 at the Agronomy Farm, School of Agricultural Science, Nagaland University, Medziphema, Nagaland. The farm is located at a height of 310 meters above sea level, with a latitude of 25°45’43’’ North and a longitude of 95°53’43’’ East. The experimental farm is in a humid subtropical region with 2000–2500 mm of rainfall on average. In summer, the average temperature is between 21°C and 31°C, conducted to study the effect of dose and time of imazethapyr on weed and yield in the summer season blackgram. The predominant weed species in the experimental field were *Eleusine indica, Amaranthus viridis, Commelina benghalensis, Alternanthera sessilis etc*. The minimum weed population was observed with two-hand weeding at 20 and 40 DAS which was closely followed by imazethapyr 100 g/ha at 25 DAS and imazethapyr 75 g/ha at 15 DAS. Imazethapyr 100 g/ha at 25 DAS recorded the pod length, number of seeds/pod, test weight, harvest index, seed and stover yield. Application of imazethapyr 100 g/ha at 25 DAS gave a higher B:C (1.03) as compared to two-hand weeding at 20 and 40 DAS.

Impact of nutrient and weed management practices on chickpea productivity and weed dynamics

Mohammad Vaheed*, Chandra Bhushan, Sunil Kumar Verma, Sudhir Kumar Rajpoot and Sameer Shrivastava

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: vaheedansari786@gmail.com*

A field experiment was conducted during the *Rabi* seasons of 2022-23 and 2023-24 at the Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (UP), India. An experiment laid out in split-plot design with three replications. The nutrient management factor comprised four levels, *viz*. Control (No fertilizer), 100% RDF (20:60:20 kg/ha N:P:K), 75% RDF with seed treatment using *Rhizobium* and PSB and 50% RDF with seed treatment using *Rhizobium*, PSB and molybdenum (2 g/kg seed) followed by two foliar sprays of 0.5% boron and 2% urea at pre-flowering and pod development stages. The weed management factors comprised eight treatments, *viz*. pendimethalin at 1.0 kg/ha (PE), quizalofop-p-ethyl at 50 g/ha (PoE), topramezone at 20.6g/ha (PoE), pendimethalin at 1.0 kg/ha (PE) followed by one hand weeding at 35 DAS, pendimethalin at 1.0 kg/ha (PE) followed by quizalofop-p-ethyl at 50g, pendimethalin at 1.0 kg/ha (PE) followed by topramezone at 20.6g/ha (PoE), weedy-check and weed-free. The predominant weed flora in the experimental site are *Melilotus indica, Melilotus alba, Medicago denticulata, Medicago truncatula, Cynadon dactylon, Cyperus rotundus, Chenopodium album, Rumex dentatus, Phalaris minor, Polygonum* spp., *Convolvulus arvensis, Anagallis arvensis, Solanum nigrum, Argemone mexicana and Vicia sativa*. Application of 20:60:20 kg/ha N: P: K with pre-emergence application of pendimethalin at 1.0 kg/ha (PE) followed by one hand weeding at 35 DAS, recorded significantly higher number of branches per plant, number of pods per plant and yield of chickpea than rest of nutrient and weed management practices except for 15:45:15 kg/ha N: P: K with pendimethalin at 1.0 kg/ha as a pre-emergence followed by topramezone at 20.6 g/ha as a post-emergence, where the differences were observed non-significant between them.

Efficacy of pre- and post-emergence herbicides for chemical weed management in sesame

Uma Bermaiya*, Namrata Jain, A.K. Vishwakarma and Surabhi Jain
Project Coordinating Unit Sesame & Niger, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: barmaiya.uma19@gmail.com*

A field experiment was conducted ICAR-PC Unit (Sesame and Niger), JNKVV, Jabalpur field during *Kharif*-2022 to study the evaluation of pre- and post-emergence herbicides on weeds and yield of sesame crop. The experiment was laid out in randomized block design with nine treatments replicated thrice. The treatments comprised of herbicides, *viz.* oxyflourfen at 60 g/ha and pyroxasulfone at 40 g/ha and pyroxasulfone at 80 g/ha and pendimethalin + imazethapyr at 250 g/ha as pre-emergence and post-emergence quizalofop-ethyl at 50 g/ha, fenoxaprop-p-ethyl at 100 g/ha and propaquizafop at 100 g/ha, weed free (hand weeding at 20 and 40 DAS) and weedy check. The sesame variety 'TKG-308' was sown with seed rate of 5 kg/ha in 30 cm apart with fertilizer dose of 60 kg N, 40 kg P2O5 and 20 kg K2O/ha. During *Kharif* season, the major dominant weed flora in the experiment field included *Cynodon dactylon*, *Echinochloa colonum, Dactyloctenium aegyptium* as grassy weeds, *Cyperus rotandus* L., *Cyperus iria* L. among sedges and *Commelina benghalensis, Alternanthera sessilis, Digera arvensis Forssk*., *Eclipta alba* (L.), *Phyllanthus niruri, Physalis minima* L. as broadleaved weeds. All the herbicidal treatments and hand weeding significantly reduced the weed intensity as compared to weedy check. The lowest weed intensity, weed dry weight were registered under weed free treatment among all the herbicidal treatments whereas application of pyroxasulfone 80 g/ha followed by oxyflourfen as pre-emergence herbicides and post-emergence herbicides fenoxaprop-p-ethyl was registered significantly highest weed intensity as well as dry weight followed by quizalofop-ethyl. The weed control efficiency among herbicides and its combination varied from 15.80-36.70%. The highest weed control efficiency was recorded under weed free (82.30%) followed by pre-emergence herbicide pendimethalin + imazethapyr (36.70%), whereas lowest under oxyflourfen (15.80%). The result of chemical weed management treatments on seed yield revealed that it was significantly highest under weed free (hand weeding twice at 20 and 40 DAS) at 534 kg/ha. Among the herbicides, propaquizafop (417 kg/ha) registered significantly higher followed by quizalofop-ethyl (407 kg/ha) and fenoxaprop-p-ethyl (385 kg/ha) and these herbicidal treatments significantly higher over the pre-emergence application of pyroxasulfone at 80 g/ha (415 kg/ha) at par with pyroxasulfone at 40 g/ha (407 kg/ha) and lowest seed yield recorded under pendimethalin + imazethapyr (352 kg/ha) followed by weedy check (238 kg/ha). The maximum NMR (Rs. 31625/ha) was recorded in weed free plots followed by propaquizafop (Rs. 25325/ha) and minimum NMR (Rs. 19225/ha) pendimethalin + imazethapyr followed by (Rs. 9025/ha) weedy check. However, the maximum B:C ratio (2.55) was found with application of post-emergence propaquizafop 10% EC 100g/ha and minimum B:C of 1.61 recorded under weedy check.

Bio-efficacy of post-emergent herbicides in common bean under rainfed conditions of Kashmir Valley

Aroosa Khatoon*, A.A. Saad, Amjad Masood, R.H. Kanth, Inayat M. Khan, Showkat Maqbool, Amal Saxena, Ummaisa Rehman, Bhanuwanti and Himansha Tanwar
Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura, Jammu and Kashmir 193201, India
**Email: aroosakhatoon15@gmail.com*

Common bean (*Phaseolus vulgaris* L.) is a major summer grain legume that occupies a niche in the north western Himalayan region like union territory of Jammu and Kashmir. The crop is grown on an area of about 26.75 thousand hectares with an annual production of 14.2 thousand metric tonne. Common bean being a weak competitor to weeds, subjected to heavy crop-weed competition which often inflicts huge yield loss. Weeds also interfere with harvest operation which tends to result reduced market value. High weed infestation is one of the key biotic constraints that hamper overall crop development and yield. Pendimethalin, herbicide of dinitroaniline group is generally used as a pre-emergence *fb* manual weeding at 25-30 DAS, is recommended to manage weed flushes in most pulses including common bean in most of growing regions. Manual weeding is efficient in controlling weeds. But in addition to time consuming and labour expensive, it is not feasible during the months of April and May due to intermittent rains. Therefore, it is an urgent need to go for evaluation of selective and broad spectrum post-emergent herbicide for common bean in Kashmir valley to enhance productivity and weed control. A field experiment was carried out during *Kharif* 2024 to evaluate the bio-efficacy of different post-emergent herbicides in common bean under rainfed condition of Kashmir Valley. The study comprised of seven treatments namely imazethapyr 10% SL (75 g/ha), quizalofop-p-ethyl 5% EC (50 g/ha), propaquizafop 10% EC (100 g/ha), premixed quizalofop-p-ethyl 7.5% EC + imazethapyr 15% EC (500 mL/ha), premixed propaquizafop 2.5% EC + imazethapyr 3.75% EC (2000 mL/ha), weed-free and weedy check. The treatments were laid out in a completely randomized block design replicated thrice. Each unit plot of experiment had dimension of 3.0 m × 4.0 m on which common bean genotype SKUA-WB 5002/185 was sown in line and maintained the population with spacing of 30 × 10 cm. Pre-emergence application of pendimethalin 30% EC (750 g/ha) was applied to all the treatment plots except weed free and weedy check within two days of sowing. The crop was raised following standard package of practice of the university. Results showed that all herbicides reduced weed density and weed biomass significantly over weedy check treatment. Among all the herbicides, propaquizafop 2.5% EC + imazethapyr 3.75% EC (2000 mL/ha) was the most effective, providing broad-spectrum control for both grassy and broad-leaved weeds, closely followed by quizalofop-p-ethyl 7.5% EC + imazethapyr 15% EC (500 mL/ha). Imazethapyr 10% SL (75 g/ha) worked mostly against broad-leaved weeds and lesser effect on Sorghum halepense. However, quizalofop-p-ethyl 5% EC (50 g/ha) and propaquizafop 10% EC (100 g/ha) were particularly effective against grassy weeds. The maximum seed yield was recorded with weed free treatment which was at par to propaquizafop 2.5% EC + imazethapyr 3.75% EC (2000 mL/ha). The study concluded that under rainfed condition in the Kashmir valley, propaquizafop 2.5% EC + imazethapyr 3.75% EC (2000 mL/ha) applied at 25 DAS can effectively manage weeds in common bean offering a practical alternative to manual weeding.

Effect of post-emergence herbicides combined with guar gum polymer on weed dynamics, growth, productivity and economic performance of mungbean

Fuhar Sharma*, Ram Kumar Singh, Virendra Choudhary and Pawan Kumar Verma
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: fuharsharma910@gmail.com*

A field investigation was carried out at the Agricultural Research Farm of the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during the *Kharif* season of 2023. The study aimed to examine the effect of post-emergence herbicides in combination with guar gum polymer (GG) on the growth, productivity and profitability of mungbean [*Vigna radiata* (L.)]. The primary objective was to assess the combined impact of guar gum and various post-emergence herbicides on weed dynamics, growth and yield of mungbean. The economic feasibility of different treatments was also analyzed to identify the most cost-effective and productive weed management strategy. The study was arranged in a randomized complete block design (RCBD) with three replications. The experiment involved ten treatments, including propaquizafop + imazethapyr at 2 L/ha, quizalofop-ethyl at 50 g/ha halosulfuron-methyl at 67.5 g/ha, imazethapyr at 100 g/ha and combinations of these herbicides with guar gum polymer (GG) at a dosage of 0.15%. Additionally, weed-free and weedy check plots were included. The herbicides combined with guar gum were applied 20 days after sowing (DAS). The key findings of the study showed that the treatment combining propaquizafop + imazethapyr (Shaked) with GG polymer resulted in the lowest weed density and dry weight of grasses, sedges and broad-leaved weeds at both 40 DAS and at harvest. This treatment also recorded the lowest weed index while achieving the optimum growth attributes, *viz*. tallest plant, highest plant dry matter accumulation (at 40 DAS), number of leaves per plant. The treatment exhibited superior weed control efficiency and weed control index compared to all other herbicide treatments. Furthermore, this combination demonstrated superior performance in terms of yield attributes, *viz*. pods per plant, pod length and grain yield, indicating its effectiveness in reducing weed competition and enhancing crop productivity. In terms of economic analysis, the propaquizafop + imazethapyr (Shaked) with GG treatment recorded the highest net returns and benefit-cost ratio. The minimal yield reduction observed with this treatment reinforced its status as the most efficient and economical weed management strategy for mungbean cultivation. Overall, the study underscores the significance of post-emergence herbicides in improving weed control, enhancing crop growth and increasing profitability in mungbean farming. The combination of herbicides with guar gum polymer, particularly propaquizafop + imazethapyr (Shaked) with GG, emerged as an effective and economically viable option for weed management in mungbean, providing valuable insights for farmers and agronomists seeking to optimize crop production.

Integrated weed management for chocolate weed (*Melochia corcholifolia* L.) in Sesame

Dhanu Unnikrishnan*[1], Sheeja K. Raj[1], D. Jacob[2], Shalini Pillai[1] and C.S. Arunima Babu[1]
[1]*College of Agriculture, Vellayani, Thiruvananthapuram, Kerala 695522, India*
[2]*OFR Centre, Onattukara Regional Agricultural Research Station, Kayamkulam, Kerala 690502, India*
**Email: dhanunni91@gmail.com*

Sesame is the most important oilseed crop of Kerala. However, heavy weed infestation in the early stages of crop growth largely restricts the crop from achieving its yield potential. The occurrence and spread of *Melochia corchorifolia* L. (chocolate weed), a broad-leaved weed has become a serious concern in sesame cultivating tracts of Onattukara. Being a broadleaf weed in a broadleaf crop, herbicidal management of chocolate weed is difficult in sesamum. Integrated weed management involves diverse control strategies reduces the reliance on herbicides, mitigating resistance development, and promoting sustainable crop production. With this background, an experiment was conducted at Onattukara Regional Agricultural Research Station, Kayamkulam Kerala, during summer 2020-21 and 2021-22 with the objective to develop an integrated management strategy for the management of Melochia corchorifolia L in sesame. The experiment was laid out in RBD with two factors, replicated thrice. The first factor comprised of stale seed bed (S1) and no stale seed bed (S2) and the second factor comprised of seven weed management practices such as post-emergence application of glufosinate ammonium 375 g/ha and carfentrazone-ethyl 20 g/ha at 20 DAS followed by wheel hoe weeding at 45 DAS, pre-emergence application of pendimethalin 500 g/ha followed by carfentrazone-ethyl 20 g/ha and glufosinate ammonium 375 g/ha at 20 DAS followed by wheel hoe weeding at 45 DAS, manual hoeing at 20 and 45 DAS and a weedy check. Pre-emergence and post-emergence herbicides were applied with the help of a novel machinery, crop protective herbicide applicator and hence no phytotoxicity symptom were observed in sesame. *Melochia corchorfolia* and *Cleome viscosa* were the two predominant weeds present in the experimental area. *Melochia corchorifolia* constitutes more than 96% of the weed density during both the years. During the summer 2020-21, stale seedbed + pre-emergence pendimethalin 500g/ha followed by post-emergence application of carfentrazone-ethyl at 20 DAS and wheel hoe weeding at 45 DAS resulted in the lowest total density of weeds (42.7 no./m2). However, during 2021-22, though it recorded lower density of weeds (35.1 no./m2) it was on par with stale seedbed + post-emergence application of carfentrazone-ethyl 20g/ha at 20 DAS followed by wheel hoe weeding at 45 DAS. Stale seedbed + pre-emergence pendimethalin 500g/ha followed by post-emergence application of carfentrazone-ethyl at 20 DAS and wheel hoe weeding at 45 DAS resulted in the highest seed yield per hectare during 2020-21 (477 kg/ha), but during 2021-22, though it recorded higher seed yield (401 kg/ha) it was on par with stale seedbed + post-emergence application of carfentrazone-ethyl 20 g/ha at 20 DAS followed by wheel hoe weeding at 45 DAS (400 kg/ha). The results on benefit cost ratio also revealed that stale seedbed + post-emergence application of carfentrazone-ethyl at 20 DAS followed by wheel hoe weeding at 45 DAS had the highest benefit-cost ratio.

Bio-efficacy of post-emergence herbicides against weeds in soybean

Alok Sinha*, J.K. Singh and Sudhir Kumar Rajpoot

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Division of Agronomy, ICAR-indian agricultural research institute, New Delhi 110012, India*

**Email: aloksinha2304@gmail.com*

In the quest for effective weed management in soybean (*Glycine max* L.), a field experiment was conducted during the rainy (*Kharif*) season of 2022-23 at the Banaras Hindu University, Varanasi. The study aimed to evaluate the efficacy of haloxyfop-R-methyl 10.5% w/w EC against weeds in soybean, alongside other herbicides, hand weeding (at 20 and 40 DAS), and a weedy check. The experiment followed a randomized complete block design with 8+1 treatments (one for phytotoxicity study) and 3 replications. Herbicides were applied post-emergence at 20 DAS of soybean (cv. JS 20-98) which sown on 27th June. The predominant weed species in the field included *Cyperus esculentus* (55%), *Cyperus rotundus* (11%), *Parthenium hysterophorus* (L.) (7%), *Lindernia procumbens* (7%), and *Eclipta alba* (L.) Hassk. The weedy check recorded the highest weed density, dry matter, and weed index, whereas hand weeding at 20 and 40 DAS resulted in significantly lower values for these parameters and the highest weed control efficiency. Among herbicidal treatments, the post-emergence application of haloxyfop-R-methyl 10.5% w/w EC (BCSPL sample) at the rate of 164.1 g/ha showed superior efficacy in controlling weeds, enhancing growth parameters, and improving yield-related characteristics without causing any phytotoxic effects on soybean. This treatment also resulted in the highest weed control efficiency, minimal weed index, and superior economic returns, with a net monetary benefit of Rs. 50,149/ha and a benefit-cost ratio of 1.37. These findings suggest that haloxyfop-R-methyl is a highly effective and economically viable option for weed management in soybean cultivation.

Weed management in direct-seeded rice: A farmer field study

Meenakshi Sangwan*, Ram Karan Gaur, Meena Sehwag and Meena Siwach
Chaudhary Charan Singh Haryana Agricultural University (Hisar) Krishi Vigyan Kendra, Rohtak, Haryana 125001, India
**Email: sangwanmeenakshi@hau.ac.in*

Farmers in Rohtak district are shifting from transplanting to direct-seeded rice (DSR) systems due to decreased availability of good quality water, labor and increased production costs. The establishment of paddy crop through direct-seeding technique is not only simple to use but also has been found effective in sustaining the production of rice. However, weeds are the major biological constraints under direct seeded rice technique limiting productivity, profitability and sustainability of paddy. Early crop-weed competition in direct-seeded rice can cause paddy yield losses of up to 50% due to absence of suppressive effect of standing water on weed emergence and growth at initial crop period. Thus, the success of DSR at farmers field depends on adoption of timely and effective weed management practices as DSR exposed to more competitive and diverse weed flora than transplanted rice. Although, manual weeding and herbicides are commonly used methods to control weeds but manual weeding is costly and labour-intensive operation. Thus, integration of herbicides is best way to control complex weed flora in DSR. Therefore, a farmer field study was conducted to assess the efficacy of pre- and post-emergence herbicides on weed flora in DSR for enhancing paddy productivity and profitability in the district during *Kharif* season 2022-23 and 2023-24 under CCS Haryana Agricultural University, Krishi Vigyan Kendra, Rohtak. Trial was conducted at 20 different locations at farmers' field in district Rohtak, Haryana (India) with recommended package of practices. Technological options comprised of farmers' practice *i.e.* bispyribac-sodium 10% SC 250 mL/ha and assessed practice *i.e.* application of PRE pendimethalin 30 EC 3.25 l/ha + pyrazosulfuron-ethyl 10% WP 250 g/ha *fb* (triafamone 20% + ethoxysulfuron 10% WG) 225 g/ha POE at 25 days after sowing. *Echinochloa crus-galli* (L.) Beauv, *E. colona* (L.) Link, *Dactyloctenium aegyptium* (L.) Willd., *Leptochloa chinensis* (L.) Nees, *Cyperus rotundus* L., *Cyperus iria* L., and *C. difformis* L., *Digitaria sanguinalis* (L.) Scop., *Trianthema portulacastrum* L. were the major weeds at farmers field limiting yield of paddy under DSR. Only post-emergence herbicide (bispyribac-sodium) was used by all the selected farmers for the control of mix weed flora, but poor efficacy of this herbicide was observed against *L. chinensis, Cyperus rotundus, D. aegyptium, D. sanguinalis* and *T. portulacastrum*. On the other hand, the sequential application of PRE pendimethalin 30 EC 3.25 l/ha + pyrazosulfuron-ethyl 10% WP 250 g/ha *fb* (triafamone 20% + ethoxysulfuron 10% WG) 225 g/ha at 25 days after sowing (DAS) provided 90- 95% visual weed control while 45-50% weed control was observed under farmers' practice. The assessed practice of weed management in DSR found to be better with 18.9 per cent increase in yield over farmers' practice. The B:C ratio of assessed technology was 2.42 as compared to 2.07 under farmers' practice. Therefore, the on-farm trial concluded that promoting sequential herbicide application at the farmer's field along with stale seed bed technique is crucial for managing mixed weed flora during the critical crop-weed competition period, ensuring the success of direct-seeded rice (DSR).

Brush-cutter with rotary tiller: An economically viable weeding tool for small and marginal farmers of India

C.R. Chethan*[1], R.P. Dubey[1], D.V. Pawar[1], D. Sreekanth[1],K. Manjunath[2], D.J. Shrinivasa[3] and P.K. Singh[1]

[1]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[2]*ICAR-Directorate of Cashew Research, Puttur 574202, India*

[3]*Banaras Hindu University- Institute of Agricultural Sciences, Varanasi, Uttar Pradesh 221005, India*

**Email: chethan704@gmail.com*

In India, most farmers (more than 86%) are smallholders and farm on fragmented and marginal lands with low-cost production methods. They rely mainly on hand weeding with simple, traditional tools for weed management in all major crops. However, the manual weeding is one of the most tedious and laborious jobs in agriculture, consumes 25% of the total labour requirement in agricultural production. Even after using the traditional tools, still results 10-15% of crop loss in India. Further, the farm power availability at Indian farm is about 3.045 kW/ha, with 32% of mechanization for weed management mechanization. The adoption of mechanical weeders in India is greatly hindered by smaller land holdings, farmers' economic conditions, high initial cost of machines, high repair and maintenance costs, and non-availability of weeders and repair services at the village level. Therefore, a suitable mechanical weed management method should be identified to uplift the socio-economic status of the small and marginal farmers and also to increase the adoption level of mechanical weeders. A study on mechanical weed management was conducted in sweet corn crop (cv. Sugar 75) during *Rabi* season for three years to fulfil the objective of the study. The mechanical weeders such as, brush-cutter with rotary tiller, hand grubber, cycle hoe, nail weeder and twin wheel hoe were selected for the study. The mechanical weeding was conducted at 25 DAS and at 50 DAS based on the weed flush appearances. The weed data, crop parameters and physiological load on the operator to perform weeding operation *etc* were recorded and were compared with the hand weeding and weedy plot treatments. The mechanical weeders used to perform weeding operation between the crop rows (inter-row). One hand weeding within the mechanical weeders treatment plot was used to remove the weeds between plants within a crop row (intra-row). A highest weeding efficiency of up to 100% was seen hand weeding. However, the weeding cost (up to 33,000 Rs. /ha) and time (up to 598 man-h/ha) require for the operation was highest among other treatments. The brush-cutter with rotary tiller can be easily operated in sweet corn and wider row crops (>30 cm row spacings) with minimal operational cost and operator fatigue. The weeding can also be performed up to 50 days after sowing (DAS) and crop height of up to 90 cm without having much difficulties and plant damage. It had highest weeding efficiency of 85.5 and 85.2% respectively during first and second weeding which was 20-50% higher compared to other weeders, operator drudgery has been reduced drastically and the overall discomfort rating (ODR) score was within the moderate discomfort level. Further, 560.8 man-h/ha of labour was saved by using brush-cutter compared to manual hand weeding *i.e.* 94% reduction of labour. The field capacity of brush-cutter (0.059 ha/h) was increased by 1730% over hand weeding and 197.2 to 300.5% over other weeders. The brush-cutter with rotary tiller costs Rs. 980 to 1050/ha for weeding operation and saved almost 91% of cost over hand weeding and 63.1-70.5% over other weeders.

Punjab successfully converted an additional 2.5 lac ha area under *Kharif* maize?

Pardeep Sagwal
Borlaug Institute for South Asia (BISA-CIMMYT), Ludhiana, Punjab 141008, India
Email: pardeep.kumar@cgiar.org

Maize is the most versatile crop, adaptable under varied agro-climatic conditions also the queen of cereals and is known for its highest genetic yield potential. This crop is grown in majority of Indian states throughout the year for various purposes, *viz.* grain, fodder, feed, green cobs, sweet corn, baby corn, popcorn, *etc*. The two major seasons for maize cultivation in India are the rainy (*Kharif*) and winter (*Rabi*) seasons. Though It is predominantly a *Kharif* crop, as 85% of the area remains under cultivation during the season; *Rabi* maize is also cultivated under limited geography and presently its gaining momentum, where productivity is higher than *Kharif* maize. Presently in India, Maize is the third most important cereal crop after rice and wheat. Amid present hydrological situation, growing rice is not sustainable option in Punjab as it requires too much water. Already, water is being over-pumped in most districts of Punjab, and the water table is getting depleted too fast. Punjab can enhance its environmental sustainability by replacing rice with maize while capitalizing on economic opportunities in the ethanol market. Cropping systems diversification with sustainable intensification has been recognized as an effective strategy for achieving the objectives of food and nutritional security and sustainable management of land and water resources. *Kharif* maize-mediated crop and cropping system diversification, is one of the potential components of sustainable intensification in Punjab, which will help in profit maximization through optimized use of natural resources especially surface water and aquifers. At present, aera under *Kharif* maize is going down in Punjab. However, it is believed that the *Kharif* maize based crop diversification for Punjab has potential to halt the groundwater deterioration and degradation of natural resources and the environment to ensure food and nutritional security and meet the industrial demand for maize. Maize requires less water than rice, offering a long-term solution to Punjab’s water scarcity issues. Punjab can enhance its environmental sustainability by replacing rice with maize while capitalizing on economic opportunities in the ethanol market. Growing ethanol demand translates to a promising market for maize, incentivizing farmers to switch. Growing maize rather than rice offers several benefits *viz.* i) Environmental Benefits: Maize requires significantly less water than rice, offering a sustainable solution amidst growing scarcity concerns in Punjab, and ii) Economic Opportunities: A shift to maize could attract subsidies and incentives aligned with government initiatives promoting water-efficient crops. Assured crop establishment to offer optimum plant stand, and early stage weed through integrated weed management approach are the central for successful maize cultivation in Punjab. Besides this agronomic practice to manage the temporary flooding due monsoon season rain fall will also be critical factor.

Oral lecture 57

Optimizing triafamone 20% + ethoxysulfuron 10% herbicide dose through drone technology for sustainable weed management in rice

Bibhudutta Misra and Ashirbachan Mahapatra*
Department of Agronomy and Agroforestry, Mankombu Sambasivan Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha 761211, India
**Email: ashirbachan@gmail.com*

The increased reliance on herbicides in combination with modern agricultural approaches, warrants enhancing precision in weed control, minimizing herbicide waste, and reducing environmental impact in rice ecosystem. By fine-tuning herbicide application via drones, farmers can ensure targeted and efficient weed management while protecting non-target plants, improving crop health, and potentially lowering input costs. A drone mounted with a low volume spray system may require a lower dose of herbicide for effective control the weed population. With this problem hypothesis, a field experiment was carried out on studies on the efficacy and economics of drone spraying of herbicide mixture in wet-seeded rice conducted during the rainy (*Kharif*) season of 2023 at Post Graduate Research Farm (18o48'16" N latitude, 84o10'48" E longitude) of M.S. Swaminathan School of Agriculture, Paralakhemundi, Gajapati District, Odisha under sandy clayey loam soil conditions. The experiment was laid out in a randomized block design with three replications and ten treatments. For spraying, the Krishak drone (Hexacopter) by General Aeronautics was used. The treatments consisted of drone spraying at 100% of the herbicide (triafamone 20% + ethoxysulfuron 10%) dose (67.50 g/ha), drone spraying at 90% of herbicide dose (60.75 g/ha), drone spraying at 80% of herbicide dose (54.00 g/ha), drone spraying at 70% of herbicide dose (47.25 g/ha), drone spraying at 60% of herbicide dose (40.50 g g/ha), drone spraying at 50% of herbicide dose (33.75 g/ha), drone spraying at 40% of herbicide dose (27.00 g/ha), knapsack spraying at 100% of herbicide dose (67.5 g/ha), weed free (HW at 20, 40, and 60 DAS), and weedy check. Rice variety 'RNR 15048' was used as test variety in this experiment which was sown with a spacing of 20 cm from row to row and 10 cm from plant to plant. The essential plant nutrients like N, P, and K were applied in the form of urea, diammonium phosphate, and muriate of Potash and fertilizers were applied by considering 80:40:40 kg/ha of N:P:K as recommended dose. In the experiment, the results revealed that, among the herbicide treatments, triafamone + ethoxysulfuron (47.25 g/ha) performed the best with the highest growth parameters, *viz*. plant height (123 cm), number of tillers (408/m^2), dry matter accumulation (2097 g/m^2), leaf area index (4.56); yield attributes, *viz*. number of panicles/m^2 (280), number of grains/panicle (280); grain yield (5.6 t/ha); straw yield (6.4 t/ha); and lowest weed parameters infestation with weed density (13.3/m^2 at 60 DAS), weed biomass (13.4 g/m^2 at 60 DAS), weed control efficiency (94% at 60 DAS), and weed index (4.4%). The treatment was found to be at par with the weed free check as well as the knapsack spraying at 100% of herbicide dose (67.5 g/ha) followed by T5: Drone spraying at 60% of herbicide dose (40.50 g/ha). The investigation finding the optimum dose of the herbicide with the reduction of the chemical load on the environment as well as financial load on the farmer, the results promoted sustainable farming practices, crucial for balancing productivity with environmental conservation in modern agriculture.

Molecular profiling of *Echinochloa* species using random amplified polymorphic DNA, simple sequence repeat, and inter-simple sequence repeat markers

S.I. Kuwardadra*, D. Sreekanth, D.V. Pawar and A.B. Gaikwad
ICAR-Directorate Of Weed Research Jabalpur, Madhya Pradesh 482004, India
**Email: sahadeokuwardadra@gmail.com*

The weeds from the genus Echinochloa are one of the most aggressive and persistent weeds affecting agricultural systems worldwide, particularly in rice-growing areas. Their adaptability to a wide range of environments, rapid growth rates, short life cycles, and competitive nature make them highly dominant, leading to significant crop yield losses worldwide. The goal of this study was to investigate the genetic relationships among three *Echinochloa* species: *Echinochloa colonum* (L.) Link, *Echinochloa crus-galli* (L.) P. Beauv., and *Echinochloa glabrescens* (Kossenko), collected from the ICAR-DWR, Jabalpur campus. The genetic analysis was performed in the Division of Genomic Resources, ICAR-National Bureau of Plant Genetic Resources, New Delhi from September to November 2023. The three different DNA-based molecular markers: Random Amplified Polymorphic DNA (RAPD), Simple Sequence Repeat (SSR), and Inter-Simple Sequence Repeat (ISSR) were employed for the profiling of Echinochloa species. We used seven RAPD markers for molecular profiling, but only two of them, i.e. OPE-03 and OPH-12, generated polymorphic bands, indicating variability among the species. In the case of SSR profiling, out of eleven markers used, eight showed amplifications, though only three (EC_03, SCA10, and P24) were polymorphic, and the rest of the SSR markers were found to be monomorphic, which suggested the lack of variation and a high degree of genetic similarity among the species. Furthermore, we performed ISSR profiling to get more polymorphic bands. A total of twenty-seven ISSR markers were screened, and twenty-four of them showed amplification. Out of these, only twenty markers (UBC-810, UBC-816, UBC-817, UBC-836, UBC-808, UBC-809, UBC-818, UBC-823, UBC-826, UBC-827, UBC-840, UBC-835, UBC-841, UBC-842, UBC-844, UBC-857, UBC-853, UBC-855, UBC-856, and UBC-848) were found to be polymorphic, able to distinguish the three *Echinochloa species.* The scoring data from these markers were analyzed using NTYSYS-pc software (version 2.1), and the Jaccard similarity index was also calculated to assess the genetic relatedness between the species. The results showed a high degree of genetic similarity, with a similarity index of 0.848 between *E. colonum* and *E. glabrescens*, 0.835 between *E. crus-galli* and *E. glabrescens*, and 0.779 between *E. colonum* and *E. crus-galli*. This high genetic relatedness suggests that these species share a common evolutionary origin and exhibit similar adaptive and biological traits like growth habits and environmental responses. These findings have important implications for weed management, especially regarding the development of herbicide resistance. The close genetic relationship among these species raises the possibility that herbicide resistance developed in one species could spread to others. This makes the identification of genetic diversity and evolutionary patterns critical for formulating effective weed management strategies. The polymorphic markers identified in this study can be further employed with genome sequencing to thoroughly explore the genetic diversity and adaptive mechanisms of *Echinochloa* biotypes collected from different agro-climatic zones in India. Understanding the genetic diversity of *Echinochloa* species is vital for developing effective weed management strategies. The insights gained from this study could provide a foundation for future research to guide the development of weed management strategies to tackle the tailored challenges posed by genetically diverse and rapidly evolving *Echinochloa* biotypes, including other dominant weed floras with many known biotypes in dynamic agricultural systems.

Impact of improved weed management technologies: An econometric approach

A. Jamaludheen*, P.K. Singh, Yogita Gharde, V.K. Choudhary and J.S. Mishra

ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India

**Email: ajamaludheen@gmail.com*

The diverse climatic conditions create an environment conducive to the prevalence of common weeds, which significantly contribute to crop yield losses. According to estimates, weeds are responsible for approximately one-third of the total crop yield losses caused by agricultural pests. In addition, weeds lower the quality of produce, increase production costs, and serve as alternate hosts for various insect pests and diseases. Indian farmers have long relied on a mix of chemical and non-chemical methods, drawing on traditional knowledge to manage weeds. Hand weeding, one of the oldest practices, continues to be widely used today, alongside modern herbicide-based strategies. These herbicide-based Improved Weed Management Technologies (IWMTs) have become a central focus for Indian researchers. Currently, IWMTs are employed across more than 20 million hectares, representing about 10% of the total cropped area in India and accounting for nearly 16-17% of the country's total pesticide usage. These technologies play a crucial role in effective weed management, particularly within the rice-wheat cropping system. In this context, the present study aims to identify the socio-economic factors influencing farmers' adoption of IWMTs and to quantify the realized impact of these technologies. Katni and Jabalpur districts in Madhya Pradesh were deliberately chosen as the study area, taking into account the extensive extension activities conducted by the ICAR-Directorate of Weed Research, Jabalpur, over the years to disseminate IWMTs in these regions. Primary data were collected from a representative sample of 240 farmers cultivating rice and wheat using a well-structured, pre-tested interview schedule. Information on socio-economic characteristics, weed flora, technology adoption, and crop yields was gathered from the farmer respondents. To quantify the impact of IWMT adoption, the Difference-in-Differences (DID) econometric approach was employed. The results indicated that key factors influencing IWMT adoption among farmers included extension contact, participation in improved weed management training, and attendance at IWMT field demonstrations. The impact assessment revealed that IWMT adoption led to an additional rice yield of 4.15 q/ha. In monetary terms, this translated to an extra income of Rs. 8,466 per hectare. Similarly, for wheat, the effect size was 1.68 q/ha, resulting in an additional income of Rs. 3,385 per hectare for farmers adopting IWMT.

Oral lecture 60

Advancing herbicide development: A computational approach combining physicochemical parameter and scaffold analysis

Priyanka Rani, Bikash Kumar Rajak and Durg Vijay Singh*
Molecular Modelling and Computer Aided Drug Discovery Laboratory, Department of Bioinformatics, School of Earth, Biological and Environmental Sciences, Central University of South Bihar Gaya, Bihar 824236, India
**Email: dvsbiotech@gmail.com*

Herbicides have proven to be a great add on in weed management in agricultural fields, thereby aiding in escalating crop production. However, the development of resistance in weeds against pre-existing herbicides is a setback in weed management, which has compelled the agrochemical industries to replace existing herbicides with novel agrochemicals. The demand to introduce new herbicide-like molecules has encouraged agro-researchers to develop efficient and potential herbicides with selective activity against targeted weeds. Developing new herbicide molecules through traditional methods is time consuming and cost prohibitive. The use of high throughput virtual screening (HTVS) through physicochemical properties, de novo design and combinatorial design of molecules with cutting edge computational methods is an alternative to the traditional techniques in lead molecule discovery. However, the lack of established optimal physicochemical criteria for screening herbicide-like molecules has hindered the herbicide discovery process. The physicochemical parameters [molecular weight, aromatic atoms, rotatable bonds, hydrogen bonding capacity, Topological Polar Surface Area (TPSA), solubility and polarity] of known herbicide molecules have been studied and evaluated, to optimal the criteria for target specific herbicides [Grouped according to Mode of Action (MoA) in 'Herbicide Resistance Action Committee aka HRAC (HRAC)]. Properties including molecular weight and hydrogen (H) bond acceptor atoms tend to have higher values, while H bond donor atoms are relatively lower in all groups of herbicides. This set distinguishable characteristics in herbicides from oral drugs. Besides, this there are significant variations in optimal physicochemical parameters between herbicides of different HRAC groups, with ALS-inhibiting herbicides having the most diverse criteria from other herbicide groups. Besides the physicochemical parameters of herbicides, their core scaffold is also of utmost importance to designing new molecules with potential herbicide-like activity rationally. Statistical analysis deduced that there are among ~800 known herbicides, there are ~196 scaffolds present, with monocyclic rings being the most common. The distribution of physicochemical features of herbicide scaffolds correlates with known herbicide molecules. As formerly mentioned, the H-bond donor is an important physicochemical feature among herbicides, establishing its importance in rationalising potential herbicide molecules. Relating to that, the number of H-bond acceptor atoms is high while H-bond donor atoms are less prevalent in herbicides' scaffolds as well. The proposed parameters for respective target sites could be used as filters for in-silico HTVS screening, designing (combinatorial designing, de-novo designing and fragment-based designing of herbicide-like molecules), prioritisation and optimisation of target specific lead herbicide molecules. Combining the knowledge of herbicide physicochemical parameters with their scaffolds could also help in rationally designing potential herbicide-like molecules with lesser failure rates on the field.

Herbicide use pattern and economics of weed control in dry and tar-wattar sowing methods of dry-direct seeded rice at farmer's field in Tarn Taran district of Punjab

Navjot Singh Brar*[1], Parminder Singh Sandhu[2], Prabjeet Singh[1], Anil Kumar[1] and Simerjeet Kaur[3]

[1]*Krishi Vigyan Kendra, Tarn Taran, Punjab 143401, India*

[2]*Farm Advisory Service Centre, Tarn Taran, Punjab 143401, India*

[3]*Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab 141004, India*

**Email: navjotbrar11@yahoo.co.in*

Direct seeded rice (DSR) is an alternate technology to transplanted rice, which is water, labour and energy efficient (Kumar *et al.* 2011). There are two methods for direct seeding of rice followed by the farmers in Punjab state. In first method, seeds are sown in dry fields and irrigation is applied immediately after sowing. In second method, the sowing is done in tar-wattar conditions after pre sowing irrigation and first irrigation is delayed up to 21 days after sowing depending upon soil and weather conditions. To quantify the adoption patterns of these two technologies, herbicide use pattern and cost of weed control under dry and tar-wattar sowing of DSR, a survey was conducted during May to August, 2024 in eight villages of district Tarn Taran (Punjab). The major weed flora observed in surveyed fields were *Echinochloa crus-galli, Echinochloa colonum, Leptochloa chinensis, Dactyloctenium aegyptium* and *Eleusine indica* amongst grasses, *Ludwigia parviflora, Trianthema monogyna, Hydrilla verticillata* amongst broad weed leaves, and *Cyperus* spp., *Scirpus roylei* amongst sedges. Out of 125 ha, 66% area was sown with dry sowing and 34% area was sown with tar-wattar sowing method. Weed infestation was reported less in fields sown under tar-wattar method as top 1-cm soil layer got dried up which retarded germination of weeds. In dry method, irrigation immediately after sowing allowed germination of weed seeds that resulted in more weed pressure. In dry sowing method, pendimethalin and pendimethalin + pyrazosulfuron-ethyl was used on 32 and 56% area, respectively and no pre-emergence herbicides were applied by farmers on 12% area. In tar-wattar sowing conditions, pre-emergence herbicides were not used on 56% area, pendimethalin and pendimethalin + pyrazosulfuron-ethyl was applied on 6 and 19% area, respectively. For post-emergence control of weeds in dry sowing method, bispyribac, bispyribac + fenoxaprop + (florpyrauxifen-benzyl + cyhalofop-butyl), bispyribac + fenoxaprop, bispyribac + fenoxaprop + hand weeding and bispyribac + fenoxaprop + (florpyrauxifen-benzyl + cyhalofop-butyl) + (metsulfuron+ chlorimuron), was used on 23, 4, 25, 24 and 4% area, respectively. In tar-wattar sowing method, bispyribac, fenoxaprop-p-ethyl, florpyrauxifen-benzyl + penoxsulam, pretilachlor, bispyribac + fenoxaprop-p-ethyl + pretilachlor and bispyribac + fenoxaprop-p-ethyl was used on 24, 7, 11, 5, 15 and 19% area, respectively for post-emergence weed control. In dry sowing, weed control cost varies from 2000 to 13700 Rs/ha with an average of 7848 Rs/ha while it varies from 2000 to 7650 Rs/ha with an average of 4316 Rs/ha in tar-wattar sowing method. The cost of weed control was less in tar-wattar sowing than dry sowing method of dry-DSR.

HierbaRobo and HierbaApp: An ai-powered weeding robot and Android mobile application for weed identification and removal

Justina Michael and M. Thenmozhi*

SRM Institute of Science and Technology, Kattankulathur, Chennai, Tamil Nadu 603203, India

**Email: thenmozm@srmist.edu.in*

Weeding is one of the biggest problems farmers confront. Since weeds drastically reduce crop productivity, they must be eradicated at their early stage. Manual weeding is a labor-intensive and time-consuming task. In order to address this problem, we present HierbaRobo and HierbaApp, which enable autonomous identification and eradication of weeds. This research designs an economical, effective, and efficient AI-powered robot named HierbaRobo for small-scale farmers to detect and remove weeds with minimal human interference. In developing countries like India, where the majority of the farmers practice small-scale farming, huge robots cannot be implemented and are not affordable. Small-scale robots will come in handy and will reduce labor costs, save time and money, and make farming easier. This project intends to construct a low-cost, compact robot whose main goal is to quickly and automatically identify and eradicate weeds. Additionally, this research also designs an user-friendly AI-powered Android mobile application named HierbaApp for weed identification through smart phones. These days, farmers utilize smartphones frequently, hence this software will be helpful to traditional farmers and contemporary aspiring farmers. Smartphone-based weed identification is feasible because of its low deployment costs and challenges. These two ideas are designed by incorporating HierbaNetV1, an unique and novel AI-model that differentiates crop from weed at their early growth stage. This AI model is trained using 'Sorghum Weed Dataset Classification' the first Indian Crop-Weed dataset created by our research team. Implementation of the proposed methodologies in practicality boosts crop productivity and promotes better plant growth by inhibiting weed growth, which eventually helps the nation's economy growth.

Modern agriculture's new weed control approaches

Ankur Singh* and Jainendra Kumar Singh
Department of Agronomy, Institute of agricultural sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*
**Email: ankursingh11534@gmail.com*

Weeds significantly reduce crop yields worldwide, causing greater losses than other pests. Sustainable weed management is crucial, and allelopathy offers an environmentally friendly alternative to herbicides. Allelopathy involves using plants that release natural chemicals to suppress weed growth. Several crops like rye, sorghum, and wheat have allelopathic properties. Techniques for using allelopathy include growing allelopathic crop varieties, intercropping, using cover crops and mulches, crop rotation, and breeding crops for enhanced allelopathic potential. This approach contributes to sustainable and integrated weed management systems. Herbicides have dominated weed management since the 1950s due to their efficiency and economic advantages, enabling large-scale farming. While technological and regulatory advancements have mitigated immediate risks, the long-term ecological impact persists, manifesting as weed population shifts and herbicide resistance. This evolutionary pressure will drive future weed management strategies and innovations. Addressing challenges in crop yield, farm efficiency, and sustainability necessitates continued technological advancements in weed control and overall agricultural practices. Modern farming's weed control strategies have become overly dependent on a single approach: crops engineered to resist herbicides. This narrow focus calls for a shift towards more diverse and sustainable long-term practices. In light of the growing problem of glyphosate-resistant weeds, agricultural companies are now developing crop varieties with resistance to both glyphosate and synthetic auxin herbicides. The widespread adoption of these multi-resistant crops may lead to three main challenges for sustainable weed management:1. The prevalence of herbicide-resistant weeds is likely to increase.2. Overall herbicide use may rise significantly, potentially harming the environment.3. This quick fix could further discourage investment in public research on integrated weed management approaches. To ensure long-term effectiveness, weed control strategies should incorporate a wider range of methods beyond just herbicide tolerance. Moreover, weed scientists faces critical challenges due to herbicide resistance and increasing global food demand. Key areas include new herbicide discovery from natural products, genetic engineering for novel control approaches, biological control advancements, and precision agriculture technologies. The integration of these new tools with improved understanding of weed biology and ecology is crucial for developing more sustainable and diverse weed management systems. This multifaceted approach requires commitment from funding agencies, researchers, and practitioners to address future agricultural needs effectively. Modern weed management requires a paradigm shift from herbicide-centric approaches to integrated strategies. This evolution is necessitated by increasing herbicide resistance and the need for stronger ecological foundations in weed science. Emerging solutions include the "many little hammers" concept, technological advancements like robotic weed control, cover crops, and weed seed destruction techniques. Future innovations may encompass RNAi technology, gene editing, and digital farming.

Empowering weed management through artificial intelligence and digital technologies

Ambuj Kumar Singh* and Kajal Verma

Department of Agronomy, Institute of Agricultural sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: ambujsingh67@bhu.ac.in*

Weed management remains a significant challenge in modern agriculture, leading to substantial crop yield losses and increased production costs. Traditional methods of weed control, including manual removal and chemical herbicides, are often labour-intensive, time-consuming, and can contribute to environmental degradation. A paradigm shift in agriculture has been brought about by artificial intelligence (AI), especially in the area of weed management. Recent advancements in artificial intelligence (AI) and digital technologies have opened new avenues for more efficient, sustainable, and precise weed management practices. The integration of AI, machine learning, robotics, and digital imaging technologies are helpful in detecting, classifying, and managing weeds. Robotics and variable rate technology (VRT) have demonstrated significant promise in the management of weeds. The application of AI in this field goes beyond simple innovation; it provides accurate and environmentally friendly solutions for weed identification and management, hence tackling important agricultural concerns.AI-powered systems can rapidly identify weed species through computer vision and deep learning models, enabling targeted application of herbicides, reducing chemical use, and minimizing environmental impact. Furthermore, digital platforms can enhance weed management by providing real-time monitoring, predictive analytics, and data-driven decision-making tools to farmers. This technological shift has the potential to transform traditional agricultural practices, promoting sustainable agriculture and improving crop productivity.

Impact assessment of chemical weed management technology in transplanted rice through field demonstration

Rabiratna Dash*[1], M.A. Alim[1], S Karubakee[1], M.M. Mishra[1] and S.K. Mohanty[2]

[1]All India Coordinated Research Project on Weed Management, Odisha University of Agriculture and Technology,Bhubaneswar, Odisha 751003, India

[2]Department of Plant Physiology, Siksha 'O' Anusandhan University (SOA) Bhubaneswar, Odisha 751030, India

**Email: rabiratnadashouat@gmail.com*

Agricultural production can be sustained through development of agro-ecological based research technologies. The field demonstrations were conducted for essential evaluation and adoption of research technologies. In this context, the field evaluations on chemical weed management were carried out taking 200 farmer beneficiaries from 2 villages of 5 blocks at 4 districts each from coastal and western zones of Odisha following stratified random sampling method in transplanted rice during the *Kharif* season of 2018. The evaluations were done to assess the effectiveness and economic benefits of the novel pre-emergence herbicide combinations of bensulfuron-methyl 0.6% + pretilachlor 6% GR (RM) 660 g/ha, pendimethalin 38.4% + pyrazosulfuron-ethyl 0.85% ZC (RM) 785 g/ha and pretilachlor 30% + pyrazosulfuron 0.75% WG (RM) 615 g/ha on weed growth and crop productivity viz-a-viz the farmers' practices (one hand weeding at 30 DAT). The soil type of Odisha greatly varies from fertile alluvial saline soils of coastal zones to red and black soil of western zones. The average soil nutrient status of the farmers' beneficiaries varies from 220-230 kg/ha N, 12-15 kg/ha P and 240-250 kg/ha K with low organic matter status of 0.3-0.5% in the coastal zones whereas it was 230-250 kg/ha N, 7-8 kg/ha P2O5 and 260-270 kg/ha with medium organic matter content of 0.4-0.6% in western zones of Odisha. The climate and rainfall during the field demonstrations were found to be normal. The most dominant weed flora on the site were grasses like Echinochloa crus-galli, Panicum repens, sedge like Cyperus iria and broad-leaved like Sphenoclea zeylanica and Ludwigia parviflora in the coastal zones of Odisha. The major weed species found in the western zones of Odisha included grasses like *Echinochloa colona*, *Cynodon dactylon*, sedge like *Cyperus rotundus* and broad-leaved like *Alternanthera philoxeroides* and *Eclipta alba*. The pre-mix herbicides used for demonstrations in the farmers' fields were found to be highly effective in controlling weeds and thereby increasing average grain yield by 55-60% and 20-35% in coastal and western zones, respectively over the farmers' practice. The average weed control efficiency was found to be 78.95-85.56% with the application of the pre-mix novel herbicides whereas the average weed control efficiency for farmers' practice was 52.21% and 53.62% in coastal and western zones, respectively. The economic benefits of herbicide demonstration over the farmers' practice varied from Rs. 44,752- 54,190/ha. With B: C (2.32 and 2.50) the application of bensulfuron-methyl + pretilachlor and pendimethalin + pyrazosulfuron-ethyl in the coastal and western zones of Odisha, respectively. Therefore, it has been concluded that application of bensulfuron-methyl 0.6% + pretilachlor 6% GR (RM) 660 g/ha was found superior pre-emergence herbicide in controlling the diverse weed flora and realising the maximum yield (3.52 t/ha) in coastal zones while application of pendimethalin 38.4% + pyrazosulfuron-ethyl 0.85% ZC (RM) 785 g/ha resulted most effective and maximum yield (3.85 t/ha) in the western zones of Odisha.

Oral lecture 66

Weed management in maize during summer season in Assam

Khagen Kurmi, Tulika Narah, Sontara Kalita and Anjuma Gayan
Assam Agricultural University, Jorhat, Assam 785013, India
**Email: kkurmi7@gmail.com*

A field experiment was conducted on integrated weed management in summer maize at the Instructional-cum-Research Farm of Assam Agricultural University, Jorhat during March to June, 2022 and 2023 with the objectives to study the effect of different weed management practices on weed flora growing in maize field and on soil chemical and biological properties. The treatments consisted of different weed management practices, *viz*. Farmers practice of manual weeding, recommended practice of atrazine 1.0 kg/ha PE, Weedy fallow, PE application of atrazine 0.5 kg/ha *fb* PoE application of tembotrione 120 g/ha, Live mulching with cowpea, Live mulching with greengram, Mulching with lemongrass leaves 4.0 t/ha, Mulching with biodegradable polythene film, weedy check and Weed free check. The soil was of sandy-loam texture with a pH of 5.1, available N, P, K of 288.54, 25.37, 159.82 kg/ha, respectively. There were ten species of grassy weeds, one sedge *Cyperus rotundus* and eighteen grass and broad-leaved weeds in the crop field. The dominant species were *Cynodon dactylon*, *Panicum repens*, *Mimosa diplotricha* and *Alternanthera sessilis.* The effect of different treatments pronounced significant effects in controlling weeds in maize. Application of atrazine and tembotrione showed positive effect in controlling weeds during the early crop growth period as compared to rest of the treatments. However, mulching with lemongrass showed better weed control efficiency and weed index during the later stages of crop growth. Application of mulching recorded higher values of growth, yield attributing parameters, *viz.* number of cobs/plant, cob length and girth, 1000 grain weight, grain and stover yield. The content and uptake of NPK by maize crop was highest where lemongrass leaves were used as mulching material. However, there was no significant variation in the available NPK status in soil among the different weed management practices. The fungal and bacterial populations were high with application of various mulching materials with more pronounced effect with lemongrass mulch. The highest B-C ratio of 2.16 was also registered with lemongrass mulch.

Bio-efficacy of post-emergent herbicides in wheat under temperate condition of Kashmir valley

A.A. Saad*, Amal Saxena, Amjad Masood, R.H. Kanth, Ummaisa Rehman, Bhanuwanti, Aroosa Khatoon, Bharti Sharma and Suffaiya Wani

Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura, Jammu and Kashmir 193201, India

**Email: saad_aa@rediffmail.com*

Kashmir is a fertile intermountain valley of temperate climate in the north western Himalayan range, a part of the union territory of Jammu and Kashmir. The temperate valley is characterized by sub-microthermic regime with marked winter and spring precipitation due to north-western disturbances. The mean winter temperature ranges from 7.3 to -1.9°C while those of summer from 29.5 to 10.6°C. The valley of Kashmir has considerable potential for wheat cultivation during *Rabi* season, however takes relatively a greater number of days for maturity from mid of October to mid of June. *Rabi* crops including wheat face huge competition with weeds from the second fortnight of February when the ambient temperature is becoming moderate. An experiment under AICRP on Weed Management was conducted for three years (2021-22, 2022-23 and 2023-24) on weed management in wheat through post-emergent herbicides and manual weeding. The objectives of experiment were to evaluate influence of the herbicides and manual weeding on crop growth and weed control performance. Each unit plot of experiment had dimension of 3.0 m × 5.0 m on which wheat was sown in line with row spacing of 20 cm. The crop was raised following standard package of practice of the university. The experiment was conducted in completely randomised block design with seven treatments each replicated thrice. Out of seven, three treatments were comprised of post-emergence application of clodinafop-propargyl 15% WP (60 g/ha) at 140 DAS during the first week of March followed by *(fb)* either manual weeding, 2,4-D-ethyl ester 38% EC (500 g/ha) or metsulfuron-methyl 20% WP (4 g/ha) each at 160 DAS during the last week of March. Two treatments viz., sulfosulfuron 75% WG (25 g/ha) and isoproturon 75% WP (750 g/ha) were included and applied also at 140 DAS. To know the performance of weed control, two more treatments *i.e.* weed free and weedy check were also included. Pre-emergence application of pendimethalin 30% EC (1000 g/ha) was applied at 2 DAS in all except weed free and weedy check plots. Major weeds during the crop period were *Lolium perenne* and *Ranunculus arvensis* during spring season, while *Cirsium arvense, Convolvulus arvensis* and *Matricaria* sp. during mid-spring season. In some plots, Rumex sp. was also observed in mid-spring season. Significantly less weed dry matter was computed at 200 DAS with clodinafop-propargyl 15% WP (60 g/ha at 140 DAS) *fb* metsulfuron-methyl 20% WP (4 g/ha at 160 DAS) and sulfosulfuron 75% WG (25 g/ha at 140 DAS) which were at par to weed free treatment. These herbicidal treatments were accounted with weed control index (WCI) of 68 – 84% and 64–79%, respectively over a period of three years of experiment. Dry matter accumulation and grain yield of wheat was significantly higher with clodinafop-propargyl 15% WP (60 g/ha at 140 DAS) *fb* metsulfuron-methyl 20% WP (4 g/ha at 160 DAS) which was at par to weed free treatment. With yield loss of 7.50% in comparison to weedy check of 70%, it can be concluded that clodinafop-propargyl 15% WP (60 g/ha at 140 DAS) *fb* metsulfuron-methyl 20% WP (4 g/ha at 160 DAS) can be used for effective management of weeds in wheat for temperate Kashmir region.

Management of itch grass (*Rottboellia cochinchinensis*) in maize

M.B. Patil* and M.M. Lekhana
College of Agriculture, University of Agricultural Sciences, Dharwad, Vijayapura, Karnataka 580005, india
**Email: patilmb10399@uasd.in*

A field experiment was conducted to study the management of itch grass in maize through herbicides at RARS, Vijayapura, during *Kharif*-2023. The experiment was laid out in randomized complete block design with three replications. The study involved using of different combination of pre emergence (PE) and post-emergence (PoE) herbicides. Treatments were, *viz*. PE application of pyroxasulfone 85% WG at 150 g/ha (T1), PoE application of mesotrione 2.27% w/w + atrazine 22.7% w/w SC at 3.5 L/ha ready-mix (RM) (T2), PoE application of topramezone 10 g/L + atrazine 300 g/L SC at 3.0 L/ha RM (T3), PoE application of tembotrione 34.4% w/w SC at 287.5 g/ha + atrazine 50% WP at 625 g/ha (tank-mix) (T4), PE application of pyroxasulfone 85% WG at 150 g/ha followed by *(fb)* PoE application of mesotrione 2.27% w/w + atrazine 22.7% w/w SC at 3.5 L/ha RM (T5), PE application of pyroxasulfone 85% WG at 150 g/ha *fb* PoE application of topramezone 10 g/L + atrazine 300 g/L SC at 3.0 L/ha RM (T6), PE application of pyroxasulfone 85% WG at 150 g/ha *fb* PoE application of tembotrione 34.4% w/w SC at 287.5 g/ha + atrazine 50% WP at 625 g/ha (tank mix) (T7), pre-emergence application of pendimethalin 30% EC at 3.3 L/ha *fb* PoE application of 2,4-D Na salt 80% WP at 2.5 kg/ha at 23 DAS (T8) and PE application of atrazine 50% WP 1.5 kg/ha *fb* inter cultivation (T9) were tested along with weedy check (T9) and weed free (T10). In the treatments from T2 to T7, PoE applications were done on 2-3 leaf stage of weeds. Among the herbicidal treatments, PE application of pendimethalin 30% EC at 3.3 L/ha *fb* PoE application 2,4-D Na salt 80% WP at 2.5 kg/ha at 23 DAS recorded significantly higher itch grass control efficiency at 15,30,45 and 60 days after herbicide application (92.7, 84.3, 82.2 and 76.6%, respectively), lower weed index (2.68), higher maize yield (6,712 kg/ha), net returns (Rs. 85,722/ha) and B:C (2.57). Further, it was statistically on par with PoE application of topramezone 10 g/L + atrazine 300 /L SC at 3.0 L/ha RM (T3) and PE application of pyroxasulfone 85% WG at 150 g/ha *fb* PoE application of topramezone 10 g/L + atrazine 300 g l-1 SC at 3.0 L/ha RM (T6).

Weed control efficacy of topramezone 33.6% SC against complex weed flora of maize

S.B. Yogananda*, P.S. Fathima, P. Thimmegowda, G.K. Shruthi and C.R. Aishwarya

Department of Agronomy, College of Agriculture, V. C. Farm, Mandya, Karnataka 571 405, India

University of Agricultural Sciences, Bangalore, Karnataka 560 065, India

**Email: sbyogananda@gmail.com*

Maize (*Zea mays* L.) is one of the most important cereal crops globally, serving as a staple food, animal feed and raw material for various industries. It ranks third most vital cereal crop in India. Maize is also called 'Queen of cereals or Miracle crop' due to its wider adaptability to diverse agro-climatic conditions and higher productivity potential. Its high yield potential is significantly affected by competition from weeds, which can reduce crop productivity by up to 50% if not managed effectively. Weed management in maize is crucial for optimizing growth and enhancing economic viability. Effective strategies include cultural practices, mechanical control and the application of herbicides. Among these, chemical control is often favoured for its efficacy and effectiveness, particularly in addressing complex weed floras that can vary widely in species and resistance profile. The integration of herbicides in weed management system not only enhance maize growth but also contributes to sustainable agricultural practices when applied judiciously. A field experiment was conducted during *Kharif* season of 2020 and 2021 at the College of Agriculture, V. C. Farm, Mandya to evaluate the weed control efficacy of topramezone 33.6% SC against complex weed flora of maize. The soil of the experimental plot was red sandy loam having soil pH of 7.55, Organic Matter content of 0.43%, medium in available nitrogen (285.5 kg/ha), available phosphorus (37 kg/ha) and potassium (153 kg/ha). The treatments consisted of direct application of post-emergence herbicide, *viz*. topramezone 33.6% SC 50, 75 and 100 mL/ha, atrazine 50% WP 1000 g/ha, diuron 80% WP 1000 g/ha and pendimethalin 30% EC 1000 mL/ha. These treatments were compared with weedy check and two hand weeding (at 20 and 40 DAS) checks. These treatments were replicated thrice in randomized complete block design. The major weed flora observed was *Echinochloa colona, Digitaria sanguinalis, Cynodon dactylon* and others among the grasses; *Trianthema portulacastrum, Amaranthus viridis, Portulaca oleraceae, Parthenium hysterophorus, Phyllanthus niruri, Commelina benghalensis* and others among the broad-leaved weeds and *Cyperus rotundus* among the sedges. The data revealed that post-emergence application of topramezone 33.6% SC 100 mL/ha recorded significantly lower total weed population and total dry weight of weeds and higher weed control efficiency (95.21% and 92.53%, respectively) at 30 and 40 days after spraying. As a result of effective weed control, the same treatment recorded significantly higher kernel yield (7.89 t/ha) as that of hand weeding twice at 20 and 40 DAS (8.03 t/ha) with a weed index of 1.70. Uncontrolled weed growth throughout the cropping season reduced the kernel to an extent of 50%. It was concluded that post-emergent application of topramezone 33.6% SC 100 mL/ha is found to be economically viable and profitable to control the weeds in maize.

Integrated weed management in cotton-based intercropping system

P. Saravanane*, R. Vimalraj, S. Nadaradjan and R. Mohan
Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal, Puducherry 609603, India
**Email: psaravanane@pajancoa.ac.in*

Cotton is an important cash crop, widely spaced and relatively slow growing during its early stages of growth and development. It is very sensitive to weed menace and early weed competition is result in drastic yield reduction. Weeds compete with crops for moisture and nutrients and can harbor insects and diseases, reducing yields by 30-90% depending on the level of weed infestation. While manual weed management is labour-intensive and costly, intercropping offers an effective alternative. By growing compatible crops alongside cotton, intercropping naturally suppresses weed growth, reducing the weed population and providing additional income for farmers through the harvest of intercrops. Selective herbicides are available for weed management in cotton as sole crop but studies under intercropping are very meagre. Hence, it is necessary to find out the best weed management practice for efficient weed management for intercropped cotton. Field experiments were conducted during two consecutive years (2022-24) to study the effect of integrated weed management practices in cotton based intercropping system at Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA and RI), Karaikal, Puducherry UT. The experiment was laid out in a split plot design with three replications. Four intercropping systems, *viz*. sole cotton, cotton + sesame, cotton + greengram and cotton + dhaincha were included in the main plot. The subplot consisted of weed management practices, *viz*. pendimethalin 38.7 CS 640 g/ha (PE), pendimethalin 38.7 CS 640 g/ha *fb* quizalofop-ethyl 10 EC 45 g/ha (PoE, 25 DAS), hand weeding at 30 and 60 DAS and control were included in the sub plot. Results of the filed experiments indicated that cotton intercropped with either greengram or sesame significantly restricted grasses and total weeds compared to sole cotton. Among the weed management treatments, herbicidal management significantly reduced the grasses and total weed density compared to unweeded control. Intercropping system and weed management showed significant effect in terms of seed cotton yield. Among the intercropping system, cotton intercropped with either greengram or sesame recorded higher seed cotton yield during both year of study. Among the weed management, herbicidal management significantly recorded higher seed cotton yield compared to unweeded control. Field study revealed that cotton + green gram intercropping system or sole cotton with herbicidal management of weeds (pendimethalin 38.7 CS 640 g/ha (PE) *fb* quizalofop-ethyl 10 EC 45 g/ha (PoE, 25 DAS) resulted in higher seed cotton yield in coastal deltaic region of Karaikal, Puducherry UT.

Compatibility of herbicides tank mixed with nano urea in wheat and impact on wheat and weeds

Amarjeet Nibhoria*, Jitender Kumar, Dharam Bir Yadav, Satyajeet and Mehak Nagora
Chaudhary Charan Singh Haryana Agricultural University, Regional Research Station, Bawal, Rewari, Haryana 123501, India
**Email: amarnibhoria@gmail.com*

Wheat is one of major cereal crop of the world. As per FAO estimates, with 13.3% of total wheat production across the world (219.15 mt in 2022), India is the largest producer of wheat. Weeds are major challenge for sustaining wheat productivity. Uncontrolled weeds may reduce wheat yield upto 50% and in very severe cases may lead to complete failure as well. The effectiveness of weed management program depend not only of species and density of weeds, but also depends upon various factors like time of emergence of weeds as well as crop, competitive ability of variety, time of weed management *etc*. Among various methods of weed management, chemical method is relatively efficient, cheap and time saving. Nutrient management is another important factor affecting wheat productivity. Among various nutrients, nitrogen is most important. nutrient. Recently, nano urea has been tested by many researchers for its efficacy in wheat and other crops to improve crop yields. Its efficacy is more than prilled urea because of its small size and larger surface area, with more nutrient mobilization in plants. As the time of spray of nano urea and herbicides is almost same, hence the present study was conducted to explore compatibility of herbicides with nano urea and its impact on crop and weeds so as to spray in one go. The experiment was conducted at CCSHAU Regional Research Station, Bawal (Rewari)- India during *Rabi* (winter) season of 2023-24. The experimental treatments consisted of two nano urea levels, viz. control (no spray of nano urea) and spray of nano urea 0.4% over RDF and seven weed control treatment including metsulfuron 4 g/ha, carfentrazone 20 g/ha, 2, 4-D salt 500 g/ha, clodinafop 160 g/ha, sulfosulfuron 25 g/ha, weedy check and weed free, replicated thrice in factorial randomized block design. Wheat variety HD 2967 was gown with seed rate of 100 kg/ha. The spray of herbicides + nano urea was done at 30-35 DAS in a spray volume of 312.5 L/ha. The major weeds flora consisted of mainly broad-leaf weeds, *viz. Chenopodium album, Corronopus didymus, Fumaria parviflora, Rumex* spp., *Anagallis arvensis* and grassy weed *Phalaris minor.* The superimposition of nano urea over RDF tank mixed with herbicides caused 5% non-significant increase in wheat yield over RDF. No phyto-toxicity was observed on crop with any one of the treatments. Among weed control treatments, carfentrazone 20 g/ha was most effective with maximum yield (5457 kg/ha: 30% more than weedy check). All broad-leaf herbicides produced statistically similar grain yield. Since weed flora was dominated by broadleaf weeds, the grain yield under treatment with clodinafop 160 g/ha was significantly lower than treatments with broadleaf herbicides. The weed control efficiency was also maximum (77%) under carfentrazone 20 g/ha treatment followed by metsulfuron (4 g/ha). The minimum weed control efficiency was observed in treatment under clodinafop 160 g/ha.

Early post-emergence herbicides effect on weeds, yield and economic of Bt cotton

J.K. Singh*, Sanskruti Nayak, Mrinal Sen, M.K. Singh and Swapnashree Sahoo

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: jksinghbhu3@gmail.com*

A field trial was conducted at the Banaras Hindu University, Varanasi, in the rainy (*Kharif*) season to study the bio-efficacy of various early post-emergence herbicides against weeds in cotton. The trial consisted of eleven treatments (including a treatment for phytotoxicity studies), replicated thrice, and laid out in a randomized block design. The different treatments that were incurred in this study were pyrithiobac-sodium 7.5%+ haloxyfop-r-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 650, 825, 1000 mL/ha EPoE, pyrithiobac-sodium 10% EC at 750 mL/ ha EPoE, haloxyfop-R-methyl 10.5%w/w EC at 1250 mL/ ha EPoE, fenoxaprop-p-ethyl 9.3% EC at 750 mL/ ha EPoE, propaquizafop 10% EC at 625 mL/ ha EPoE, hand weeding at 30 and 60 days after sowing (DAS), weed-free and control (water spray). The most predominant weeds found in the experimental field were *Cyperus rotundus, Cynodon dactylon, Echinochloa colonum, Parthenium hysterophorus, Trianthema portulacastrum and Phyllanthus niruri*. The spraying of pyrithiobac-sodium 7.5% + haloxyfop-R-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ ha in early post-emergence resulted in the lowest total weed density and dry matter. The highest weed control efficiency, herbicide efficiency index, agronomic management index and lowest weed index and weed persistence index were also recorded in this treatment. After weed free treatment, pyrithiobac-sodium 7.5% + haloxyfop-R-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ha (EPoE) recorded higher value of growth parameters like plant height, number of sympodial branches/plant etc. While, the number of monopodial branches/plant did not vary significantly across the treatments. The yield attributes such as the number of green bolls/plant at various growth stages and the total number of picked bolls/ plant resulted in higher value for treatment involving pyrithiobac-sodium 7.5% + haloxyfop-r-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ ha. Among the different quality parameters, lint index and seed index did not give significant result, while the ginning percentage was significantly higher for pyrithiobac-sodium 7.5% + haloxyfop-R-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ ha as EPoE. The seed cotton yield, stalk yield, biological yield and harvest index were the highest for pyrithiobac-sodium 7.5% + haloxyfop-r-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC 1000 mL/ ha (EPoE). The available nutrient content in soil and nutrient uptake by the plant were also higher in this treatment than others. The highest gross return was obtained in weed free treatment, but EPoE application of pyrithiobac-sodium 7.5% + haloxyfop-r-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ ha in cotton achieved the highest net return and B-C ratio. Thus, it is concluded that EPoE application of pyrithiobac-sodium 7.5% + haloxyfop-R-methyl 13.5% + fenoxaprop-p-ethyl 1% MEC at 1000 mL/ ha can be recommended as an effective weed management strategy for higher productivity and profit in Bt cotton.

Weed management in cotton using new ready-mixed and tank-mix herbicides to enhance productivity, profitability, and fibre quality

Rishi Raj*, T.K. Das and S.S. Rathore
Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India
**Email: rishirajiari@gmail.com*

Cotton is one of India's most important commercial crops and accounts for around 23% of the total global cotton production. It plays a major role in sustaining the livelihood of 6 million cotton farmers and 40-50 million people engaged in related activities such as cotton processing and trade. India stands first in the world in cotton acreage with 13.06 million hectares, which is around 40% of the total world area of 32.4 million hectares. Regarding productivity, India is in the 39th rank with a yield of 447 kg/ha. The low productivity of cotton in India is attributed to constraints, such as improper agronomic management (insufficient use of fertilizers, incorrect irrigation practices, inefficiency in sowing and harvesting), poor soil health, inadequate irrigation facilities, climatic factors (temperature, rainfall variations, and droughts) and attack of insect, diseases, and weeds. Cotton fields are prone to a wide variety of weed species, such as grasses, broad-leaved, and sedge weeds. Weeds compete with cotton plants for essential resources such as water, nutrients, sunlight, and space (Das 2008). This competition is particularly severe during the early growth stages of cotton, as weeds can grow faster and cover the crop, reducing its vigor and yield. Uncontrolled weeds can lead to significant yield loss. In extreme cases, poor weed management can cause up to 90% yield loss in cotton (Manalil *et al.* 2017). Different weeds may require different management strategies, making weed control complex and region-specific. The increasing development of herbicide-resistant weed species has made weed management more challenging. Growers need integrated weed management strategies to deal with this growing issue. As cotton is grown in diverse environments, weed management strategies vary depending on local conditions, regulations, and environmental concerns. Therefore, an experiment on weed management in cotton was carried out at ICAR-Indian Agricultural Research Institute, New Delhi, to evaluate the effect of low dose high potency herbicides on weed control, productivity, profitability, and fiber quality of cotton. Weed management treatments comprised of pendimethalin at 1000 g/ha as pre-emergence (PE), pendimethalin at 1000 g/ha (PE) *fb* pyrithiobac-Na at 62.5 g/ha as post-emergence (PoE), pendimethalin at 1000 g/ha (PE) *fb* quizalofop-ethyl at 50 g/ha (PoE), pendimethalin at 1000 g/ha (PE) *fb* tank mixed pyrithiobac-Na + quizalofop-ethyl (62.5+50.0 g/ha) (PoE), pendimethalin at 1000 g/ha (PE) *fb* tank mixed pyrithiobac-Na + quizalofop-ethyl (46.8+37.5 g/ha) (PoE), pendimethalin at 1000 g/ha (PE) *fb* ready mixed Hitweed Max at 112.5 g/ha (pyrithiobac-Na 6%+ quizalofop-ethyl 4%) (PoE), pendimethalin at 1000 g/ha (PE) *fb* ready mixed Hitweed Max at 84.3 g/ha (pyrithiobac-Na 6%+ quizalofop-ethyl 4%) (PoE), pendimethalin (PE) *fb* one hand weeding (HW) at 40 days after sowing (DAS) and these were compared with un-weeded control (UWC) and weed-free control (WFC) under randomized block design with three replications. Results of the experiment demonstrated that sequential application of pendimethalin 1000g/ha (PE) *fb* tank mixed pyrithiobac-Na + quizalofop-ethyl (62.5+50 g/ha) (PoE) observed significantly lower dry weight of grassy, BLWs, sedges and total weeds and resulted in 86.7% weed control index than other treatments except WFC. The cotton yield was significantly higher in pendimethalin (PE) *fb* tank mixed pyrithiobac-Na + quizalofop (PoE) over other herbicide treatments and remained similar with WFC and pendimethalin (PE) *fb* 1 HW treatment. This treatment resulted in 86% higher cotton yield than UWC. Cotton fibre quality parameters (fiber length, fiber uniformity, fiber strength, and fibre fineness) were also significantly improved with the pendimethalin 1000g/ha (PE) *fb* tank mixed pyrithiobac-Na + quizalofop-ethyl (62.5+50 g/ha) (PoE) and WFC treatment rest of treatments.

Oral lecture 74

Eco-friendly weed management in maize through legume intercropping in the hilly terrain of Eastern Himalayas

Jeetendra Kumar Soni*[1,2], Lungmuana[1], I. Shakuntala[3] and S. Doley[1]

[1]*ICAR-RC NEH Region, Mizoram Centre, Kolasib, Mizoram 796081, India*

[2]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[3]*College of Veterinary Sciences and Animal Husbandry, Jalukie, Nagaland 797110, India*

**Email: jeetendra.soni@icar.gov.in*

The hilly terrain of the Eastern Himalayas, including states like Mizoram, is characterized by undulating topography with rich biodiversity, and unique ecosystems that define the region's distinct landscape. In Mizoram, 96.9% of the land is hilly, with agriculture primarily practiced on sloping terrain, where jhum (shifting cultivation) remains a predominant method. Agriculture is the main occupation for the Mizo people, with maize as the leading cereal crop, while cowpea, french bean, rice bean, and groundnut are the primary legumes contributing to Mizoram's food grain production, supporting livelihoods and food security. However, agricultural productivity in the state is considerably lower than in other regions, likely due to factors such as severe weed infestations, poor agronomic practices, limited mechanization options, and minimal use of herbicides for weed control. To address this issue, an experiment was conducted from *Kharif* 2020 to 2022 at the ICAR Farm, Kolasib, under RBD design with ten treatments. The treatments included maize as the main crop intercropped with four legumes (cowpea, groundnut, french bean, and rice bean), either sown simultaneously or 20 days later as relay intercropping, in a 2:2 paired row cropping system (45/75 cm spacing) with one hand weeding (HW) at 20 days after sowing (DAS). For comparison, the control treatments were sole maize with HW at 20, 40, and 75 DAS, and maize without weeding. The findings suggest that intercropping legumes with maize in a 2:2 paired row system resulted in 44.8-70.2% weed smothering efficiency at 60 DAS and 35.4-87.9% at 90 DAS. The highest WSE was observed with rice bean, which was on par with groundnut. For effective weed management and improved yield and system productivity, simultaneously sowing maize with groundnut in a 2:2 paired row system (45/75) along with hand weeding (HW) at 20 DAS proved to be the best option. This treatment achieved a 276% higher grain yield than weedy check, and only 7.8% lower than sole maize with HW at 20, 40, and 75 DAS (4167 kg/ha). Also, demonstrating superior system productivity compared to all other treatments. Additionally, intercropping legume with maize enhanced soil biological activity compared to sole maize cropping, indicating improved soil health in cereal-legume systems. Notably, maize intercropped with rice bean significantly increased urease activity (42.24 µg NH4"N/g/h), dehydrogenase activity (6.21 µg/g/h), and microbial biomass carbon (421.01 µg/g) compared to other maize+legume intercropping system. Therefore, based on the findings, it can be concluded that intercropping maize with groundnut, followed by other legumes, provides an eco-friendly and sustainable weed management strategy for low-input Jhum agriculture in the hilly terrain of the Eastern Himalayas. This approach also enhances system productivity and reduces the cost of two hand weeding.

Evaluation of performance of new herbicide molecules for enhanced productivity and weed management in maize under rainfed ecology of Madhya Pradesh

Gaurav Mahajan

AICRP on Maize, Zonal Agricultural Research Station, Jawaharlal Nehru Krishi Vishwavidyalaya, Chhindwara, Madhya Pradesh 480001, India

Email: aicrpagrorewa@gmail.com

Maize (*Zea mays* L.), among the food grain crops, is the most versatile crop with wider adaptability and highest genetic yield potential. Studies and surveys conducted from time to time has indicated that among major constraints for crop production, weed management is listed as one of the major problems in crop production systems. The losses caused by weeds exceed the losses from any other category of agricultural pests. The prevailing herbicides available in the market target only specific weed spectrum resulting in weed shift and increased menace due to weeds and lower crop yields. The present study was conducted to evaluate the new herbicide molecules for increasing production along with effective weed management in maize under rainfed ecology. A field experiment was conducted on weed management in maize with new generation herbicides during *Kharif* 2021 to 2022 consecutively at a fixed site at JNKVV, Zonal Agriculture Research Station, Chandangaon, Chhindwara. The experiment was laid out in randomised block design with three replications keeping with twelve treatments *viz*: weedy check, weed-free check, atrazine 500 g/ha *fb* hand weeding at 25-30 DAS, pyroxasulfone 127 g/ha *fb* hand weeding at 25-30 DAS, atrazine 500 g/ha *fb* halosulfuron-methyl 67 g/ha at 25-30 DAS, atrazine 500 g/ha *fb* tembotrione 120 g/ha at 25-30 DAS, atrazine 500 g/ha *fb* topramezone 25 g/ha at 25-30 DAS, atrazine 500 g/ha *fb* mesotrione + atrazine 300 g/ha at 25-30 DAS, pyroxasulfone 127 g/ha *fb* halosulfuron-methyl 67 g/ha at 25-30 DAS, pyroxasulfone 127 g/ha *fb* tembotrione 120 g/ha at 25-30 DAS, pyroxasulfone 127 g/ha *fb* topramezone 25 g/ha at 25-30 DAS, pyroxasulfone 127 g/ha *fb* mesotrione + atrazine 300 g/ha at 25-30 DAS. The crop was grown and managed with their recommended package of practices for the zone. Results of the study revealed that effective weed control and maximum yield was obtain with hand weeding or the treatments involving the integration of hand weeding and herbicide application. However, among the options of chemical weed control in maize, application of pyroxasulfone 127 g/ha *fb* mesotrione + atrazine 300 g/ha at 30 DAS resulted in higher yield and significantly minimum weed density, weed dry weight and weed index, being at par with, application of Atrazine 500 g/ha *fb* topramezone 25 g/ha at 30 DAS over rest of the treatments particularly including herbicide application. Application of herbicides in the form of pyroxasulfone 127 g/ha *fb* mesotrione + atrazine 300 g/ha at 25-30 DAS fetched the higher net returns (Rs. 97507/ha) as a result higher benefit cost ratio (2.1) as compared to other herbicides application. Better returns under treatment were due to higher yields and lower input cost as compared to treatments involving hand weeding.

Influence of integrated nutrient and weed management on yield and weed dynamics of zero till maize

K. Naganjali*, K.P. Vani and M. Madhavi
Professor Jayashankar Telangana State Agricultural University, Telangana 507301, India
**Email: naganjali_kesipeddy@yahoo.com*

A field experiment was conducted during *Rabi* season of 2016-17 and 2017-18 at College Farm, Agricultural College, Aswaraopet, Bhadradri Kothagudem District, Telangana to evaluate and suggest suitable nutrient and weed management practices for maize grown under zero till condition. Maize variety grown was '*DHM-117*'. The experiment was conducted in split plot design with three replications comprising three levels of nutrient management (M1 - 100% recommended dose of fertilizer (RDF), M2 - 75% RDF + 25% Nitrogen through vermicompost and M3 - 75% RDF + 25% Nitrogen through Farmyard Manure) were imposed to main plots and four levels of weed management practices to sub plots, *viz*. S1 - Control, S2 - atrazine 50% WP 500 g/ha + paraquat 24% SL 0.6 kg/ha *fb* 2,4-D 0.5 kg/ha at 25 DAS, S3 - atrazine 50% WP 500 g/ha *fb* (topramezone 0.03 kg/ha + atrazine 50% WP 500 g/ha) at 25 days after sowing (DAS) and S4 - topramezone 0.03 kg/ha + atrazine 50%WP 500 g/ha at 15 DAS *fb* intercultivation /hand weeding at 35 DAS (Farmer's Practice). The soil of experimental field was sandy clay loam in texture, low in organic carbon, available nitrogen and potassium and medium in available phosphorus with pH of 6.92. The pooled means of two-year results indicated that among nutrient management practices, density of diverse weeds (broad-leaved weeds, grasses and sedges) and weed dry matter recorded was found to be minimum and yield of zero till maize was maximum with 75% RDF + 25% Nitrogen through vermicompost. Regarding weed management treatments, tank mix application of topramezone 0.03 kg/ ha + atrazine 50% WP 500 g/ha at 15 DAS *fb* intercultivation/hand weeding at 35 DAS (Farmer's Practice) registered significantly lower density of broad-leaved weeds, grasses, sedges, total weed density, weed dry weight, weed index and higher yield while, higher weed density, weed dry matter and lowest yield was recorded with the control.

Oral lecture 77

Impact of herbicide mixture on weed flora, yield and quality of *Rabi* popcorn (*Zea mays* var. everta)

Partha Sarathi Patra* and Ayush Lal Das
Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal 736165, India
**Email: parthaagro@gmail.com*

Popcorn (*Zea mays* L. var. everta (Sturtev) L H. Bailey) is one of the major types of corn that is being grown throughout the world. The seeds of popcorn are slow in germination and they require much longer time than that of the normal corn for germination thereby increasing the chances of weed infestation in the crop. Proper management of weeds during the critical period of crop growth is very much essential for realizing the maximum crop yield. Hence, for better weed management and control the use of herbicides are becoming day by day popular in the country. Herbicides not only reduce the drudgery of farmers but also improve the weed control and reduce the cost of cultivation. Keeping the above fact in mind present experiment has been undertaken to study the impact of herbicide mixture on weed flora and yield of *Rabi* popcorn at the instructional farm of Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal during 2022. The experiment was fitted out in randomized block design, with eight treatments and replicated thrice. Treatment comprising of Twice hand weeding (20 and 40 DAS); atrazine 1.5 kg/ha *fb* tembotrione 100 g/ha; metribuzin 1.0 kg *fb* tembotrione 100 g/ha; atrazine 1.5 kg/ha *fb* halosulfuron-methyl 67.5 g/ha; metribuzin 1.0 kg a.i. *fb* halosulfuron-methyl 67.5 g/ha; atrazine 1.5 kg a.i. *fb* 2,4-D-sodium salt 0.75 kg/ha and Metribuzin 1.0 kg a.i. *fb* 2, 4-D-sodium salt 0.75 kg/ha and unwedded control. Findings of the present investigation clearly indicated that herbicidal treatment metribuzin followed by tembotrione recorded tallest plant, produced maximum number of active leaves, larger leaf area, better chlorophyll index and dry matter over other weed management options. The entire yield attributing parameter namely cob length (16.20 cm), cob girth (11.62 cm), number of kernel rows cob-1(16.67) and number of kernels/row (35.50) were found maximum whenever tembotrione was applied followed by metribuzin that eventually helped in producing 4.35 and 80.82% higher grain yield over twice hand weeded and unweeded plots. Rest of the weed managements were found inferior as compared to twice hand weeded plot. With respect of quality, metribuzin *fb* tembotrione attained higher flake size (2.61 mL), expansion volume (19.48 cm3 g1) and protein (10.25%) while twice hand weeded plot recorded higher popping value (95%), carbohydrate (65.80%) and amylose (21.98%) though it was statistically equal with herbicidal treatment metribuzin + tembotrione. Considerable reduction in weed dry weight was recorded under twice hand weeded plot and recorded significant lowest value of 1.73 and 10.78 g m^2 at 30 and 45 days after sowing respectively which resulted into better weed control efficiency and afterwards herbicidal treatment metribuzin *fb* tembotrione found most efficient in reduction of weed dry matter (24.93, 34.80 and 57.07 g/m^2 at 60, 75 and 90 DAS respectively) and improving weed control efficiency. From the economic point of view, highest net return to the tune of Rs. 248375.87/ha as well as higher B: C ratio of 3.63 was realized under herbicidal treatment metribuzin + tembotrione. Hence farmers of North Bengal could introduce popcorn during *Rabi* season as a remunerative crop with metribuzin and tembotrione combination as weed combating chemical.

Efficacy of mesotrione on weed management, growth and yield of summer maize

Mahua Banerjee*, Harapriya Behera and G.C. Malik
Dept. of Agronomy, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal 731204, India
**Email: mahua.banerjee@visva-bharati.ac.in*

A field experiment was conducted during summer season of 2022 in Agricultural Farm, Palli Siksha Bhavana (Institute of Agriculture) at Visva-Bharati, Sriniketan, India which lies in the sub-humid sub-tropical lateritic belt of West Bengal with maize variety "*Bioseed 9780*" to study the efficacy of mesotrione on summer maize (*Zea mays* L.) The experiment, consisted of ten treatments (mesotrione 10% SC 75 g/ha, mesotrione 10% SC 100 g/ha, mesotrione 10% SC 125 g/ha, mesotrione 10% SC 150 g/ha mesotrione 10% SC 250 g/ha, tembotrione 34.4% SC 120 g/ha, atrazine 50% WP 1000 g/ha, hand weeding at 15, 30 and 45 DAS, mechanical weeding at 20 DAS *fb* hand weeding at 45 DAS and weedy check) which was laid out in randomized block design with three replications. From the experimental findings, it was revealed that the problematic weeds of the experimental plot were *Digitaria sanguinalis, Cynodon dactylon, Eleusine indica, Echinochloa colonum, Cyperus iria, Alternanthera sessilis, Polygonum plebium etc*. The experimental results clearly indicated the need of different weed management practices to reduce the influence of weeds in summer maize cultivation. The results showed that the application of mesotrione 10% SC 250 g/ha, mesotrione 10% SC 150 g/ha and Atrazine 50% WP 1000 g/ha, improved growth attributes, yield components and productivity of summer maize. Lower values of weed density, weed dry weight and weed index, higher values of weed control efficiency was observed in mesotrione 10% SC 250 g/ha. The aforesaid treatments and hand weeding at 15, 30 and 45 DAS efficiently controlled the weeds. Mesotrione 10% SC 250 g/ha provided higher net returns with highest return per rupee invested which was statistically at par with mesotrione 10% SC 150 g/ha and atrazine 50% WP 1000 g/ha. The weed index data revealed that weed infestation caused about 57.44% yield reduction in maize. The study therefore indicated that the use of mesotrione10% SC 150g/ha may be effective for better growth, higher productivity and greater profitability of summer maize. There were no phytotoxicity symptoms due to the application of the herbicides on the growth of summer maize.

Oral lecture 79

Optimizing weed management and herbicide efficacy in wheat: Influence of rice residue mulch and herbicide application methods in zero-tillage systems

Charul Chaudhary*[1], Dharam Bir Yadav[2], Ankur Chaudhary[3] and RS Chhokar[4]
ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana 132001, India
**Email: ccsagwal@gmail.com*

Rice-wheat is the country's major cropping system and occupies 10.6 million hectare, spreading over the Indo-Gangetic Plains. The two north-western states of Haryana and Punjab account for about 3 million hectare of rice-wheat cropping land and about 35 per cent of India's wheat production. The presence of weeds is reducing the grain yield and quality of wheat. Sole reliance on herbicides has given rise to herbicide resistance in wheat weeds in India and new resistant species are being confirmed every few seasons. There is a need to formulate the conditions for higher efficacy of pre-emergence herbicides in surface retained residue scenarios by modifying spray volume, spray nozzles and time of herbicide application. The present investigation was carried out at the Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Regional Research Station, Uchani, Karnal, during the seasons of 2019-20 and 2020-21. The experiment aimed to evaluate the effectiveness of chopped rice residue mulch (6 tonnes/ ha) in conjunction with fourteen different weed control treatments in wheat. The treatments included the application of a pre-emergence herbicide (pendimethalin 1500 g/ha), as well as a sequential application of pre-emergence followed by post-emergence herbicide (pendimethalin 1500 g/ha followed by pinoxaden 50 grams/ha). A weedy check and a weed-free plot were also included for comparison. The trial was conducted in a randomized block design (RBD) with three replications to ensure the reliability of the results. Pre-emergence herbicides were applied on the surface of rice (*Oryza sativa* L.) residues using two different water volumes (500 and 1000 liters/ha) and three types of nozzles: flat-fan, flood-jet, and air-injection. The chopped rice residue mulch (6 tonnes/ha) effectively suppressed most of the weed species under study. However, the degree of suppression varied among different weeds. Higher suppression rates were observed for species such as *Coronopus didymus*, *Chenopodium album*, *Anagallis arvensis*, *Rumex dentatus* and *Phalaris minor*, while weeds like *Melilotus alba*, *Medicago denticulata, and Lathyrus aphaca* were less affected. In wheat sown using a turbo happy seeder (Zero tillage + rice residue), the application of pendimethalin followed by pinoxaden onto the mulch, especially when applied as a pre-emergence treatment with a higher water volume (1000 litres/ha), improved herbicide penetration through the mulch layer. This method provided satisfactory weed control, achieving 85-90 per cent efficiency, and resulted in grain yields comparable to those in weed-free plots. Also, a single pre-emergence application is not sufficient to control all weed cohorts and to evade post-emergence application is necessary. Therefore, pre-emergence herbicides need a mixing partner for improved and broad-spectrum control of weeds. The study demonstrated the potential of proactively integrating pre-emergence herbicides with non-chemical tools like residue mulching to manage herbicide-resistant weeds. The findings also highlight the possibility of reducing herbicide use in wheat cultivation while maintaining effective weed control. This approach could contribute to more sustainable weed management practices by minimizing chemical inputs and enhancing the efficacy of existing herbicide treatments.

Supplemental effects of chemical weed management in straw-mulched rainfed maize under drought-prone central plains of India

Diyan Mandal*, Probir Kumar Ghosh, Anil Dixit, Tapas Kumar Das and Prithwiraj Dey

Indian Agricultural Research Institute, New Delhi 110012, India

**Email: diyanmandal25@gmail.com*

Impact of climate change has been evident in India in recent years through increasing variability of rainfall, late onset and early withdrawal of monsoon with its erratic distribution. Particularly the central part of India has been observed to shift from moist subhumid to dry subhumid condition which is now threatening the livelihood of farmers with predicted decline in rice productivity with increasing drought periods. Switching the *Kharif* season crop from high water requiring monsoon dependent rice to maize could be a viable solution, as maize requires less water. Additionally, application of mulch helps to conserve soil moisture and can be utilized by the crop for its growth. Mulch also physically suppresses weeds which are a menace in cultivation of maize in *Kharif* season. Use of new generation herbicides with it can increase the extent of weed control. A field experiment aimed to harness the beneficial effect of paddy straw mulch along with supplemental chemical weed control options in maize for better crop performance and weed management was laid out in the agricultural research farm of ICAR-National Institute of Biotic Stress Management, Baronda, Raipur, Chhattisgarh, India during *Kharif* season 2022 in split plot design with three paddy straw mulch (PSM) levels viz. 8 t/ha, 5 t/ha and no mulch in the main plots and five weed management treatments *viz*. atrazine 1 kg/ha, atrazine 1 kg/ha *fb* tembotrione 120 g/ha, atrazine 1 kg/ha *fb* topramezone 30 g/ha, weed free and weedy check in the subplots, each replicated thrice. The results showed that application of paddy straw mulch lower the weed density and dry matter significantly at different stages of maize. 8 t/ha and 5 t/ha PSM treatment recorded 22.6% and 15.3% increase in grain yield over no mulch, respectively which can be explained by the smothering effect of mulch on weeds, better moisture conservation, moderated soil temperature which resulted in higher weed control and increased growth due to better use of natural resources by the crop. Positive correlation was found among the grain yield of maize, weed dry matter (R^2= 0.995) and weed density (R^2= 0.966) at harvest. The chemical weed control options showed statistically lower weed density and dry matter accumulated by weeds which alone explained 98.4% and 84.1% variation in grain yield. Growth parameters, yield attributing characters were found to be superior in atrazine 1 kg/ha *fb* tembotrione 120 g/ha resulting in higher grain yield (5.69 t/ha) followed by atrazine 1 kg/ha *fb* topramezone 30 g/ha (5.44 t/ha). It also recorded significantly lower weed density, weed dry matter and higher weed control efficiency as compared to other treatments possibly due to its enhanced efficacy resulted by application of herbicides having broad spectrum activity with different modes of action. Increase in yield was 52.5% over control with higher net monetary return, net benefit cost ratio (1.97) and net energy return. The experiment showed that a combination of paddy straw mulch of 8 t/ha and application of atrazine 1 kg/ha *fb* tembotrione 120 g/ha can be recommended for better weed control, moisture conservation and grain yield which can fetch better financial returns to sustain livelihood of farmers of central plains under the emerging threats of climate change.

Oral lecture 81

Impact of pendimethalin on germination, growth, and productivity of summer pearl millet

Vinod B. Mor*, Abhishek Inaniya and D.D. Chaudhari
College of Agriculture, Anand Agricultural University, Jabugam, Gujarat 391155, India
**Email: vinodagron18@aau.in*

The field experiment with the objectives of to evaluate the effect of different herbicides on weeds and growth, yield attributes and yield of summer pearl millet was conducted during the summer season of the year 2022-23 at the Agronomy Farm, B. A. College of Agriculture, AAU, Anand. The experiment employed on a RBD with three replications and ten treatments *viz.* atrazine 50% WP 500 g/ha PE, atrazine 50% WP 750 g/ha PE, pendimethalin 30% EC 500 g/ha PE, atrazine 50% WP 500 g/ha + pendimethalin 30% EC 250 g/ha (tank mix) PE, atrazine 50% WP 500 g/ha EPoE, tembotrione 42% SC 84 g/ha EPoE, tembotrione 42% SC 84 g/ha + atrazine 50% WP 500 g/ha (tank mix) EPoE, 2-4,D-sodium salt 80% WP 400 g/ha PoE, IC *fb* HW at 15 and 30 DAS and weedy check (control). From the results, it was observed that pendimethalin treated plot *i.e.* treatment pendimethalin 30% EC 500 g/ha PE reported lower plant population, plant height at 30, 60 DAS and at harvest, and yields. Lower dose of pendimethalin atrazine 50% WP 500 g/ha + pendimethalin 30% EC 250 g/ha (tank mix) PE reduced the plant population but later it produced more tillers, resulted higher yield. From the results, it can be concluded that use of higher dose of pendimethalin 30% EC 500 g/ha as PE in summer pearl millet shown negative impact on germination, plant height as well as yield.

Oral lecture 82

Fertilizer and weed management in sugarcane

D.D. Patel*, M.J. Zinzala, T.U. Patel, H.H. Patel and A.D. Raj
College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat 392002, India
**Email: ddpatel@nau.in*

An experiment was conducted on heavy black soil having clay in texture, medium in available nitrogen (236 and 242 kg/ha) and phosphorus (23.68 and 21.84 kg/ha) and fairly rich in available potassium (433 and 413 kg/ha) and slightly alkaline in reaction (pH 7.9 and 8.1) at College Farm, Navsari Agricultural University, Navsari during the years of 2016-17 and 2017-18, respectively. Total eighteen treatment combinations consisting of three treatment of fertilizer levels [F1: 75% RDF (187.5-93.7-93.7 N:P:K kg/ha), F2: 100% RDF (250-125-125 N:P:K kg/ha), F3: 125% RDF (312.5-156.2-156.2 N:P:K kg/ha)]and six treatments of weed management [W1: weedy check, W2: three hand weedings at 30, 60 & 90 DAP + two IC at 45 and 90 DAP, W3: atrazine 2.0 kg/ha as a pre-emergence + one HW and IC at 60 DAP, W4: metribuzin 1.5 kg/ha as pre-emergence + one HW and IC at 60 DAP, W5: pendimethalin 1.0 kg/ha as pre emergence + Gram as an intercrop, W6: pendimethalin 1.0 kg/ha as pre-emergence + sunnhemp as an green manure crop harvested and mulched it at 50-60 DAP and incorporated at final earthing up] were evaluated in factorial randomized block design with three replications for sugarcane. All the growth characters viz., plant height, number of tillers, plant dry matter accumulation as well as yield attributes viz., millable cane length, number of internodes, single cane weight, millable canes per hectare, cane yield and cane equivalent yield were observed significantly higher and equally effective under treatment F3 (125% RDF) and it remained at par with treatment F2 (100% RDF). Leaf Area Index (LAI) at all the periodical stages was recorded highest under fertilizer levels F3 (125% RDF). All the quality parameters were not influenced by the different fertilizer levels during the study except commercial cane sugar yield was found maximum under the treatment F3 (125% RDF) which was found at par with treatment F2(100% RDF). Weed counts and dry weight of weed were not found significant during experimentation due to different fertilizer levels. Among different weed management treatments, treatment W2 (Three hand weedings at 30, 60 and 90 DAP + Two IC at 45 and 90 DAP) recorded significantly higher growth and yield attributing characters *viz*., number of tillers per meter row length, plant height, millable cane length, number of internodes per cane, number of millable canes per hectare and cane yield compared to weedy check during the period of experimentation. While sugarcane equivalent yield (120.3, 122.5 and 121.4 t/ha, respectively) was observed highest under the treatment W5 (pendimethalin 1.0 kg/ha as pre-emergence + gram as a intercrop). LAI (leaf area index) at all the periodical stages was observed significantly higher under. Significantly the lowest weed population (at 45 and 90 DAP) and dry weight (at 90 DAP (g/m^2) and at final earthing up (kg/ha)) were noted under W2. Looking to interaction effect, significantly higher cane yield (125.0 t/ha) was recorded under the treatment combination F3W2 which was statistically at par with F2W2, F3W6, F2W6 and F3W5. However, significantly higher sugarcane equivalent yield (135.1 t/ha) and net realization was recorded under the treatment combination F3W5 which was found at par with F2W5 and F3W2. From the two years of experimentation, it can be concluded that application of 100% RDF *i.e.*, 250:125:125 kg NPK/ha + pre-emergence application of Pendimethalin 1.0 kg/ha with gram as an intercrop was found beneficial for effective weed control with securing higher sugarcane yield and economic returns.

Assessment of pre-mix herbicides on weed dynamics, growth, and yield of barley in a guava based agri-horti system

Manoj Kumar Singh* and Arvind Kumar

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: manoj.agro@bhu.ac.in*

Uttar Pradesh leads India in barley cultivation, contributing 36.65% of the total area and 40.11% of total production. Weed infestation can cause up to a 35.1% reduction in barley yields if left uncontrolled. Traditionally, manual weeding was used, but rising labor costs and shortages have led farmers to adopt chemical weed control due to its ease, lower cost, and efficiency. Single herbicides typically target specific weed species, so for broad-spectrum control and to prevent herbicide resistance, sequential or tank-mixed herbicide applications targeting both grassy and broad-leaved weeds (BLWs) are recommended. To evaluate this approach, a replicated field study was conducted during the *Rabi* season of 2020-21 at the Agricultural Research Farm, Rajiv Gandhi South Campus, Banaras Hindu University, Mirzapur, Uttar Pradesh. The randomized complete block design experiment included three post-emergence pre-mix herbicides: clodinafop-propargyl 15% + metsulfuron-methyl 1% [CP+MM] (Vesta™) at 400 g/ha, sulfosulfuron 75% + metsulfuron-methyl 5% [SS+MM] (Total™) at 40 g/ha, and metribuzin 42% + clodinafop-propargyl 12% [MBZ+CP] (Shagun™) at 500 g/ha. These treatments were compared with two hand weeding treatments (2-HW at 30 and 45 DAS), a weed-free control, and a weedy control. Barley (variety HUB-113) was sown under a 10-year-old guava plantation (7 × 7 m spacing), in plots of 4.55 m × 4.50 m (20.47 m^2), at a row spacing of 22.5 cm, using a seed rate of 100 kg/ha on 31 October 2020, and harvested on 17 March 2021. The experimental soil was low in organic carbon and available nitrogen, but medium in phosphorus and potassium. Results revealed that the weed-free treatment had the lowest density and biomass of grasses, sedges, BLWs, and total weeds. It also recorded the highest values for weed management indices, including weed control efficiency (WCE), weed control index (WCI), weed management index (WMI), and crop resistance index (CRI). Nutrient uptake (N, P, K) by weeds was minimized, while crop growth parameters such as plant height, dry matter accumulation (DMA), tiller count, crop growth rate (CGR), and yield attributes (effective tillers, spike length, grain count, and 1000-seed weight) were maximized. The 2-HW treatment followed this trend after 60 DAS. Among the herbicides, CP+MM (400 g/ha) demonstrated the highest values for plant height at 60 DAS, DMA, tiller count at 90 DAS and at harvest, CGR (30-60 DAS), relative growth rate (RGR, 60-90 DAS), and yield attributes, including spike length, grain count, and 1000-seed weight. Yields of grain, straw, biological yield, and harvest index were also highest in CP+MM, comparable to SS + MM (40 g/ha). Moreover, at 90 DAS and at harvest, CP+MM continued to show the lowest weed density and biomass among BLWs and total weeds. Weed management indices, including WCE, WCI, WMI, and CRI, were highest under CP + MM, followed by SS + MM and MBZ + CP. Furthermore, economic analysis revealed that CP+MM (400 g/ha) achieved the highest net returns and benefit-cost ratio, followed by SS+MM, MBZ+CP, weedy, 2-HW, and weed-free treatments. While the weed-free and 2-HW treatments were the most effective for weed control and crop growth, they were less cost-effective compared to the herbicide mixtures. Based on the data, it was concluded that the pre-mix application of CP+MM (400 g/ha) provided a balance of effective weed control, reasonable yield, and favorable economic returns, making it a viable option for managing weeds in barley cultivation under a guava-based agri-horti system.

Oral lecture 84

Effect of weed management practices on pearl millet productivity and weed dynamics under semi-arid condition of Rajasthan

Seema Sharma*, S.K. Jain, Shweta Gupta, Pratibha Singh and Bheem Pareek
Rajasthan Agricultural Research Institute, Dutapura (SKNAU, Jobner), Jaipur, Rajasthan 302018, India
**Email: seemasharma.agro@sknau.ac.in*

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is the most widely grown staple food of majority of poor and small land holders in Asia and Africa. It is also consumed as feed and fodder for livestock. It accounts for almost half of global millet production. It is the world's sixth and India's fourth important cereal food crop after rice, wheat and maize. Pearl millet is not only a quick growing short duration crop, but also a high drought tolerant and well adapted to different soil types. Pearl millet in India is being cultivated on an area of 7.55 million ha with a production of 9.22 million tonnes and the average productivity of 1374 kg/ha (Anonymous 2023). In India, the major pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujarat and Haryana contributing 90% of total national production. In Rajasthan, pearl millet occupies 4.55 million ha area with the production of 5.89 million tonnes and average productivity of 1296 kg/ha. (Anonymous 2023). Pearl millet is also called as the "Powerhouse of Nutrition" as it consists of most of the important nutrients in good quantity and quality which is required for maintaining healthy life. Pearl millet has special health benefiting properties for people suffering from life style diseases like diabetes, obesity *etc.* as it has high proportions of slowly digestible starch and resistant starch that contribute to low glycemic index. Pearl millet is gluten free and retains its alkaline properties even after being cooked which is ideal for people suffering from gluten allergy and acidity. Due to the excellent nutritional properties and resilience to climate change, pearl millet along with other millets is renamed as nutri-cereals (Anonymous 2018) for production, consumption, trade and was included in public distribution system. As pearl millet is grown predominantly in warm rainy season, weeds of different kinds deprive the crop. Weed management is an important factor for enhancing the productivity of pearl millet, as weeds compete for nutrient, water, light, and space; reduce crop yield and quality with crop during the early growth period. Weeds cause the lower grain and straw yields of *Kharif* pearl millet. Pearl millet grows slowly initially and is a relatively poor competitor with weeds during the first few weeks of growth. A heavy infestation of weed in pearl millet may reduce the yield by 40-55% (Banga, 2000; Sharma and Jain, 2003). The predominant methods of weed management are inter-culturing and hand weeding. These are found effective, but they have certain limitations like unavailability of laborers during peak periods under intensive farming and high labour cost. Herbicides are as an effective tool for weed management and replacing conventional methods of weed management. A field experiment was conducted at Agronomy Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan to study the effect of weed management practices on pearlmillet productivity and weed dynamics under semi-arid condition of Rajasthan. Eight treatments of weed management were tested in randomized block design with three replications. The treatments consisted of weedy check; weed free; two hand weeding 3&5 weeks after sowing; PE application of atrazine 500 g/ha *fb* one HW at 3-4 WAS; tembotrione 42% SC 90 g/ha at 3-4 leaf stage of weeds; tembotrione 42% SC 100 g/ha at 3-4 leaf stage of weeds; PE application of atrazine 500 g/ha + tembotrione 42% SC 90 g/ha at 3-4 leaf stage of weeds; PE application of atrazine 500 g/ha + tembotrione 42% SC 100g/ha at 3-4 leaf stage of weeds. Results on the pooled basis showed that weed free plot recorded significantly highest grain (3956 kg/ha) and stover (8827 kg/ha) yield of pearl millet followed by PE application of atrazine 500 g/ha *fb* one HW at 3-4 WAS, PE application of atrazine 500 g/ha + tembotrione 42% SC 100g/ha at 3-4 leaf stage of weeds and two hand weeding 3 and 5 weeks after sowing. From the results it is concluded that PE application of atrazine 500 g/ha followed by post-emergence application of tembotrione 42% SC 100 g/ha at 3-4 leaf stage of weeds significantly controlled the weed population and increased pearl millet productivity under rainfed condition with maximum net returns and B:C ratio.

Influence of crop establishment methods and diversification of rice-based cropping systems on weed density and diversity

Mukesh Kumar*, R.K. Jha B. Pramanick and G Nanda
Dr Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India
**Email: mukesh.agro@gmail.com*

The increased adoption of crop establishment methods, particularly direct seeded rice (DSR) and zero tillage (ZT), offers farmers numerous benefits, such as reduced labor, water savings, timely planting, and accessible machinery. However, these advantages come with the challenge of increased weed infestations, which pose a significant threat to the sustainability of these methods. Furthermore, as crop management practices evolve, the diversity of weed species also shifts, necessitating a deeper understanding of these dynamics. To investigate how weed infestations change under varying crop establishment practices, a field experiment was conducted using a randomized block design (RBD) with ten treatments.*viz.*, (i) Transplanted puddle rice (TPR)– Convectional tillage wheat (CTW), (ii) Rice (TPR)-wheat Zero tillage wheat (ZTW),(iii) PTR-Zero tillage mustard (ZTM)-Conventional tillage maize+ mung bean (CTM+Mu), (iv) PTR- CT Potato+Winter maize (WM),(v) PTR-wheat (ZTW)-ZTMu, (vi) DSR-ZTW-ZTMu,vii)DSR-ZTM-ZTMu, (viii) DSR-CTP-ZTMu, (ix) DSR-CTP+WM ,(x) DSR-mustard (ZTM)-CT-M+Mu during 2020-22. The aim was to assess the impact of these practices on weed diversity and infestation levels, helping to develop more sustainable and adaptive weed management strategies for both experimental and on-farm applications. Weed sampling was carried out from three randomly selected spots within each plot, measuring 20 x 5 meters, prior to applying any weed management practices. The survey also extended to farmers' fields, following standard assessment procedures. Weed species were identified, separated by type, and counted to determine species composition and abundance. A total of fourteen weed species namely, *Cyperus rotundus, Cyperus, difformis, Cynodon dactylon, Echinocloa colona, E. crusgalli, Eleusine Indica, Digitaria Sangunalis, Leptochloa Chinesis, Caesulia axillris. Sphenoclea zeylanica, Ludwigia octovalis, Ammania baccifera, Saggitaria guyanensis* in Rainy/*Kharif* season; eleven weed species *Cyperus rotundus, Cydodon dactylon, Polypogon monspeliensis, Chenopodium album,Cannabis sativa, Circium arvense, Sonchus arvensis, Euphorbia helioscopia, Gnaphalium, Annagalis arvensis ,Rumex dentatus*, in winter/ *Rabi* season and six weed species, *Cyperus rotundus, Cydodon dactylon , Digitaria Sangunalis, Eleusine Indica, Amaranthus viridis, Physalis minima* were recorded in summer season. In the study, higher weed density and species richness were observed in direct seeded rice (DSR), though the Shannon diversity index was lower compared to puddled rice. The Importance Value Index (IVI) for species such as *Cyperus rotundus*, *Cynodon dactylon*, and *Setaria glauca* was notably higher in DSR across cropping systems. During the winter season, *Circium arvensis* displayed a higher IVI in zero-tillage wheat (ZTW), while *Chenopodium album* exhibited a higher IVI in conventional tillage wheat (CTW), where weed diversity was also greater than in ZTW. In the summer season, *Cyperus rotundus* had the highest IVI. Crop diversification showed minimal impact on weed diversity; however, DSR after summer mung observed reduced *Cynodon dactylon* presence compared to DSR following a summer fallow.

Oral lecture 86

Effect of integrated weed management practices and nutrient management on weed and yield of millets under rainfed agroecosystem

Rakesh Kumar*, J.S. Mishra and Anup Das
Indian Council of Agricultural Research, Patna, Bihar 800014, India
**Email: rakeshbhu08@gmail.com*

Weeds are one of major constraints in rainfed millet-production system during rainy season. They compete with crops for moisture, nutrients, light, and space, and reduce crop yield by 15-58%. Manual weeding is most common method to suppress weeds in millets but scarcity of labour for timely weeding and high labour cost are major limitations. Herbicidal options in millets are very limited. Therefore, present study was conducted during rainy season 2020 at ICAR Research Complex for Eastern Region, Patna to develop an effective integrated weed management practices for millets (pearl millet, finger millet, barnyard millet) for enhancing their productivity under rainfed agroecosystem. Experiment was conducted in a randomized block design having 4-weed management practices [weedy check; 2 hand weeding HW at 20-25 & 40-45 DAS); pre-emergence application of herbicide followed by *(fb)* 1 HW at 30 DAS, pre-emergence application of herbicide *fb* post-emergence application of 2, 4-D 0.50 kg/ha at 25 DAS as a first factors and 4-nutrient management [100% RDN: N1; 75% RDN as inorganic+25% RDN through FYM: N2; 50% RDN as inorganic+50% RDN through FYM: N3; 50% RDN as inorganic+25% RDN through FYM+25% RDN through vermicompost (VC) : N4 in second factors, and replicated thrice. In pearl millet, atrazine 0.50 kg/ha, and in finger /barnyard millet, pyrazosulfuron 20 g/ha were applied as pre-emergence. Recommended dose of N was given to all nutri-cereals as per need. Uniform dose of P/K applied through DAP and MOP at basal. Major weed flora like Brachiaria ramose, Digitaria sanguinalis, Phyllanthus niruri, Amaranthus viridis, Caesulia axillaris, Portulaca oleracea, Trianthema portulacastrum observed at 40 DAS. In treatment weedy check had significantly higher total weed density (13.27, 9.72, 11.23 nos./m2) and total weed dry weight (8.77, 4.50, 4.87 g/m2) of pearl millet, finger millet and barnyard millet, respectively but being at par with application of pre-emergence herbicides *fb* 1 HW (30 DAS). Amongst nutrient management, application of 100% RDN (IN) being at par with 75% RDN (IN) & 25% RDN (FYM) provided significantly higher yields of all nutri-cereals. With respect to weed management, hand weeding twice (25 and 45 DAS) had significantly higher yields (3.08, 2.29 and 1.61 t/ha of pearl millet, finger millet and barnyard millet, respectively. Thus, to achieve higher productivity of millets, integrated weed management approach using pre-emergence herbicides *fb* HW at 30 DAS along with 75% RDN (IN) & 25% RDN (FYM) is a better option.

Standardization of weed management strategy for commercial farming of sweet potato in Indian conditions

J. Suresh Kumar* and S. Sunitha
ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala 695017, India
**Email: sureshkumar.jabu@gmail.com*

Sweet potato is the sixth most significant food crop, following rice, wheat, potatoes, maize, and cassava. However, this is the fifth important crop in developing countries. Each year, over 105 million metric tons of sweet potatoes are produced worldwide. China alone produces 60% sweet potato in the world. In India this is the most important tuber vegetable after potato. This is an important food, feed, and industrially important crop, but suffers sever yield loss up to 90% when competing with weeds, especially during the early stage of establishment. Yield loss can vary widely based on the cultivar, production environment, weed species, and management techniques. There is no package of practice available for weed management in sweet potato in India apart from conventional hand weeding. But hand weeding adds higher production cost, cause physical damage to the economical part tuber. Hence an experiment was conducted at ICAR-Central Tuber Crops Research Institute farm in 2023-24 during October 2023 to January 2024. Sree Kanaka, a short duration variety and rich in beta carotene content was used for the study. Experiment was conducted in RBD with three replications and eight treatments. The treatments included chemical methods, cultural methods, physical methods, and integrated approaches namely; pendimethalin 30 EC (1 DAP: days after planting) *fb* clodinafop propargyl 15 EC (35 DAP), pendimethalin 30 EC (1 DAP) *fb* hand weeding (35 DAP), metolachlor 50 EC *fb* clodinafop propargyl 15 EC (35 DAP), metolachlor 50 EC *fb* hand weeding (35 DAP), Soil solarisation with white transparent polyethylene sheet (200 gauge) for 30 days before planting, Stale seed bed (weed removal with hand hoe 2 weeks before planting) + hand weeding 35 DAP, hand weeding alone at 30 and 60 DAP (farmers practice), Unweeded control. Major weed species observed in the experimental area were *Sorghum halepense, Pennisetum pedicellatum* Trin*., Pennisetum polystachion* (L.) Schult., *Alternanthera sessilis*, *Amaranthus hybridus* L., and *Tridax procumbens* L. Application of pre-emergence herbicide pendimethalin at 1 DAP followed by post-emergence herbicide clodinafop propargyl at 35 DAP was found effective in managing weeds with lower weed population, weed dry weight at 60 and 90 DAP. Higher vine growth (1.64 m vine length), numbers of secondary branches (6.60) were also observed at harvest (90 DAP) in. Higher weed control efficiency (87.32%, 87.59% at 60, 90 DAP respectively), and lower weed index (-17.77) and higher total tuber yield and marketable tuber yield (23.57, 18.96 t/ha) were also recorded in same treatment due to lower weed menace and lesser crop-weed competition. Higher B:C ratio was recorded in herbicide application treatments over farmers practice of hand weedings due to lesser cost of chemical method of weed management.

Oral lecture 88

Weed dynamics in rice under different crop establishment and weed management methods

Nikhil Kumar Singh*, Richa Chaudhary, Abhishek Malav, Anurag Upadhyay, Kajal Verma, Sitesh Jha and U.P. Singh

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: nikhilkumar@bhu.ac.in*

It is evident that climate change increases the threat to rice production in India. The variation in rainfall raises concern in the occurrence of many biotic and abiotic factors. The rice production impends by one of the most affecting factors is weed. Rice poses the variation in different crop establishment systems. These establishment systems must be evaluated to seek the changes in occurrence and losses caused by weeds. A field experiment was carried out during the rainy (*Kharif*) season of 2021, 2022 and 2023 consecutively, at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, to study the weed dynamics in different crop establishment methods and weed management. The experiment was laid out with three main plot treatments and four sub plot treatments replicated thrice under split plot design. The soil of the experimental field was sandy loam The main-plot treatments were comprised of three different crop establishment methods, *viz.* M1- transplanting, M2- drum seeding and M3-dry direct seeding and sub-plot treatments subplot were comprised of four weed management practices, *viz.* W1-weed free (hand weeding), W2- weedy check, W3-mechanical weeding using weeder and W4-chemical weed control (pre emergence application of pendimethalin at 1.0 kg/ha *fb* post-emergence application of bispyribac-sodium at 0.025 kg/ha). Early rice variety '*HUR-3022*' was used as a test variety with maturity period of 115 days was sown in the last week of June. 25-30 kg of seed rate was used in dry direct seeding and 40-50 kg was used in drum seeding. Weed free treatment was kept without weed by repeated hand weeding. The findings indicated that in unpuddled dry direct seeding is having 38% more grasses, 157% more sedges and 100% more broad leaved weeds compared to transplanting (M1) at active tillering stage. Among the crop establishment methods weed control efficiency (55%) is highest in drum seeding followed by transplanting and unpuddled dry direct seeded rice. Whereas, among the weed management methods highest weed control efficiency noted in chemical weed management methods (71.5%) followed by mechanical control (50.2%). Lowest weed index was recorded in drum seeding (13.66) followed by transplanting (15.02) and unpuddled dry direct seeding (20.31). The lowest total weed biomass observed in unpuddled dry direct seeding (35.15 g/m^2) followed by drum seeding (40 g/ha) and transplanting (42 g/ha). The total weed biomass is recorded less in weed management methods (30 g/m^2) closely followed by mechanical weeding (42.08 g/m^2). Weed management methods Chemical weed management methods performs better and control weeds and increased the growth and yield attributes of rice. During first year transplanting recorded maximum grain yield (4.2 t/ha) but later on drum seeding (4.89 t/ha) during 2022 and 5.36 t/ha during 2023 recorded maximum grain yield compared to rest of the treatments. High yield recorded due to proper weed management and better growth and yield attributes in drum seeding and chemical weed management methods.

Quantification of garlic to pre- and post-emergence herbicides

H.N. Der*, B.S. Gohil, N.V. Radadiya and T.V. Ghevariya
Main Sorghum Research Station, Navsari Agricultural University, Surat, Gujarat 395007, India
**Email: drhnder@nau.in*

Garlic is the second most widely used cultivated *Allium* after onion. It is grown throughout the plains of India. The potential yield losses due to weeds can be as high as about 65% depending on the crop, degree of weed intensity, weed species and management practices. Garlic production is severely affected due to weeds because of non-branching habit, sparse foliage, shallow root system and narrow row spacing. To evaluate new pre- and post-emergence herbicides and their mix/sequential application for management of weeds in garlic this experiment was undertaken on medium black soil at Junagadh (Gujarat) in randomised block design with four replications. Garlic variety '*GG 4*' was sown with recommended package of practices. The crop was uniformly fertilized with 25 kg/ha N, 50 kg/ha P and 50 kg/ha K in form of urea and di-ammonium phosphate and as muriate of potash. Among different treatments oxyfluorfen 240 g/ ha PE + HW 45 DAS remained at par with weed free, which recorded the lowest total weed density over unweeded check. Significantly the lowest dry weight of weeds was observed under weed free. Among rest of the treatments, the lowest weed dry weight was observed under treatment oxyfluorfen 240 g/ha PE + HW and oxyfluorfen 240 g/ha PE + propaquizafop 90 g/ha PoE. Among rest of the treatments, the lowest weed index of 9.54% was recorded under oxyfluorfen 240 g/ha PE + HW 45 DAS. Besides weed free, highest bulb yield was recorded with oxyfluorfen 240 g/ha PE + HW 45 DAS and increase over 550% over unweeded check. Unweeded control recorded the lowest bulb yield. The 0% weed index under weed free indicates that complete absence of competition due to weed. The highest weed index of 84.63% was recorded under unweeded check which indicates that unrestricted weed growth reduced the bulb yield of garlic. The maximum net returns of 182555 Rs./ha and BCR of 6.36 were realized with treatment weed free followed by oxyfluorfen 240 g/ha PE + HW 45 DAS with net returns of 162965 Rs./ha and BCR of 4.94.

Oral lecture 90

Evaluation of new herbicide molecules for integrated weed management in sugarcane plant cane

S.S. Nooli, Sourabh Munnoli*, B. Arunkumar and Jyoti Potadar
ARS, Sankeshwar, University of Agricultural Sciences, Dharwad, Sankeshwar, Karnataka 580005, India
**Email: sourabh.ssm@gmail.com*

A field experiment was conducted at the Agriculture Research Station in Sankeshwar, during 2022. The experiment was laid out in Randomized Complete Block Design with three replications. There were total of 9 treatments which encompassed 7 different herbicides *viz*., Pre-emergence application of clomazone 22.5% + metribuzine 21% WP ready mix (RM) 2.5 kg/ha (T1), Pre emergence application of clomazone 30% + sulfentrazone 28% WP RM 2.5 kg/ha (T2), post-emergence application of 2,4-D-sodium salt 44% + metribuzin 35% + pyrazosulfuron-ethyl 1.0% WDG RM 3 kg/ha (T3), post-emergence application of halosulfuron-methyl 12% + metribuzin 55% w/w WG RM 1.0 l/ha (T4), post-emergence application of topramezone 10 G/L + atrazine 300 G/L SC RM 3 l/ha (T5), Pre-emergence application of atrazine 80% WP 2.5 kg/ha (T6), post-emergence application of 2,4 D Na salt 2.5 kg/ha (T7). The other two treatments were weed free (T8) weedy check (T9). The treatments with pre-emergence applications were followed by *(fb)* partial earthing up at 60 days after planting (DAP) and treatments with post-emergence application were followed by earthing up at 120 DAP. Among the tested herbicides, pre emergence application of clomazone 30% + sulfentrazone 28% WP RM 2.5 kg/ha *fb* partial earthing up at 60 DAP (T2) and post-emergence application of 2 4-D-sodium salt 44% + metribuzin 35% + pyrazosulfuron-ethyl 1.0% WDG RM 3 kg/ha at 2-4 leaf stage of weeds *fb* earthing up at 120 DAP (T3) recorded maximum total weed control efficiency and lower weed index, weed count and weed dry weight as compared to other herbicide treatments. Similarly, T2 recorded significantly higher cane yield of 127.43 t/ha which was on par with T3 (123.03 t/ha) in herbicide applied treatments. However, weed free check recorded significantly higher cane yield of 131.97 t/ha and lower cane yield of 81.73 t/ha was with weedy check. Similar trend was noticed with yield attributes. The economic analysis indicated that, significantly higher net returns (Rs 2,66,438/ha) and B:C (3.3) was recorded with pre emergence application of clomazone 30% + sulfentrazone 28% WP (ready mix) 2.5 kg/ha *fb* partial earthing up at 60 DAP, which was on par with post-emergence application of 2 4-D-sodium Salt 44% + metribuzin 35% + pyrazosulfuron-ethyl 1.0% WDG RM 3 kg/ha at 2-4 leaf stage of weeds *fb* earthing up at 120 DAP (Rs. 2,55,338/ha and 3.24, respectively).

Efficacy of new herbicides on weed dynamics and productivity of clusterbean

Shweta Gupta*, Seema Sharma, R.N. Choudhary, Pratibha Singh, Bheem Pareek, Anju Kanwar Khangarot and Kavita Bhadu

Rajasthan Agricultural Research Institute, S.K.N. Agriculture University, Jobner, Durgapura, Jaipur, Rajasthan 302018, India

**Email: shweta.agro@sknau.ac.in*

A field experiment was conducted under All India Coordinated Research Project on Weed Management for three consecutive years during *Kharif* 2021 to *Kharif* 2023 at Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan to study the "Efficacy of new herbicides on weed dynamics and productivity of clusterbean". The experimental site was located at 26°512 N latitude and 75°472E longitude and at an altitude of 390 m above mean sea level. The mean maximum temperature was 31.62°C, 33.42°C, 34. 12°C and minimum temperature was 22.5°C, 23.1°C, 22.4 °C and total rainfall was 718.2 mm, 489.4 mm 510.0 mm, during the crop period in the year 2019, 2020 and 2021, respectively. The soil of the experimental site was well-drained loamy sand and coarse in texture. Ten treatments of weed management were tested in randomized block design with three replications. The treatments consisted of T1: weedy check; T2: weed free; T3: pendimithalin 30% + imazethaper 2% (PE) at 800 g/ha, T4: diclosulam 84% WDG (PE) at 24 g/ha T5: sulfentrazone 28% + clomozone 30 % WP (PE) at 725 g/ha; T6: fluazifop-p-butyl 13.4% + fomesafen 11.1% EC (ready mix) at 230 g/ha at 2-3 leaf stage of weed; T7: propaquizafop 2.5% + imazethapyr 3.75% w/w (ready mix) at 125 g/ha at 2-3 leaf stage of weed; T8: sodium acifluorfen 16.5% + clodinofop-propargyl 8% EC at 245 g/ha at 2-3 leaf stage of weed; T9: fomesafen 12% + quizalofop-ethyl 3% SC (ready mix) at 230 g/ha. at 2-3 leaf stage of weed and T10 - imazethapyr 35% + imazamox 35% WG (ready mix) at 60 g/ha at 2-3 leaf stage of weed results in the pooled analysis showed that minimum weeds and maximum Weed Control Efficiency (93.29%) were recorded in Weed free which was found at par with T7 - propaquizafop 2.5% + imazethapyr 3.75% w/w (Ready mix) at 125 g/ha at 2-3 leaf stage of weed (91.18%). Seed yield (1.30 t/ha) and straw yield (3.26 t/ha) was recorded maximum in weed free which was found at par with T7 - propaquizafop 2.5% + imazethapyr 3.75% w/w (ready mix) at 125 g/ha at 2-3 leaf stage of weed (1.21 t/ha and 2.95 t/ha, respectively). Diclosulam 84% WDG (PE) at 24 g/ha (T4) ; sulfentrazone 28% + clomozone 30 % WP (PE) at 725 g/ha (T5) and T6 - fluazifop-p-butyl 13.4 % + Fomesafen 11.1 % EC (ready-mix) at 230 g/ha at 2-3 leaf stage of weed showed phytotoxicity on clusterbean crop.

Dynamics of weed flora in major *Kharif* crops

B.S. Gohil*, S.B. Vadhavana and P.K. Chovatia
Weed Control Research, Department of Agronomy, Junagadh Agricultural University, Junagadh, Gujarat 362001, India
**Email: bsgohil@jau.in*

Life on earth never stands still and it is a continuous process of change and flux. Succession is the interaction of both environmental factors and plant species. The soil is reservoir of weed seeds. Weed succession can occur amongst different weed species themselves in response to long term adoption of an agricultural practice, including the use of herbicides. This leads to the destruction of the susceptible group of weed species, leaving behind few plants of the resistant species to gradually build up their population and finally emerge as the dominant weed flora of the area. Density of weed species can be changed depending on some factors during a long period. During rainy season, weed flushes emerge according to irrigation, fertilization, weed management practice, weather condition, *etc*. The knowledge of weed flora is essential for the management of weeds in crop fields. In view to generate the information about weed flora in different *Kharif* crops, the present experiment was proposed to undertake. A field experiments were conducted during *Kharif* seasons at Junagadh (Gujarat) with an objective to study the weed species growing in succession throughout the *Kharif* season. Experiment was laid out in split plot design with four replications with imposed of three treatments (crops) in main plot and four treatments (weed management practices) in sub-plots. The information was generated from the experimentation on weed dynamics in groundnut, soybean and pearl millet during *Kharif* season is 1) From total nineteen weeds species, families constituted as *Aizoaceae, Amaranthaceae, Asteraceae, Commelinaceae, Cyperaceae, Euphorbiaceae, Fabaceae, Lamiaceae, Lythraceae, Poaceae, Portulacaceae, Solanaceae* and *Tiliaceae*. Highest weeds observed of families; Poaceae > Asteraceae > Euphorbiaceae 2) Total weeds in floristic composition are *Cyperus rotundus, Echinochloa colona, Elymus villosus, Dactyloctenium aegyptium, Digitaria sanguinalis; Digera arvensis, Eclipta alba, Euphorbia hirta, Indigofera glandulosa, Tridax procumbens, Leucas aspera, Phyllanthus niruri, Corchorus olitorious, Commelina benghalensis, Portulaca oleracea, Ammania baccifera, Parthenium hysterophorus, Physalis minima* and *Trianthema portulacastrum,* 3) The most dominant succession of *Cyperus rotundus, Echinochloa colona, Commelina benghalensis, Leucas aspera and Digera arvensis* were noted throughout season, 4) *Echinochloa colona* and *Elymus villosus* with pearl millet, Indigofera glandulosa with groundnut and soybean; *Cyperus rotundus* throughout the *Kharif* season were associated, 5) The weeds late to emerge were observed *i.e.*, *Digitaria sanguinalis* up to 15 DAS and *Elymus villosus* up to 30 DAS and *Ammania baccifera* up to 45 DAS, 6) *Ammannia baccifera* found dominating around 45 DAS in weed free condition when the rainfall amount was more.

Oral lecture 93

Effect of eco-friendly weed management practices on weed dynamics and yield of organic tomato

Meesala Srija*[1], B. Padmaja[1], T. Ram prakash[1] and M. Venkateshwara Reddy[2]
1 AICRP on Weed Management 2 College of Agriculture, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana 500030, India
**Email: meesalasrija26@gmail.com*

Tomato is one of the most important vegetable crops in the World. In India, tomato is cultivated in an area of about 8.73 lakh hectares with the production of 212.4 lakh tonnes. Demand for organically grown vegetables is increasing in urban areas. Organic vegetable producers rank weeds as one of the most troublesome, time consuming and costly production problems. Hence, there is a need to develop effective non chemical weed management strategies for organic vegetables especially tomato. A field experiment entitled "Assessment of ecofriendly weed management practices in organic tomato" was conducted during *Kharif*, season of 2022-2023 and 2023-2024 at AICRP on weed management block, college farm, PJTAU, Rajendranagar, Hyderabad. The treatments comprised of "Live mulch with dhiancha and incorporation at 30 DAT, Stale seed bed *fb* HW at 20 & 40 DAT, Polymulch+intrarow hand weeding (HW) at 30 DAT, Rice straw mulch 5 t/ha *fb* intrarow HW at 30 DAT, Hoeing twice at 20and 40 DAT, Intercrop (Fenugreek) green leaf vegetable *fb* HW at 40 DAT, Tamarind leaf aqueous extract 10% at 3 and 30 DAT followed by hand weeding at 40 DAT, Unweeded control, T9- Chemical weed control-metribuzin70%WP 0.525 kg/ha *fb* HW at 40 DAT (outside the layout). Out of all ecofriendly weed management treatments tested; polythene mulch + intra row handweeding (HW) at 30 DAT showed lower weed density at 30 DAT (39 and 12.7 no./m2) and 60 DAT (31 and 13 no./m2), lower weed dry weight at 30 DAT (24.67 and 29 g/m2), and 60 DAT (22.64 and 21.60 g/m2) and highest weed control efficiency at 30 DAT (54.88 and 70.89%) and 60 DAT (77.3 and 87.22%) during 2022 and 2023, respectively. It was followed by rice straw mulch 5t/ha *fb* intra row HW at 30 DAT which showed weed density at 30 DAT (44.3 and 19 no./m^2), 60 DAT (25.70 and 27.33 no./m^2), weed dry weight at 30 DAT (36.33 and 45.53 g/m2), 60 DAT (34 and 18.13 g/m2) and weed control efficiency at 30 DAT (33.54 and 41.46%), at 60 DAT (73.30 and 89.28%). Live mulch with dhaincha and incorporation at 30 DAT and hoeing twice at 20 & 40 DAT were the next best treatments. Tamarind leaf aqueous extract 10% at 3 and 30 DAT was not effective. Polymulch also recorded highest yield (21.34 t/ha in 2022 and 18.07 t/ha in 2023) which was followed by rice straw mulch (19.04 t/ha and 12.45 t/ha). Hence it can be concluded from this study that polythene mulch + intra row hand weeding (HW) at 30 DAT was effective in controlling weeds and also recorded higher yield which was comparable to conventional farming (21-25 t/ha). Rice straw mulch 5t/ha *fb* intra row HW at 30 DAT performed equally to poly mulch both in weed control and yield parameters and it is very sustainable and ecofriendly weed management practice in organic farming.

Nutrient and weed management in buckwheat after Sali rice

Bamon Timung*, J.K. Chowdhury, Rinjumoni Dutta, Bhaskar Saikia, Manuranjan Roy and Swgwmsar Basumatary

College of Agriculture, Department of Agronomy, Assam Agricultural University, Jorhat, Assam 785013, India

**Email: timungbamon5@gmail.com*

An experiment entitled "Nutrient and weed management in buckwheat (*Fagopyrum esculentum*) after Sali rice" was conducted at Instructional-cum-Research farm, Assam Agricultural University, Jorhat during the *Rabi* season of 2018-19 to study the effect of nutrient and weed management practices on buckwheat after Sali rice harvest. The factorial experiment was laid out in randomized block design with three replications. The treatment consisted of four nutrient management practices *viz*., N0: control, N1: application of 20-10-10 kg/ha N-P-K, N2: application of 20-10-10 kg/ha N-P-K + 1.25 t/ha vermicompost and N3: application of 20-10-10 kg/ha N-P-K + 2.5 t/ha vermicompost and three weed management treatments, viz. W0: control, W1: pre-emergence application of pendimethalin 0.75 kg/ha and W2: pre-emergence application of pendimethalin 0.75 kg/ha + dryland weeder at 40 days after sowing (DAS). Weeds of the experimental field were *Eleusine indica, Panicum repens, Paspalum compressus, Digitaria setigera, Cynodon dactylon* among the grasses; *Cyperus rotundus* among the sedge; and *Ageratum houstonianum, Commelina benghalensis, Polygonum plebeium, Mimosa pudica and Acmella ciliata* among the broad leaved. The density and dry weight of weeds in rainfed buckwheat were found to be significantly lesser with N3: application of 20-10-10 kg/ha N-P-K + 2.5 t/ha vermicompost compared to other treatments. As a result, the uptake of N, P and K by weeds was found to be significantly lesser with N3. The growth parameters like plant height, number of primary branches/plant and yield attributing characters, *viz*. number of cyme/plant, number of seeds/cyme were found to be significantly higher in N3. The highest seed yield (1.25 t/ha), stover yield (2.05 t/ha) was thus recorded with this treatment. In respect of weed management, W2: pre-emergence application of pendimethalin 0.75 kg/ha + dryland weeder operation at 40 DAS was found to significantly lower the density and dry weight, N, P and K content and uptake of weeds in rainfed buckwheat. Thus, the growth and yield attributing characters of rainfed buckwheat improved with this treatment which recorded the highest seed (1.08 t/ha) and stover (1.82 t/ha) yields. Nutrient as well as weed management interacted significantly and combination of the two above-mentioned treatments were the best treatment combination with the seed yield of 1.33 t/ha and stover yield of 2.08 t/ha. This treatment combination was also found to be the best with a gross return of Rs. 47,705.92, net return of Rs. 26,032.72 and B: C ratio of 1.20.

ISWS Biennial Conference on "*Climate-smart Weed Management for Global Food Security*", Banaras Hindu University, Varanasi, (India) 28-30 November, 2024.

Oral lecture 95

Please don't degrade weeds; these are highly medicinal!!

C.K. Venugopal*[1] and J.A. Hosmath[2]

[1]*Hi Tech Horticulture Unit, University of Agricultural Sciences, Dharwad, Karnataka 580005, India*

[2]*Dept. of Agrometeorology, AC, University of Agricultural Sciences, Dharwad, Karnataka 580005, India*

**Email: venuck2010@gmail.com*

The growing demand for plant-based drugs in the world in recent years has led to increased trade of plant materials within and between the countries. The therapeutic properties of medicinal plants, many of them are said to be 'weeds', are due to secondary metabolites like alkaloids, glycosides, steroids *etc*., which have marked pharmaceutical action as anti-cancer, anti-malarial, anti-diabetic, anti-microbial, anti-dysenteric etc., Since time immemorial, thousands of plants and their products are being used for their curative properties. WHO has estimated around 80 per cent of the total population rely even today on use of traditional medicine, most of it is plant based. The word 'weed' means a plant out of place that greatly affects growth and yield of crops. However, looking to their astounding ability to cure several diseases, the word 'weeds' sounds very harsh on them as all the weeds are basically medicinal, be it the most notorious weeds in agriculture, *Cynodon dactylon* and *Cyperus rotundus,* which have several of the medicinal properties. Many of them offer economic viability for commercial production, *e.g.,* Andrographis paniculata and Bacopa monnieri. Some weeds which have already attained the status of medicinal plants are Periwinkle, Kalmegh, Punarnava *etc*., Out of 8000 drug yielding plants, around 178 species have annual consumption levels in excess of 100 metric tons in India, in which many are weeds, listed as above. Following are the statements always made in agriculture, when mentioned about weeds. That, (i) they rob of nutrients; (ii) reduce the yield; (iii) absorb lot of soil moisture; (iv) reduces the quality of produce by adulteration/ their seeds getting mixed *etc*. But there must be an angle of inclusiveness in the profitability of agriculture. The medicinally active weeds needs to be separately harvested, processed and sold to pharmaceutical and ayurvedic drug companies, to enhance the overall profitability of the farm. For example, many of the weeds, *viz*. rhizomes of *Cyperus rotundus*, whole herbs of *Eclipta prostrata* and *Bacopa monnieri* are priced between Rs.50-150 per kg in herbal markets in Delhi at Khari Baoli street. Raw material of hundreds of herbal plant species including that of weeds is sold to drug manufacturing industries in this street. The list of weeds which is being utilized as medicinal plants is too big. To name a few, *Abutilon indicum; Acalypha indica; Achyranthes aspera; Alternanthera sessilis; Boerhaavia diffusa; Datura stramonium; Euphorbia hirta; Oxalis corniculata; Sida cordifolia; Phyllanthus amarus; Tribulus terrestris etc*. The first author of this article has been responsible for establishing one herbal garden at the main campus of UAS, Dharwad comprising 150 different species of medicinal and aromatic plants and has the experience of 25 years in the field of research on medicinal plants. It was later realized that many of the collections are basically classified as weeds! Hence, we need to exploit the weed flora available in the country for our benefit by extracting herbal drugs to cure different diseases of mankind so that, the bad label on them can be rubbed off.

Oral lecture 96

Allelopathic potential of *Alternanthera philoxeroides* (Mart.) Griseb. extracts and its bioefficacy as bioherbicide in blackgram

S. Kamala Bai*, R.N. Ashwini, K.N. Geetha, C.J. Sinchana and B.S. Vidyashree
AICRP Weed Management, Bangalore Centre, Bangalore, Karnataka 560002, India
**Email: skamalabai@gmail.com*

The present investigation was carried out to have a deeper insight of allelopathic potential of Alternanthera philoxeroides (Mart.) Griseb. Study on use of different plant parts of A.philoxeroides, *viz*. stem, root, leaf and whole plant at 120 and 160 g/L each was studied with an objective to evaluate the efficacy of the potential metabolite/allelochemical of A.philoxeroides as pre-emergent herbicide during the year 2022-23. In laboratory study, most effective aqueous extract in suppressing the germination of black gram was stem extract 120 g/L followed by other plant part extract at 160 g/L. Significant variation in seedling length (cm) and seedling vigor index (SVI) was observed and decreased with increase in concentration of aqueous extract of A. philoxeroides. Highest inhibition in germination was observed in whole plant followed by root, leaf and stem at 160 g/L compared to lower concentration at 120 g/L on germination of black gram whereas control was not affected. The allelochemicals released arrested the primary biochemical process during the seed germination resulted in failure of germination. In field condition aqueous extracts of A. philoxeroides as pre-emergent bioherbicde on weed control and its effect on growth of black gram was studied. Significantly lower weed density and dry weight in sedges, broadleaved, grasses and total weeds was observed in treated plots. The presence of different allelochemicals in the different plant parts of aqueous extracts of A. philoxeroides significantly reduced the weed density and weed dry weight. Plant height, number of clusters per pod and seed yield differed significantly due to application of aqueous extract. The decrease in growth and yield parameters were noticed due to allelopathic potential of different plant parts of aqueous extracts of A. philoxeroides, which adversely affects various biophysical and biochemical processes in plants by decreasing nutrient uptake, photosynthesis, leaf water potential, osmotic pressure, water uptake, foliar expansion and root elongation. Significant difference in the seed yield was noticed compared to control. The highest yield was recorded in control (310 kg/ha) whereas the lowest seed yield kg/ha was observed in the plots sprayed with leaf extract at 160 g/L (150 kg/ha) followed by root extract at 120 g/L (193.3 kg/ha). These extracts hindered germination, seedling growth, consequently lower water potential disrupting nutrient movement negatively impacting overall plant health and productivity. Further reduced germination led to lower plant population, which in turn affected the yield in the plots treated with extracts.

Oral lecture 97

Climate change influence on multitrophic interactions of invasive aquatic weeds and their biocontrol agents

Puja Ray
Presidency University, Kolkata, West Bengal 700073, India
Email: puja.ray@gmail.com

Human induced climate change and biological invasions are two of the most persistently growing threat impacting the ecosystem and its services drastically. A rapidly changing climate may directly or indirectly influence the invasion potential of a non-native plant species by altering the vectors and pathways of the recipient communities. Prediction of climate change impacts on ecosystem and its functioning becomes a challenging problem due to scientific uncertainties. These uncertainties arise as climate change and biological invasions interact with other existing stressors to shape the distribution, spread, diversity and abundance of species, substantially altering biodiversity, causing changes in phenology, genetic composition, species ranges, species interactions and ecosystem processes. Invasive aquatic plants, such as water hyacinth, alligator weed, giant salvinia, *etc*, often grow aggressively causing significant ecological and socio-economic impacts. Biological control of invasive species with host specific insects and plant pathogens is considered a cost-effective, permanent and environmentally friendly method. But on one hand where climate change is anticipated to benefit the invasive plant species, on the other hand how this will impact the biological control agents and the control mechanism is less known. Biological control in an aquatic ecosystem is largely influenced by highly eutrophic waters, cooler climates that slow the build-up of the biological control agent populations, frost, floods and inappropriate application of other control methods such as herbicide application that affect the agents or cause a reduction in the weed population thereby decimating the agent population. Elevated CO_2 and temperature, together with phytopathogenic infection or arthropod herbivory, can significantly modify plant biochemistry and hence plant defense responses. Similarly, the field performance of a microbial herbicide in terms of virulence, host-range, *etc*, depends on several biological traits of the organism and its environmental conditions. There is a greater need to examine approaches for predicting the invasiveness of non-native plants and their biocontrol agents, under changing environmental conditions and their ecological interactions and impacts. There is also a critical need for a wider study of ecological, behavioural, physiological and life-history responses to be addressed across a greater range of geographic locations, particularly in areas of high human population growth and habitat modification, like India. This paper reviews how modified interactions, between mutually interacting species, like spatial or phenological decoupling of herbivore-predator, host-parasite or plant-pollinator populations, *etc*, may have ecological and economic consequences globally in aquatic invasive species and their biocontrol agents under changing climatic conditions.

Non-chemical approaches to weed management in organic systems

A.S. Sidhu*, Amanpreet Singh, S.S. Walia and C.S. Aulakh
School of Organic Farming, Punjab Agricultural University, Ludhiana, Punjab 141004, India
**Email: sidhuas@pau.edu*

Organic agriculture has a pedigree stretching over a century and is now increasingly a role model for how mainstream agriculture needs to change. The shift in global consumption patterns, health awareness among consumers and the increasing significance of sustainability are now putting organic products to the forefront locally, nationally and also at the international level. For decades, agriculture worldwide was fully reliant on herbicides as the most efficient and most effective weed control measure. However, the rising awareness of the environmental and health impacts of chemical inputs has fueled a movement towards more sustainable farming practices, such as organic agriculture, which relies on natural methods for weed management. This transition underscores the need for a broader transformation in agricultural practices, emphasizing the importance of ecological balance, biodiversity and long-term soil health. As a result, organic farming is increasingly seen not just as an alternative, but as a necessary model for the future of food production in a world that demands both high yields and environmental stewardship. One of the top production constraints in organic agriculture is the management of weeds by non-chemical methods as synthetic agrochemicals are prohibited. There are several non-chemical methods by which weeds can be managed such as cultural practices, thermal treatments, allelopathic approaches, and mechanical control. Cultural practices such as adjusting sowing times, increasing crop density, and using cover crops enhance crop competitiveness and suppress weed growth. Thermal methods, including flaming and hot water treatments, provide effective weed management without chemical use. Allelopathic weed control utilizes plant extracts to inhibit weed growth, while mechanical control relies on physical methods like tillage and mowing. Precision agriculture technologies, such as remote sensing and robotics, further refine non-chemical strategies by providing targeted and efficient weed management. Direct weed control has also seen developments, with new implements appearing on the market that could benefit in the future from sophisticated machine guidance and weed detection technology. There is a need to understand weed biology and population dynamics for long-term improvements in sustainable weed management and benefiting both conventional and organic growers. A flexible approach combining weed biology knowledge, cultural methods, and direct control is needed to keep weed populations manageable. Non-chemical methods, though beneficial, require careful implementation and ongoing research to optimize their effectiveness in various farming systems. By assessing the strengths and weaknesses of different techniques, we can propose a new approach to organic food production. Integrating diverse non-chemical methods with precision agriculture technologies ensures sustainable weed management, fostering environmental sustainability and resilience in agriculture.

Isolation and characterization of phytopathogenic microbes from plant phyllosphere for phytotoxicity against *Echinocloa colona*

Pramod Kumar Gupta*[2], Taniya Nigam[2], Divya Gupta[1], Himanshu Mahawar[1] and K.K. Barman[1]

[1]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[2]*Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

**Email: pkgupta@jnkvv.org*

A study was conducted to isolate phytopathogenic microorganisms from the phyllosphere of plants to characterize their phytotoxic potentials against *Echinochloa colona*. Microbes were isolated from the phyllosphere of four millets [Barnyard (SN), Kodo (KD), Kutki (KT), Foxtail (FX)], *E. colona* (EC) and *Aegle marmelos* [Bel Patra (BP)]. A total of 30 microbes (21 bacterial and 9 fungal) were isolated and characterized for total phenol content and cellulase enzyme activity. Based on these parameters, 15 isolates, BP-1, BP-4, SN-1, SN-2, SN-3, KT-4, KT-5, KD-5, FX-1, FX-2, and EC-1-5 were selected for phytotoxicity test against *E. colona*. The total phenolic content (TPC) ranged from 12 to 19 GAE mg/ml, while cellulase activity varied between 0.131 and 6.875 mg G/g/day. A leaf-dip test was performed to assess the phytotoxic effects of these isolates on *E. colona* leaves. *E. colona* leaves were surface sterilized and incubated with CFE of isolates. After 48 hours of incubation, isolate numbers FX-1, KT-5, EC-3, EC-5, SN-2, SN-3, BP-1, and BP-2 showed chlorotic symptoms on *E. colona* leaves.

Unravelling the effects of drought stress on rice and weeds through physiological and biochemical approaches

Dasari Sreekanth*, Pawar Deepak Vishwanath, I.K. Sahadeo, C.R. Chethan, Shobha Sondhia and P.K. Singh

ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India

**Email: sreekanthplantsciences@gmail.com*

The sustainability of food production is seriously threatened by biotic and abiotic stresses. Rice crop is known to be sensitive to weeds and drought stress particularly at the early phase. Rice is one of the most important food crops drastically affected by weeds stress under drought particularly at early in the season when the rice is most susceptible to weed competition. The present study was conducted using rice (Shahabagi) solely and rice grown along with its major weeds *Echinocloa colona* (L.) Link. and *Alternanthera paronychioides* were selected to characterize the rice response under drought at the critical competitive period. Drought stress imposed at the critical competitive period (25 days after showing) showed considerable changes in physiological, biochemical attributes and yield, which were evident by a decline in relative water content, membrane stability index, antioxidant enzymes, non-enzymatic oxidants and chlorophyll content, rate of photosynthesis, starch and total soluble sugar content linked with oxidative stress and the accumulation of reactive oxygen species. Taken together, all the physiological and biochemical indicators, such as proline accumulation, lipid peroxidation, and electrolyte leakage, clearly revealed significant differences in rice in the presence of *A. paronychioides* and *E. Colona* under drought, establishing their contrasting nature at this stage. In the presence of *A. paronychioides,* MDA content found to be increased to 1.67 fold and 2.23 fold, whereas *E. colona* interference increased to 3.27fold and 4.53 fold under control and drought respectively, relative to weed free control. Similarly, *A. paronychioides* interference significantly increased the Superoxide ion content by 44.29% and 56.55% under control and drought respectively, relative to weed free control. Similarly, *E. colona* interference increased the Superoxide ion content to 64.21% and 92.26% under control and drought respectively, relative to weed free control. This observation led us to conclude that the adverse impact of *E. colona* in terms of biotic stress was more and pronounced on rice than *A. paronychioides* under drought stress.

Insecticidal activities and phytochemical screening of crude extract of *Argemone mexicana* L.

Kranti Waghmare*, Nivedita Ghayal[1], Mahesh Shindikar[2] and Rajendra Jadhav[3]

**Annasaheb Kulkarni Department of Biodiversity, MES Abasaheb Garware College, Pune, Maharashtra 411004, India*

[1]Department of Botany, MES Abasaheb Garware College, Pune, Maharashtra 411004, India

[2]Department of Applied Science, COEP Technological University, Pune, Maharashtra 411004, India

[3]Agri- Entomology Division, Ross Life Science Ltd, Pune, Maharashtra 411004, India

**Email: waghmare.kranti87@gmail.com*

The management of invasive weeds is the global issue. Despite using several control techniques weeds keep on posing newer challenges for researchers and farmers. The present study focuses on an eco-friendly management technique of *Argemone mexicana* L. In this work, the insecticidal toxicity of aqueous extract of an invasive weed *Argemone mexicana* L. was carried out against mustard aphid, *L. erysimi* Kalt and lablab bean, *A. craccivora* Koch aphid. The toxicity experiment was carried out by repellency method and pot method (randomized block design) by replicating it for three times. The statistical analysis revealed the significant activity on both the aphids. To dig down the possible reason behind this noticeable efficiency, phytochemical screening was carried out. GC-MS analysis revealed the presence of 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl, 3-Hydroxy-3-methylglutaric acid, Phytol with higher prob.%. Also *A. mexicana* L. showed potential antioxidant activity, which was carried out by DPPH and lipid peroxidation method. The study suggested the use of *A. mexicana* L. as an insecticide against aphids as it possess varied range of potential phytochemicals with various biological properties. This management technique can manage *A. mexicana* L. without harming the environment as well as control aphid population at effective level.

Oral lecture 102

Use of weed biochar as a novel technology in carbon sequestration for enhancing the crop productivity under climate change

Suchismita Satapathy* and Ram Swaroop Meena
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: suchismitasatapathy@bhu.ac.in*

The swift pace of industrialization is causing a concerning rise in the concentration of carbon dioxide (CO_2) and other greenhouse gases (GHG) that contribute to global warming. Consequently, it is imperative to devise an environmentally sustainable approach to address the issue. Biochar, derived from weed biomass, has emerged as a promising tool for enhancing crop productivity, particularly in the context of climate change. Recent advancements in biochar production and application technologies are driving its adoption as a sustainable soil management. The production of biochar from weed biomass and its application in soil carbon management is a sustainable technique for weed management. In addition to sequestering carbon in soils, it also enhances soil quality (Renard *et al.* 2012). The creation of biochar from weed biomass is the most effective way for long-term carbon sequestration from the atmosphere. The incorporation of biochar into soil improves its cation exchange capacity and diminishes nitrogen losses. Consequently, it enhanced nitrogen use efficiency and decreased greenhouse gas emissions (Gaunt *et al.* 2008). The majority of carbon in biochar possesses an aromatic structure and exhibits significant environmental recalcitrance (Lehmann *et al.* 2007). The conversion of biomass carbon to biochar carbon results in the sequestration of approximately 50% of the initial carbon, in contrast to the minimal retention observed after combustion (3%) and biological decomposition (less than 10–20% after 5–10 years), thereby producing more stable soil carbon than either burning or direct land application of biomass (Lehmann *et al.* 2006). Moreover, biochar possesses an estimated mean residence time in the soil exceeding 1000 years, and this prolonged stability is a critical criterion for its use in carbon sequestration (Tang *et al.* 2013). Consequently, weed biochar is a compelling and viable solution for addressing several environmental and food-related challenges encountered by contemporary civilization due to rapid population growth and development. Therefore, the primary issue that must be addressed prior to utilizing weed biochar for soil carbon management is the investigation of its long-term impacts on ecosystems and human health. These novel technologies provide a multi-faceted approach to sustainable farming, ensuring that weed biochar can be effectively utilized to combat the adverse impacts of climate change. Further research is required to optimize these technologies for wide-scale adoption.

Bio-herbicides: An eco-friendly approach for integrated weed management

Kratika Nayak*, R.P. Sahu and Amit Kumar Jha
Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya,
Jabalpur, Madhya Pradesh 482004, India
**Email: nayakkratika9@gmail.com*

Bio-herbicides are emerging as a promising eco-friendly alternative to traditional chemical herbicides, addressing concerns about environmental degradation and human health risks associated with synthetic chemicals. These biological control agents, including Devine, Collego, and Biomal, utilize naturally occurring organisms or their by-products to manage weed populations effectively while minimizing harm to non-target species. Notably, weed-related crop yield losses account for about 37% of overall pest-induced losses in agriculture, underscoring the need for effective solutions. The effectiveness and economic viability of bio-herbicides make them attractive to farmers seeking sustainable weed management strategies. By targeting specific weed species, bio-herbicides reduce reliance on chemical herbicides and promote biodiversity, contributing to ecological balance. Their non-toxic nature further mitigates risks associated with chemical exposure for both farmworkers and consumers, aligning with the increasing demand for organic and sustainably produced food. However, the widespread adoption of bio-herbicides faces several challenges. Developing these biocontrol agents requires careful attention to formulation, fermentation systems, and strategic evaluation. Optimizing formulations is crucial for ensuring stability, efficacy, and user-friendliness, while fermentation systems must produce high yields of active ingredients while maintaining microbial efficacy. Researchers must also tackle significant constraints to enhance the adoption of bio-herbicides. Environmental challenges, such as varying climatic conditions and soil types, can affect performance, necessitating a deeper understanding of ecological interactions. Additionally, biological challenges include the potential for target weeds to develop resistance, mirroring issues faced with chemical herbicides. Technological hurdles involve advancing formulation and delivery systems to ensure optimal application. Commercial challenges relate to market acceptance, requiring robust marketing strategies and education to inform farmers about the benefits and proper use of bio-herbicides. Despite these obstacles, bio-herbicides hold promise as key components of integrated weed management (IWM) systems. They should not be seen as complete replacements for chemical herbicides but rather as part of a broader strategy that combines multiple approaches to weed control. This integrated perspective enhances the effectiveness of weed management and fosters sustainability in agricultural practices. To overcome current limitations, advancements in target selection, formulation techniques, and marketing efforts are essential. Collaboration among researchers and practitioners is vital for developing innovative solutions that address the constraints facing bio-herbicides. By enhancing their effectiveness and commercial appeal, bio-herbicides can contribute to a more sustainable agricultural future, reducing the environmental footprint of weed management while ensuring crop productivity.

Molecular diversity of fungal pathogens associated with *Trianthema portulacastrum* for the development of mycoherbicide

Vaddi Saitheja*, K. Thirukumaran, V. Sendhilvel, R. Karthikeyan, M.K. Kalarani, S. Vellaikumar, P. Parasuraman and S. Navarasu

Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, 641 003, India

**Email: vaddi.s.theja@gmail.com*

Trianthema portulacastrum (Horse purslane) belonging to the family of Aizoaceae is a noxious and troublesome broad-leaved weed highly competitive in garden land ecosystem which significantly affects the productivity of crops. It has the ability to produce flowers within 20-25 days after germination and each flower produces almost 10 to 12 seeds. Various chemical herbicides are commercially available for the management of *T. portulacastrum*, but their residual toxicity deteriorates the soil health and ecosystem. So, there is an emerging need to formulate and develop non-chemical methods of weed management. One such approach of non-chemical weed management is the mycoherbicidal approach. To explore the fungal pathogens associated with *T. portulacastrum*, a field survey was undertaken during 2023 and 2024 to collect the infected *T. portulacastrum* plants from 20 different locations which covers all the agro-climatic zones of Tamil Nadu except the hill and high-altitude zone. A total of 78 fungal isolates were isolated from the infected samples where each isolate shows different morphological characters. A preliminary screening study using detached leaf assay was conducted to identify the potential mycopathogens for the management of *T. portulacastrum*. Among the 78 fungal isolates screened, 10 fungal isolates produced the maximum necrotic spot observed on 5th day after inoculation. Morphological characters viz. spore and mycelial characters of these potential isolates were examined under the microscope. Further, molecular characterization of the potential isolates was also done by extracting the DNA from the fungal culture which were then amplified using the universal primers ITS 1 and ITS 4. The ITS gene amplification for the genomic DNA was observed at ~ 500 bp. The obtained PCR product was sequenced using sanger method. The obtained sequences were aligned in the BLASTN search algorithm in NCBI database. The results revealed that among the ten potential fungal isolates sequenced, seven were Gibbago trianthemae and the others were *Fusarium incarnatum*, *F. equiseti* and *F. fujikuroi*. On comparing the isolates screened, the pathogens of Fusarium sp. are pathogenic to various field and horticultural crops and so it does not possess the ability to act as a mycoherbicidal agent. Whereas, G. trianthemae is highly specific to *T. portulacastrum* and shows a huge potential for the development of a novel mycoherbicidal formulation for sustainable and eco-friendly management of *T. portulacastrum.*

The utility of weeds in different fields

Vishwajeet Singh*, G.S. Panwar and Stuti Maurya
Banda university of agriculture and technology, Banda, Uttar Pradesh 210001, India
**Email: vishusingh02001@gmail.com*

Weeds have been used for long time as sources of food, fiber, dye, medicines, *etc*. Unlike other crop plants, weed plants are less vulnerable to disease and insect attack. The indigenous system of medicine practiced in India is based mainly on the use of plants. Weeds are highly valued in traditional medicine systems and have been used by indigenous communities for curing different ailments for thousands of years. Most of weeds have been known to posses therapeutic properties and the pertinent traditional knowledge was transferred orally through generations. Use of crop field weeds as folk medicines in Bankura district have been reported earlier. Weeds maintain the biological diversity of farming landscapes, providing food and shelter for a variety of animals. Insects, which pollinate crops, extensively use weeds as a source of nectar, when crops are not in flower. Weeds also attract crop pests; and nectar, when crops are not in flower. Weeds also attract crop pests; and there is evidence that pest populations in some crops are much lower in ‘weedy fields’ than in ‘weed-free’ crops. As many of our primary crops have ‘weedy-relatives’ the genes present in weeds appear crucial for future evolution of crops, particularly to confer ‘hardiness’, (ability to tolerate variable environmental conditions). Some weed species contribute to aesthetic pleasure, as part of ‘wild nature’, while others provide culinary delights for humans, and are important as food sources for both vertebrate and invertebrate animals. Many weeds with medicinal values continue to be used either as traditional ‘herbal’ remedies, or extracted for secondary metabolites. Weed species Impomea carnea when used as a green manure was assessed at Hyderabad, on the basis of equivalent to these obtain by equal split application of N fertilizer. Assessed a total 15 annual weed species for the suitability as green manure plant determine the N,P, and K content and dry matter production of pot, growth plants and recorded the response. some of the perennial weeds on bunds, avenues and waste lands and used them as green manure were, *Thespesia populenea, Cassia auriculata, Cassia tora, Pongamia glaboa, Melia azadirachta, Calotropis giguntica, Tatroph gossypifolia, T.glandilitora, Gliricidia specium* and *Ipomoea caruca.* A green manure of Crotolaria was effective in improving the productivity of the crop but to improve the efficiency use of large amounts of N biologically fixed by Crotolaria. For the nitrogen assimilation rate of Achyranthus aspera was better as compared to the other weeds followed by *Parthenium hysterophorus.* Phosphorus assimilation was faster in Parthenium as compared to other weeds. Better result were observed from *Cassia tora* because it is a legume and contain better NPK as compared to other weeds, but its assimilation rate was less as compared to other weeds. From the above mentioned points it is concluded that weeds having various notorious effect but they have some usefulness value too.

Germination ecology of annual ryegrass populations in Eastern Australia

Pankaj Ghodke*[1,2], Gulshan Mahajan[1] and Bhagirath S. Chauhan[1]
[1]*Queensland Alliance for Agriculture and Food Innovation, University of Queensland, Gatton, Queensland, Australia-4343*
[2]*Punjab Agricultural University, Ludhiana, Punjab 141001, India*
**Email: pankaj-2105005@pau.edu*

Annual ryegrass (*Lolium rigidum* G.) is the most problematic winter weed in Australian grain systems, costing about $100 million per annum to growers. Although its occurrence is well documented in southern Australia, its recent detection in eastern Australia increases its significance. Also, this winter weed has been reported during the summer season, suggesting potential seasonal and regional expansion. A study was conducted at the University of Queensland, Gatton, Queensland, to evaluate the effect of environmental conditions on the germination and emergence of four populations (ARG2/23, ARG3/23, ARG7/23, and ARG10/23) of annual ryegrass collected from different areas in eastern Australia. Significant interactions were observed between populations and environmental factors, including temperature regimes, light/dark conditions, water potential, and burial depth. ARG2/23 had higher germination (42-55%) at 25/15°C and 20/10°C compared with 15/5°C and 35/25°C. A similar trend was found for ARG3/23 at 25/15°C and 20/10°C, but the germination percentages (71-73%) were higher than ARG2/23. ARG7/23 had the highest germination (62%) at 25/15°C, which declined at other temperature regimes. ARG10/23 exhibited greater germination (69-76%) at both 25/15°C and 30/20°C than other temperature regimes. Under alternating light/dark conditions, ARG7/23 and ARG10/23 had higher germination (78-81%) than other populations. However, in complete darkness, ARG10/23 and ARG3/23 had higher germination (40-42%) than ARG2/23 (14%) and ARG7/23 (23%). The varying germination responses under different temperature regimes and light conditions suggest that *L. rigidum* populations are more adaptable to fluctuating temperatures and alternating light/dark cycles and have the potential for regional expansion. All tested populations, except ARG7/23, experienced reduced germination under an osmotic potential of -0.1 MPa. Populations ARG3/23, ARG7/23, and ARG10/23 demonstrated greater tolerance to osmotic stress with over 60% germination at -0.2 MPa, whereas ARG2/23 had only 35% germination at -0.2 MPa. Emergence was highest in ARG2/23 (59%) from a 1-cm burial depth but dropped at deeper depths. ARG7/23 and ARG10/23 showed consistent germination at burial depths of 0-2 cm, while ARG3/23 achieved peak germination at 2 cm. Across all populations, emergence rates were negligible (<10%) at burial depths of 8-10 cm. These results suggest that annual ryegrass can grow under a wide range of environmental conditions, with population-specific responses. Emergence may be favoured by no-till systems but can be managed by deep tillage operations that bury seeds deeper than 10 cm. These findings can inform more targeted weed management strategies.

Utilization of a widespread invasive taxa Prosopis juliflora for metal bioaccumulation and detoxification in metal-contaminated Sites

R.V. Akil Prasath* and R. Mohanraj

Department of Environmental Science and Management, Bharathidasan University, Tiruchirappalli, Tamil Nadu 620024, India

**Email: akilprasath13@gmail.com*

Heavy metals emissions from diverse anthropogenic activities accumulate in topsoil, which intern being identified as a hazard zone and causes multiple health hazards to the inhabiting organisms. In India's semi-arid plains, invasion of *Prosopis juliflora* is a menace, the cosmopolitan weed *Prosopis juliflora* flourishly grow even in metal-enriched soils. Therefore the present study envisages to investigate its potential as a hyper-accumulator and detoxifier by analyzing metal concentrations (Cu, Fe, Cr, Cd, Ni, Pb - metal concentration were estimated using AAS) in soil and various plant parts (root, stem, leaves, and pods) from 100 sites at vicinity of vehicular emissions and industrial operations in central districts of Tamil Nadu (Tiruchirappalli, Pudukkottai, Dindigul, Perambalur, Ariyalur) spread across 5500 km2. The study was conducted between October 2021 to October 2023. To evaluate the heavy metal stress tolerance potential physiological parameters like glutathione (oxidized; reduced) and Proline levels were estimated using spectrophotometer. To identify the metals and its respective toxic and non-toxic oxidation states in pods X-ray photoelectron spectroscopy was used. Prosopis juliflora bio-accumulate metals at the rate of 0.138 mg/kg/day DW for Copper (Cu), Fe: 0.142 mg/kg/day DW, Cr: 0.114 mg/kg/day DW, Ni: 0.048 mg/kg/day DW, Pb: 0.052 mg/kg/day DW, Cd: 0.009 mg/kg/day DW. X-ray Photoelectron Spectroscopy (XPS) metal oxidation state analysis infer that in the pods of Prosopis juliflora heavy metals (Fe, Cr, Pb) mostly existed in non-toxic form (toxic: non-toxic - 3:6), while in the under canopy soil, metals primarily existed in toxic form (toxic: non-toxic - 7:2). Stress physiological experiments revealed that metal detoxification potential is attributed to the stress metabolites like oxidized and reduced glutathione, which was found to be high in pods, in comparison to stem and leaf of Prosopis juliflora. Moreover stepwise linear regression revealed that glutathione (GSH) ($R2 = 0.8424$, $p < 0.01$) and proline ($R2 = 0.7924$, $p < 0.01$) increased with a concomitant increase in metals Iron (Fe), Copper (Cu), Chromium (Cr), Cadmium (Cd), Nickel (Ni), and Lead (Pb) in plant system. Between October 2021 and October 2023, metals concentration of iron (Fe), copper (Cu), and chromium (Cr) in the soil of Prosopis juliflora invaded lands decreased over time. On the contrary the concentrations of lead (Pb), nickel (Ni), and cadmium (Cd) in soil increased due to continuous emission form mobile metal sources (vehicular emissions) and the stationary sources (metal industries). There by the present study conclude that the existence of *Prosopis juliflora* at transportation corridors and metal based industrial zones unleash phyto-remediation of heavy metals.

Oral lecture 108

Ecological assessment of weeds of wheat crop in moradabad district, Uttar Pradesh

Sachin Sharma*, S.P. Joshi and Manisha Pandey
Eco-Taxonomy Research Laboratory, Department of Botany, D.A.V. (P.G.) College, Dehradun, Uttarakhand 248001, India
**Email: sachin54907@gmail.com*

Wheat (*Triticum aestivum* L.) is India's second-most important food crop after rice; however, wheat fields are often infected with weeds. Weeds cause irreparable crop damage because of their high level of competition and allelopathic interference. Weed inventory surveys and phyto-sociological investigations in wheat fields were undertaken in Kunderki Block, Moradabad district, Uttar Pradesh, during 2021–23 to determine the weed flora composition, density, frequency, and importance value index of 34 weed species *i.e.* (*Ageratum conyzoides, Cynodon dactylon, Brassica rapa, Lepidium didymum, Poa annua, Chenopodium album, Gnaphalium peguense, Vicia sativa, Solanum nigrum, Lysimachia arvensis, Argemone mexicana, Argemone ochroleuca, Parthenium hysterophorus, Fumaria parviflora, Cyperus difformis, Trifolium repens, Cannabis sativa, Lindenbergia indica, Physalis angulata, Chenopodiastrum murale, Soliva sessilis, Phalaris minor, Melilotus albus, Avena fatua, Eclipta prostrata, Eragrostis minor, Spergula arvensis, Capsella bursa-pastoris, Stellaria media, Euphorbia hirta, Medicago polymorpha, Silene conoidea, Trifolium tomentosum, Trifolium alexandrinum*) in wheat. This study determined and measured the ecological makeup of weeds in wheat crops. The study found six monocot species and 28 dicot species among 34 weed species. The frequency, density, abundance, and relative values were examined. In this study, out of 13 Angiospermic families *i.e.* (*Asteraceae, Amaranthaceae, Brassicaceae, Cannabaceae, Caryophyllaceae, Cyperaceae, Euphorbiaceae, Fabaceae, Orobanchaceae, Papaveraceae, Poaceae, Primulaceae and Solanaceae*), Fabaceae had the most weed species (6 species), while Poaceae and Asteraceae tied for second place with 5 each. Phytosociological studies revealed that *Cynodon dactylon, Brassica rapa, Poa annua, Chenopodium album, Lysimachia arvensis,* and *Fumaria parviflora* have the highest frequency (100%) and Stellaria media have the lowest frequency (30%). Gnaphalium peguense has the highest density (8.77), and the lowest (0.55) is from Chenopodiastrum murale. In terms of abundance, *Gnaphalium peguense* has the highest abundance (8.77), and the lowest (1.20) is represented by *Argemone ochroleuca.* Stellaria media has the lowest important value index (2.33), while Phalaris minor has the highest (21.38). The study aids in planning effective weed management strategies for wheat crops, minimising yield losses, and providing quantitative species appraisal for effective decision-making and further research towards improved control measures. The current study was the first attempt to examine and identify wheat crop weeds. The findings emphasise the need of controlling important weeds at the appropriate time to prevent wheat production loss. To limit seed production, weeds must be eradicated before flowering, either mechanically or with herbicides coupled with cultural activities (manual weeding). Weeding should be done before the booting stage to prevent the slow establishment of a seed bank in the soil, as well as to reduce competition for water and nutrients between crops and weeds. Farmers and agriculturists in the research region would benefit from this sort of study since it will help them create a proper weed management strategy.

ISWS Biennial Conference on "*Climate-smart Weed Management for Global Food Security*", Banaras Hindu University, Varanasi, (India) 28-30 November, 2024.

Oral lecture 109

Hidden tale of glyphosate in Indian environment

Tirthankar Banerjee*[1], Sudama Ram Sahoo[1,3], Subhajit Rakshit[1,3], Sumit Sekhar[1,3], Garima Sethi[1,3], Priya Saini[1], Neethu Narayanan[1], Rishi Raj[2], Suman Gupta[1], Tapas Kumar Das[2] and Neera Singh[1]

[1]Division of Agricultural Chemicals, 2Division of Agronomy, 3The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India

**Email: banerjeetirthankar72@gmail.com*

Glyphosate, the 'once in a century herbicide' (Duke and Powles 2008), introduced half a century ago, is highly effective broad-spectrum weed killer, and it has become the most used herbicide globally and as well as in India. Since then, the myth is, the molecule is considered toxicologically and environmentally safe as people believe that it degrades/disappears within few hours or days after performing broad spectrum weed control. When glyphosate became a generic compound, the cost of it has dropped dramatically and on introduction of transgenic glyphosate-tolerant crops, the use of glyphosate all over the world increased enormously. International Agency for Research on Cancer (IARC) in 2018 opined that glyphosate is associated with liver cancer, diabetes, and cardiovascular illnesses and is "probably carcinogenic to humans" [Group 2A carcinogen] (Anonymous). In 2019, a study was conducted in 11 EU Member States comprised of Northern (United Kingdom and Denmark), Southern (Italy, Greece, Spain), Eastern (Hungary and Poland) and Western EU regions (The Netherlands, France and Germany) highlighted the hidden danger envisaging 80% of the tested soils contained with pesticide residues and glyphosate & its metabolite aminomethylphosphonic acid (AMPA), were most frequently found at the highest concentrations (Silva *et al.* 2019). Peruzzo *et al.* (2008) also detected glyphosate at the levels of 0.10 to 0.70 mg/L in surface water in Argentina. Although, those countries are known to comply with all safety norms for good agricultural practices to protect human health and environmental safety of their country. Predicting the scenario, a study has been conducted all over India to evaluate the glyphosate and AMPA residue status in soil and water using LC-MS/ MS. Glyphosate and its metabolite AMPA, are considered as difficultly analysable pesticides because of high polarity, lack of chromophore group, low vapour pressure, low volatility and it is challenging to accommodate them in the routinely used QuEChERS-based multiresidue sample preparation methods and LC-MS/MS based analysis using most commonly used reverse phase (RP C18) column. Because of the above sighted hindrances, monitoring of these pesticides in food and environmental components in India are lacking and hance people are unaware about fate of these most abundantly used pesticides in India. Therefore, efforts have been made to develop two validated methods for estimation of glyphosate and AMPA in soil and water. The LOQs for glyphosate were 0.01 mg/kg and 0.05 µg/l for soil and water, respectively. More than 400 soil samples and 250 water samples were collected from different parts of India and analysed by LC-MS/MS. The study revealed 75% soil samples were contaminated with glyphosate and 67% with AMPA, whereas 94% water samples were contaminated with glyphosate. Therefore, if glyphosate is used, may be applied judiciously in a restricted manner in the recommended/ designated areas and monitored periodically and cautiously.

Adengo SC 465®: A reliable ally in the battle against hard to control weeds in corn

Ramisis Fulgencio*, Karanpreet Singh, K.S. Vinayaka, Tushar Ghule, K.N. Sharath and Mayank Yadav

Bayer SouthEast Asia Pte. Ltd., Singapore 427161
Bayer CropScience Limited, Mumbai, Maharashtra 400607, India
**Email: ramisis.fulgencio@bayer.com*

Rottboellia cochinchinensis also known as itchgrass has become a serious weed problem in the corn producing areas of Karnataka & Madhya Pradesh, India. It is a highly competitive & invasive grass that can severely reduce corn yields if not managed effectively. This weed is hard to control & farmers are resorting to inter-cultivation practices & manual hand weeding because of heavy infestation of Rottboellia in corn fields. The problem is increasing every year due to the spread of the grass species to other parts of India. Currently, there is no effective one solution for managing Rottboellia in Corn. A combination of chemical control and manual hand weeding is necessary to manage severe infestation which increase labour cost for growers. Sustainable weed management of such hard to control weeds species including *Setaria* spp. and *Commelina* spp, are crucial to maintain the productivity & profitability of corn crop. Bayer CropScience's novel corn herbicide, Adengo SC 465, provides corn growers a new tool to manage Rottboellia and other pernicious weeds. Adengo SC 465 is a pre-emergence herbicide composed of two active ingredients, isoxaflutole (225 g/L) and thiencarbazone-methyl (90 g/L), that combines a dual mechanism of action to target key biochemical pathways in weeds. Isoxaflutole belongs to HRAC Mode of Action Group 27 which inhibits the enzyme 4-hydroxyphenylpyruvate dioxygenase (HPPD), disrupting carotenoid biosynthesis, while thiencarbazone-methyl belongs to HRAC Group 2 that inhibits acetolactate synthase (ALS), affecting amino acid production. Both active ingredients are absorbed by the roots and shoots of weeds, leading to systemic effects that disrupt essential physiological processes. In addition, Adengo SC 465 contains the safener cyprosulfamide (150 g/L), which ensures good crop safety at pre-emergence application. The combination of two mode of actions with different pathways allows Adengo SC 465 to effectively manage a broad range of weeds, including problematic species and delay weed resistance build up. Field trials with use rates of 0.325-0.400 L/ha formulated product have demonstrated that Adengo SC 465 significantly reduces weed biomass and population of Rottboellia, and other weed flora to improve corn yield. It provides better residual control of hard to control weed species than the current post-emergence herbicides in corn in India, while a tank mixture of Adengo SC 465 with other herbicides such as PS II inhibitors (Group 5) or VLCFA inhibitors (Group 15) further extends the residual control with a one-shot application. Thus, helping to prevent new weed emergence throughout the growing season while reducing need for manual weeding. Overall, Adengo SC 465 will be a vital and powerful tool for Indian corn farmers aiming to enhance crop productivity while managing diverse weed populations with reduced weed management cost.

Mateno More®: A promising solution for controlling *Phalaris minor* and mix of broad-leaves weed in wheat crop

Karanpreet Singh*, Ramisis Fulgencio, Yogeshwar More, Gourav Kumar, Anudit Kumar and Mayank Yadav

Bayer CropScience Ltd, Chandigarh, Punjab 160017, India

**Email: karanpreet.singh@bayer.com*

Phalaris minor, a pernicious weed, poses significant threat to wheat productivity in Northern part of India including Punjab, Haryana & UP. Phalaris minor can cause significant yield loss if left uncontrolled in the wheat field. Over the years, this weed has developed resistance to most of the herbicide chemistries including ACCase, ALS inhibitors which is limiting farmers to increase their productivity and causing threat to the food security. Hence, the need of a novel chemistry is necessary for successful cultivation of wheat and is also crucial for the integrated weed management for sustainable Wheat cropping system. Bayer CropScience has been working on various sustainable solutions to resolve complexities of weed management in wheat. Mateno contains a combination of active ingredients that work synergistically to provide effective weed control. Mateno More, a pre-mixture of Aclonifen, Diflufenican & Pyroxasulfone was proven to effectively control *Phalaris minor* and key broad-leaved weeds in wheat. It offers three mode of action herbicides with aclonifen (HRAC Group 32) inhibiting solanesyl diphosphate synthase, diflufenican (HRAC group 12) inhibiting phytoene desaturase thus inhibiting carotenoid biosynthesis in target weeds & Pyroxasulfone (HRAC group 15) inhibiting VLCFA (very long chain fatty acid inhibitor). Mateno works through a systemic action, where it is absorbed by the leaves and roots of the weeds, disrupting their growth processes. This leads to the eventual death of the targeted plants Mateno More was evaluated in multi-location field trials across Punjab, Haryana and western UP states against *Phalaris minor* along with other broad-leaved weeds *Anagallis* spp., *Brassica* spp., *Chenopodium* spp., *Coronopus* spp., *Melilotus* spp., *Solanum* spp. Mateno More provided the best control against aforementioned weed along with better soil residual activity by acting on both root and shoot portion of weeds when pre-emergence stage applied using knapsack sprayer fitted with flat-fan nozzle with water volume of 375 L/ha. This novel herbicide pre-mixture showed consistent performance against different flushes of *Phalaris minor* across different tillage and residue management practices in north-western Indo Gangetic Plains. Mateno More offers the opportunity to successfully manage the resistant biotypes of *Phalaris minor* which cannot be controlled by ALS & ACCase chemistries and will provide an effective option to wheat farmers in India. It enhances wheat yield by reducing competition from weeds, thereby improving nutrient & water availability. Mateno Complete is a versatile herbicide that provides effective weed control in various agricultural settings. Proper usage according to the label instructions will maximize its effectiveness. Overall, Mateno More represents a valuable tool for wheat farmers to control weeds sustainably and optimize crop productivity.

Surfactant-induced modifications in leaching patterns of mesosulfuron-methyl and iodosulfuron-methyl and environmental impact

Harshdeep Kaur* and Pervinder Kaur
Punjab Agricultural University, Ludhiana, Punjab 141004, India
**Email: harshdeepkaur850@gmail.com*

Herbicide leaching in soils poses significant environmental risks, particularly because of its potential to contaminate groundwater resources, which are crucial for drinking water and agriculture. The impact of surfactants on herbicide mobility in soils is complex and can lead to either enhanced or reduced leaching, depending on factors such as the type of herbicide, surfactant, and specific soil conditions. This study investigates how surfactants influence the leaching behaviour of two sulfonylurea herbicides, mesosulfuron-methyl and iodosulfuron-methyl, as well as their transformation products (TPs), across various soil types. In the absence of surfactant, mesosulfuron-methyl residues were primarily confined to the upper 0-10 cm soil layer, with only small amounts leaching to deeper layers, demonstrating limited mobility. However, when surfactants were applied, mesosulfuron-methyl showed significantly increased leaching, with residues detected at depths of 30-40 cm. At the same time, concentrations of the herbicide in the upper soil layers were reduced, suggesting that surfactants facilitated its downward movement. A similar pattern was observed for iodosulfuron-methyl. When surfactants were used, higher concentrations of iodosulfuron-methyl were found at greater soil depths and in leachates, indicating that surfactants enhance its mobility. Furthermore, surfactants accelerated the breakthrough curves (BTCs) for iodosulfuron-methyl, indicating that the herbicide leached more rapidly through the soil profile compared to treatments where surfactants were not present. In addition to their effects on herbicide mobility, surfactants also promoted the downward movement of the TPs. TPs were detected in greater quantities in the lower soil layers and in leachates when surfactants were applied. This suggests that surfactants not only enhance the leaching of the parent herbicides but also increase the movement of their degradation products. The increased mobility of TPs is of particular concern because these compounds can also pose risks to the environment and human health if they enter groundwater supplies. The findings of this study have important environmental implications. The enhanced mobility of both herbicides and their transformation products in the presence of surfactants suggested that the use of surfactants in herbicide formulations could increase the risk of groundwater contamination. This is especially critical for hydrophobic herbicides, which tend to have limited solubility in water but may become more mobile when surfactants are present. Consequently, it is important to carefully evaluate the use of surfactants in agricultural practices, taking into account the potential for increased herbicide leaching. Moreover, the study highlights the complex interactions between surfactants, herbicides, and soils. The effect of surfactants on herbicide mobility depends not only on the chemical properties of the herbicide and surfactant but also on the characteristics of the soil, such as its composition, organic matter content, and texture. Tailored management practices are necessary to minimize the environmental risks associated with herbicide leaching. These practices should consider the specific soil type, herbicide, and surfactant involved, as well as local environmental conditions. By doing so, it may be possible to mitigate the risks of herbicide contamination while still achieving effective weed control.

Trace level quantification of tembotrione and its metabolites in soil, water and plant

Debabrata Ghoshal*[1], Neethu Narayanan, Tirthankar Banerjee, Aman Kumar and Suman Gupta

Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi 110012, india

[1]The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110012, india

**Email: debabrataghoshal47@gmail.com*

Over the recent years, due to increasing population, there is a need for higher production of food crops. For the purpose of getting higher yield, various agrochemicals such as herbicides, insecticides, fungicides *etc*. are applied in the field. For the purpose of weed control, herbicides play a great role along with other weed control measures. And nowadays, different novel herbicides are getting priorities over the conventional ones. One such novel herbicide is tembotrione [2-(2-chloro-4-methylsulfonyl-3-(2,2,2-trifluoroethoxy)-methyl] benzoyl) cyclohexane-1,3-dione)], which belongs to triketone group and has been registered for application in maize in India. It is marketed under the trade name Laudis® (tembotrione 34.4% SC). It is basically a post-emergence herbicide used along with the herbicide safener cyprosulfamide for the control of broad-leaved and grassy weeds. It disrupts carotenoids biosynthesis in plants by inhibiting the enzyme 4-hydroxyphenylpyruvate dioxygenase (HPPD). In India, it is registered for use on maize to control *Trianthema portulacastrum, Echinochloa* sp. and *Bracharia* sp. After foliar application, tembotrione is rapidly taken up into the leaves and transported to the growing parts of the plant. Apart from that, tembotrione also has a potential to contaminate the environment. It is reported to be persistent in soil and water medium. TCMBA (2-Chloro-4-(methylsulfonyl)-3-[(2,2,2-trifluoroethoxy)-methyl] benzoic acid) is the major soil metabolite of tembotrione. It has been reported that tembotrione and its soil metabolite, TCMBA can persist in soil for more than 90 days and can leach up to 30 cm in soil. It shows the groundwater contamination potential of both tembotrione and TCMBA. Apart from the soil metabolite TCMBA, a plant metabolite of tembotrione i. e. M5 (4, 6-dihydroxy tembotrione) has also been reported which is taken into account along with the parent compound in residue definition of tembotrione. From the above, importance of the study of persistence and dissipation pattern of tembotrione is clearly understood. Based on this inference, an extraction-cum-detection and quantification method for tembotrione and its two metabolites has been developed. The extraction of tembotrione and its two metabolites were performed using modified QuEChERS method from soil and plant samples and using DCM based partitioning method from water samples. Subsequently the detection and quantification experiments were performed using LC-MS/MS based method. The calibration curve was prepared with the concentration ranging from 0.001 to 10 µg/g with coefficient of determination (R^2) more than 0.99. The observed limit of detection (LOD) and limit of quantification (LOQ) are 0.001µg/g and 0.05µg/g at signal:noise ratio of 3:1 and 10:1 respectively.

Development of an extraction method for novel triketone and pyrazolone herbicide from various matrices by using response surface methodology and genetic algorithm models

Atanu Sarkar[1], Neethu Narayanan[1], Tirthankar Banerjee[1], Tapas Kumar Das[2] and Suman Gupta*[1]

[1]*Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

[2]*Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: drsumangupta2002@yahoo.com*

Weed infestation is a major problem in crop production. Economic loss of our crops caused by weed infestation is much more than the loss occurred by other phytopathogenic pests like insects, fungi, bacteria, *etc*. That's why the use of herbicides has become foremost important to protect the crop from weeds. In this aspect, there are some novel herbicides of the triketone (tembotrione, mesotrione) and pyrazolone (topramezone, pyroxasulfone) group that are now extensively applied in maize crops to control weeds, viz. *Eleusine indica, Digitaria sanguinalis, Dactyloctenium aegyptium, Echinochloa* spp.*, Chloris barbata, Digera arvensis, Amaranthus viridis, Physalis minima, Alternanthera sessilis, Convolvulus arvensis, Celotia argentea*, etc. These novel herbicides are selective for maize and effectively control weeds in the field. But the problem is that because of injudicious use of herbicides, it can cause residual toxic effects on subsequent crops, resistance development and also may cause toxic effects on non-target organisms. In this regard, there should be a monitoring technique for pesticide residues and their environmental behavior. That's why we developed an extraction method for these triketone (tembotrione, mesotrione) and pyrazolone (topramezone, pyroxasulfone) groups of herbicides from soil, water, and plant matrices (maize and wheat). We tried various extraction and clean-up methods, including QuEChERS, modified QuEChERS, liquid-liquid partitioning (LLP), and SPE (HLB cartridge). Finally, we developed a miniaturized LLP method for extraction and clean-up of herbicide(s). The method was developed by using topramezone, and then recovery% of tembotrione, mesotrione, and pyroxasulfone were also investigated. We used the response surface methodology (RSM) and the genetic algorithm model to develop and optimize the method conditions. Final analysis was done in an LC-MS/MS instrument, and the limit of detection (LOD) of the analytical method was 1 ppb (at 3:1 signal-to-noise ratio). The overall recovery% of all the above-mentioned herbicides were found to be 85% to 97%. The method was repeatable as well as reproducible, with a relative standard deviation (RSD) of d" 10%. As a result, the developed method is valid and efficient for monitoring the residual content of these novel triketone and pyrazolone groups of herbicides in soil, water, and plant systems (maize and wheat).

Adsorption-desorption dynamics of glyphosate in wheat straw biochar enriched biomixtures

Garima Sethi[1,2], Renu Saini[1,2], Tirthankar Banerjee[1], Sudama Ram Sahu[1,2] and Neera Singh*[1]

[1]*Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

[2]*The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: neerasingh@iari.res.in*

This study aims to evaluate the adsorption-desorption behaviour of glyphosate in rice straw-compost biomixtures. To improve pesticide retention and bio-purification effectiveness, 1% and 5% wheat straw biochar (WBC) was added to the rice straw-compost (BM) biomixture, and the adsorption of glyphosate in these biomixtures was assessed. The kinetics study revealed that the pseudo-second-order model best explained the time-dependent adsorption of glyphosate. The percent adsorption of glyphosate in BM, WBC-BM 1% and WBCBM 5% biomixtures ranged from 42.90-67.16, 46.67-76.82 and 53.48-82.04%, respectively. The adsorption coefficients for glyphosate in BM, WBC-BM 1%, and WBC-BM 5% were 26.74, 38.16, and 51.97, with the Freundlich isotherm providing the best fit among the Langmuir, the Freundlich and the Temkin models. The results from desorption experiments suggested that glyphosate's adsorption was irreversible and dependent on the initial concentration of glyphosate. This research proposes that wheat straw biochar mixed with rice straw-compost increased the sorption capacity and can be effectively employed in bio-purification systems for glyphosate removal.

Trace level analysis of glyphosate and AMPA in water using LC-MS/MS

***Subhajit Rakshit[1,3], Sumit Shekhar[1,3], Sudama Ram Sahu[1,3], Soumyajit Ghosal[1,3], Neethu Narayanan[1,3], Neera Singh[1,3], Rishi Raj[2,3] and Tirthankar Banerjee[1,3]**

[1]Division of Agricultural Chemicals, [2]Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India

[3]The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India

**Email: subhajitrakshit99@gmail.com*

Glyphosate, one of the most commonly used herbicides in the world is now become a serious matter of concern to the mankind because of contamination in drinking water resources with glyphosate and it's toxic metabolite, aminomethyl phosphonic acid (AMPA). Several literatures reported the presence of glyphosate in surface water resources which is an alarming sign for us. Additionally, in 2018 the International Agency for Research on Cancer (IARC) classified glyphosate as "probably carcinogenic to humans" (Type IIA carcinogen) and linked to cardiovascular diseases, diabetes, and liver cancer. In these circumstances, a validated mass confirmatory method was developed for trace level analysis of glyphosate in water using Agilent 6470 LC-MS/MS. The method can detect glyphosate at 0.01 µg/L level (LOD) and quantify glyphosate at 0.05 µg/L (LOQ). The method showed good recovery percentage (within 70-100%) for both the analytes. The developed method was validated by SANTE/11312/2021 guidelines. The developed method is rapid, additional pre-concentration step not required, less usage of organic solvent and sample can be prepared within 30 minutes. Real water samples collected from different parts of India and analyzed by the developed, validated mass-confirmatory method for quantification of glyphosate and it's metabolite in water samples. Glyphosate was detected in a number of water samples above the safe limit (As per EU drinking water directive the safe limit of any individual pesticide in drinking water is 0.1 µg/L). AMPA, the major toxic metabolite of glyphosate, was not detected in any of the water samples. The developed validated method can be used for routine quantification of glyphosate and AMPA at µg/L levels in drinking water. In order to understand the true nature of the untold tale and to protect the next generation from drinking water poisoning, it is imperative that glyphosate and AMPA residues in drinking water be monitored exhaustively.

Impact of *Lantana camara* invasion on major soil nutrients and floral diversity of forest in Chhattisgarh

Neelu Singh[1], Rathod Digvijaysinh[2], Himanshu Mahawar[3], Nikita Rai[4] and Shashank Gupta[5]
[1,2,4,5]ICFRE-Tropical Forest Research Institute, Jabalpur, Madhya Pradesh 482021, India
[3]ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India
**Email: singhn@icfre.gov.in*

Alien Invasive weed species are harming native biodiversity, impact on ecosystem services through changing plant communities and soil conditions but it is inadequately documented and remains poorly understood. The aim of study was to assess the variation in the major soil nutrients in the eradicated and uneradicated *Lantana camara* invaded forest area of Chhattisgarh. The present study was conducted in the Chhattisgarh Plains (Marwahi Forest Division). The soil samples were collected from three depths (0-15 cm, 16-30 cm and 31-45 cm) and vegetation analysis also carried out from established permanent sample plots of 1 ha on high, medium and low-density invaded sites. The soil samples were analysed for available nitrogen (N), available phosphorus (P) and available potassium (K) using standard methods. The study revealed significant changes in major nutrients (N, P, and K). The range of N were recorded between 420.22 to 257.15 kg/ha in eradiated area and 388.8 to 128.58 kg/ha in the uneradicated area. The range of P value was recorded between 8.66 kg /ha to 4.18 kg/ha and 7.45 kg /ha to 1.41 kg/ ha in the eradicated and uneradicated area, respectively. The K value was observed between 935.15 kg/ ha to 396.00 kg /ha and 489.92 kg/ha to 280.55 kg/ha in the eradicated and uneradicated area, respectively. The total density of regenerated seedlings and sapling in eradicated area were 620 per ha, 548 per ha and 532 per ha in high, medium and low-density area respectively, whereas in uneradicated area 284 per ha, 236 per ha and 316 per ha in high, medium and low-density area respectively. The recorded good regenerated species under different eradicated area *i.e.* high density: *Shorea robusta, Diospyros melanoxylon, Lagestroemia speciosa and Cliestanthus collinus; medium density: Diospyros melanoxylon* and *Adina cordifolia;* low density: *Peltophorum pterocarpum* and *Butea monosperma*. None of the species has shown good regeneration in the high, medium and low-density uneradicated area. It was concluded that the higher value of major nutrients was observed in the eradicated area compared to uneradicated area. It indicated that eradication of *Lantana camara* boost up the nutrient availability which may be useful for forest tree growth and regeneration of other native species. The management of invasive weed was found helpful to improve the nutrient health of forest soil.

Parasitic weed *Cuscuta* in lucerne and its management

V.J. Patel*, D.D. Chaudhari, H.K. Patel and P.H. Rathod
AICRP-Weed Management, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat 388110, India
**Email: avjpatel28@aau.in*

Lucerne (*Medicago sativa* L.) is an important fodder crop in which parasitic weed Cuscuta is the most damaging annual obligate stem parasite is a serious problem. Looking to this, an experiment was conducted at AICRP-WM farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *Rabi* season of the year 2022-23 on loamy sand soil. The experiment consisted of pendimethalin 30% EC 500 g/ha at 10 DAS, pendimethalin 30% EC 750 g/ha at 10 DAS, pendimethalin 30% + imazethapyr 2% EC (PM) 640 g/ha at 10 DAS, pendimethalin 30% + imazethapyr 2% EC (PM) 800 g/ha at 10 DAS, imazethapyr 35% + imazamox 35% WG (PM) 70 g/ha at 10 DAS, propaquizafop 2.5% + imazethapyr 3.75% ME (PM) 125 g/ha at 10 DAS, quizalofop-ethyl 7.5% + imazethapyr 15% w/w EC (PM) 90 g/ha at 10 DAS and weedy check were tested under randomized block design with three replication. All the recommended package of practices were adopted to raise the crops. At the time of sowing, 5 gram seeds of Cuscuta were mixed with lucerne seed and sown in furrow keeping 30 cm distance between rows in each plot of 18 m^2 area. Herbicides were applied as per the treatment with knapsack sprayer fitted with flat fan nozzle. Results indicated that application of pendimethalin 30% EC 500 and 750 g/ha at 10 DAS and pendimethalin 30% + imazethapyr 2% EC (PM) 640 and 800 g/ha showed some phytotoxic effect (1 score) on lucerne as compared to other herbicides but recovered after 14 days after herbicide application. Further, it was observed that emergence of Cuscuta was initiated 12-15 days after sowing of lucerne. Application of pendimethalin 30% EC 500 and 750 g/ha at 10 DAS and pendimethalin 30%+imazethapyr 2% EC 640 and 800 g/ha at 10 DAS were found effective for Cuscuta management in lucerne in which no emergence of Cuscuta was recorded even after 60 DAS. In general, significantly higher total Cuscuta twines was observed in weedy check as compared to rest of the herbicidal treatments. Significantly higher green fodder yield at 75 DAS was recorded in pendimethalin 30% + imazethapyr 2% EC 640 g/ha at 10 DAS but remained at par with pendimethalin 30% EC 500 and 750 g/ha at 10 DAS. There was no any residual effect of applied herbicides was observed in green fodder of lucerne at 45 DAS.

Ecological consequences of Singapore Daisy invasion on the native weed flora

Soorya Ganesh, P. Gayathri Karthikeyan*, T. Sajiha Rani, K.V. Sumesh and Manju Mary Paul

College of Agriculture, Padannakkad, Kasaragod, Kerala 671314, India

**Email: gayathrikp2013@gmail.com*

Invasive weeds, with their capability to survive and expand even under conditions of sudden ecological disturbances are considered as a threat to global biodiversity. Singapore daisy (*Sphagneticola trilobata* L.), a native of Central America, is a perennial weed belonging to Asteraceae family is listed as one of the world's 100 worst invasive species. The weed is prevalent in all districts of Kerala and is listed as an invasive weed species of the state; the spread has expanded drastically after the flood events that happened in 2018 and 2019. The plant with its lush growth supresses the growth of native flora and once invaded an area, it is very difficult to control and the farmers are unable to cultivate the invaded land. A proper understanding of the factors favouring the spread of the species in a particular habitat along with weed seed bank study would help to analyse weed ecology and predict further infestations for developing successful management practices. Habitat analysis was done by correlating the different soil parameters with plant characteristics from three different invaded areas. Plant height and density had a positive correlation with the available nitrogen content in soil. Weed density had positive correlation with soil moisture, dry weight and soil organic carbon. Negative correlation with soil pH was recorded for plant height, dry weight and leaf area per plant. Weed seed bank studies were done during the three seasons to analyse the effect of the invasive species on the germination of native weed flora. The study revealed that there were about 56%, 22% and 30% reduction in weed flora density during *Kharif*, *Rabi* and Summer seasons respectively in the invaded soils compared to the uninvaded sites. There was reduction in light intensity at ground level by 95.99, 97.71 and 97.77% during *Kharif*, *Rabi* and Summer seasons, respectively in the invaded sites compared to the uninvaded sites. Habitat and weed seed bank analysis of Singapore daisy revealed that the invasive weed has the capacity to survive under a wide range of pH, EC, soil nutrients as well as soil moisture conditions which could be the reason for its survival under various ecosystems in the State. The weed species imparted a negative effect on the presence of native weed flora as revealed by the reduced density of native flora in the invaded soils. The thick lush growth of the weed has also resulted in the reduced light penetration to the soil as revealed by the results of light intensity studies which might have possibly inhibited the germination of the native weed seeds. Further, this study would support in formulating management strategies for controlling the weed and also to prevent further spread.

Influence of *Lantana camara* removal by uprooting on soil microbial properties in deciduous forest of Balrampur, Chhattisgarh

Himanshu Mahawar*[1], Digvijaysinh Rathod[2], Anand Saiyam[1], Ajin Sekhar[2], Saurabh Dubey[2], Sushil Kumar[1], Neelu Singh[2] and K.K. Barman[1]

[1]*ICAR-Directorate of Weed Research Jabalpur, Madhya Pradesh 482004, India*

[2]*Tropical Forest Research Institute, Jabalpur, Madhya Pradesh 482021, India*

**Email: hm.cazri@gmail.com*

Forest soils are among Earth's most diverse microbial habitats, and invasive species like *Lantana camara* (LC) has significantly affected forest biodiversity and soil health. LC, an invasive alien species, invaded Chhattisgarh's major and sub-forest types and has become a nuisance weed. Invasive plants can alter the soil environment through root exudates and litter in ways that differ from those of native plants. Additionally, they may impact the native soil microbiota by affecting the diversity, richness, and function of bacteria, free-living fungus (FLF), and arbuscular mycorrhizal fungi (AMF), as well as the composition of SMC, potentially influencing biogeochemical processes. In the present investigation, LC removal through uprooting in Balrampur forest and its impact on soil microbial populations and major enzyme activities at the surface (0–15 cm) and subsurface (15–30 and 30-45 cm) layers of soil at different densities of LC (high-HD, medium-MD, and low-LD) in Lantana-treated (T) and untreated (UT) plots were studied. The activity of microbial decomposers groups, as measured by FDA's activity, significantly interacted with LC density and eradication ($p = 0.005$, á = 0.05). It was 2.2 and 22.2% higher in HDT and MDT, respectively. In LD, activity was higher in UT soils by ~72% than in T soils. The total bacterial fungal population was higher in the presence of LC, increasing with density at 0–15 cm depth. The HD and MD-infested LC soils showed higher bacterial populations by 1.9 and 3.2-fold, respectively. The fungal population in the soils of UT plots was 32% higher than in T soils. Unlike the total bacterial population, LC infestation, density and soil depth significantly impacted the P-solubilizer population, as evaluated by 3-way ANOVA. Removing L. camara increased the proliferation of P-solubilizing microorganisms by 105%. The population also varied significantly with different infestation densities (high, medium, low), with the highest population recorded under HDUT. The highest population was recorded in the surface layer (0–15 cm) and increased with the depth of the soil. The removal of LC (T) positively affected the FLNF population by 23–45% compared to UT. The study examined the impact of Lantana invasion on native plant species germination and regeneration. Results showed less weed seed germination in soils from Lantana invaded sites compared to uninvaded sites, suggesting Lantana invasion may eventually exhaust other species' soil seed banks. The management approach was successful, with lantana reappearance being greater in untreated areas and lower in treated areas. Our results showed that distribution of functional microbial groups significantly regulated by LC eradication than total microbial populations. This investigation will give insight about soil microbial characteristics under invasive species L. camara.

Survey insights on the ecological and agricultural threat of Ambrosia psilostachya in Karnataka

Mudagadde G Deeksha*[1], Yogita Gharde[1], A.S. Gnanesh[2], A.N. Shylesha[3] and Richa Varshney[3]

[1]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*
[2]*University of Agricultural & Horticultural Sciences, Shivamogga, Karnataka 577201, India*
[3]*ICAR-National Bureau of Agricultural Insect Resources, Bengaluru, Karnataka 560024, India*
**Email: deekshamudagadde@gmail.com*

Ambrosia psilostachya, commonly known as Western Ragweed, is a highly invasive perennial weed native to North America, now spreading across the Tumkur and Hassan districts of Karnataka, India. This study aimed to map its spread and assess its ecological and agricultural impacts in key cropping regions. Field surveys conducted in 2019-2024 across 100 locations in these districts revealed the extensive infestation of *A. psilostachya* in coconut, arecanut, mulberry, bajra, ragi, and vegetable fields. The weed's robust rhizomatous root system and its ability to regenerate from root remnants within 12-20 days of uprooting make it particularly difficult to control. In quadrats, the number of upright plants varied from 20 to 120, indicating dense colonization in some areas, leading to intense competition for resources such as nutrients and moisture, thus reducing crop yields. Additionally, grazing animals such as cattle and goats avoid feeding on the plant, suggesting its potential unpalatability or toxicity. Interestingly, *A. psilostachya* was found to suppress the growth of other weed species in infested areas, indicating its dominance in these ecosystems. Despite the severity of the infestation in Tumkur, successful management efforts in the Bandihalli region of Channarayapatna, Hassan District, led to the weed's eradication. This highlights the potential for targeted management to mitigate its spread. The findings of this survey underscore the need for sustained control measures and further research to predict future spread and mitigate the weed's impact on crop yields and biodiversity. The regeneration ability of *A. psilostachya* poses a significant threat to agricultural productivity and ecosystem health in Karnataka, particularly in areas where it has recently established.

Phanerogamic plant parasites: Approaches of managing parasitic weeds

Stuti Maurya*, Dinesh Sah, Vishwajeet Singh and Alka Pandey
Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India
**Email: stutimaurya0501@gmail.com*

Parasitic plants rely on neighbouring host plants to complete their life cycle, forming vascular connections through which they withdraw needed nutritive resources. Parasitic plants become established in low bio diversified agro ecosystems, their persistence causes tremendous yield losses rendering agricultural lands uncultivable. Parasitic weeds include mainly *Orobanche, Cuscuta, Striga* & *Loranthus*. The management of parasitic weeds is also hindered by their high fecundity, dispersal efficiency, persistent seed bank, and rapid responses to changes in agricultural practices. Several different approaches (cultural, mechanical, chemical, use of resistant varieties, and biological) to control parasitic weeds are currently in use. The only methods currently available to farmers are the use of resistant varieties and chemical control, although both have their limitations. Chemical control with systemic herbicides such as glyphosate or imidazolinones at low rates is possible. Some fungal metabolites assayed were very active even at very low concentrations, such as some macrocyclic trichothecenes, which at 0.1 µM strongly suppressed the germination of *Orobanche ramosa* L. seeds. Interesting results were also obtained with some novel toxins, such as phyllostictine A, highly active in reducing germ tube elongation and seed germination both of *Orobanche ramosa* and of *Cuscuta campestris*. Among the amino acids tested, methionine and arginine were particularly interesting, as they were able to suppress seed germination at concentrations lower than 1 mM. Most promising recent developments has been a technique involving the establishment of *Desmodium uncinatum* between maize rows. The legume exudes isoschaftoside, a C-glycosyl flavonoid which has a powerful allelopathic effect on both *Striga hermonthica* and *Striga asiatica*. Another method proving valuable, at least on a local basis, is the use of naturally herbicide-resistant maize varieties whose seeds can be dressed with an imidazolinone herbicide which kills striga seeds germinating close to the host plant. A possible novel approach has been suggested that an increase in salicylic acid is observed when the plants are inoculated with an incompatible strain of Rhizobium unable to synthesize the Nod factor. Treatment of orobanchae crenata-inoculated peas with Rhizobium leguminosarum 248, mutant nodC- gave a reduction of 74% in orobanchae crenata infection. Another approach has been develop, treatment of seeds of sunflower with salicylic acid to induce phytoalexins which reduce Orobanche attachment and growth. Among novel potential control methods, the development of transgenic tobacco to generate small RNAs which move from the host into *Cuscuta pentagona* haustoria, where they inhibit haustorium development, so reducing infection.For control of loranthus one very novel approach is the use of a'paint-ball' gun to allow direct application of ethephon or other herbicide to mistletoe bunches from the ground. Overall, it may be concluded that we may be winning battles against parasitic weeds here and there but the war is far from won. Continued research is vital to further reduce the problems where they currently occur, while vigilance and the enforcement of sound phytosanitary regulations are vital to reduce the risk of new problems developing.

Poster 1

Climate-smart weed management: Combating weeds for global and Indian agricultural resilience

Kuldeep Kumar*, S. Karmakar and Shruti Jaiswal[1]

Department of Agronomy, Birsa Agricultural University, Ranchi, Jharkhand 834006, India

[1]Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: kdbauranchi@gmail.com*

Climate-Smart Weed Management (CSWM) plays a crucial role in mitigating the substantial effects of weeds on global and Indian agricultural productivity, particularly in light of climate change. Weeds account for 34% of global crop losses, which surpass the damage caused by parasites and diseases. The situation is equally dire in India, where weed infestations are responsible for up to 40% of crop yield reductions in staple commodities such as wheat, rice, maize, and pulses. A comprehensive analysis of weed prevalence in Indian states has been carried out. In the northern regions, *Phalaris minor* and *Chenopodium album* are the most prevalent species, resulting in up to 30% yield losses in wheat fields. In the southern states, *Parthenium hysterophorus* and *Cyperus rotundus* cause significant damage, resulting in 25-35% yield reductions in rice and pulses. CSWM reduces the use of chemical herbicides by 30-50% through the integration of traditional methods, such as mechanical weeding and crop rotation, with contemporary approaches, such as precision agriculture and biological control. Innovative solutions emphasize the utilization of drones to monitor weed proliferation, CRISPR-Cas9 to develop weed-resistant crops, and allelopathic crops to naturally suppress weed growth. The impact of climate change on the proliferation of weeds has also been highlighted, observing that rising temperatures and elevated CO_2 levels disproportionately benefit C3 weeds (*e.g., Chenopodium album*), resulting in accelerated growth and increased competitive pressure on C4 crops such as maize. The focus is put on the fact that food security is in jeopardy, particularly for smallholder farmers in India who rely significantly on agriculture for their livelihoods, in the absence of adaptive weed management strategies that are optimized for local climate conditions. By implementing integrated weed management (IWM) strategies, including biological controls, cover cropping, and no-till farming, farmers can preserve soil health and mitigate environmental degradation, all while ensuring stable yields. The global applicability of CSWM is illustrated through the examination of international case studies, which include the United States, Africa, and Australia. In the United States, precision agriculture reduces herbicide usage by emphasizing site-specific plant control. In Africa, biological control agents are employed to combat invasive species such as *Striga hermonthica*, while in Australia, herbicide-resistant species such as *Lolium rigidum* are managed through diversified cultivation systems and IWM. Under the changing climate conditions, these case studies underscore the importance of a global approach to vegetation management, with CSWM providing sustainable solutions to safeguard both environmental health and food security. By synthesizing data from both Indian and international sources, the widespread adoption of CSWM turned out as an essential strategy for addressing the twin challenges of weed proliferation and climate change in agriculture, to ensure food security globally.

Climate-smart weed management for global food security

Savita Dewangan[1*], Madhusudan Dewangan[2], Bipin Kumar Singh[1] and Alok Kumar Singh[1]
[1]*Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*
[2]*Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India*
**Email: savita87bhu@bhu.ac.in*

Climate-smart weed management (CSWM) is a critical strategy for safeguarding global food security as agriculture faces growing threats from both climate change and weed infestations. Weeds contribute to approximately 34% of global crop yield losses annually, imposing a significant burden on food production systems. With climate change altering weed behaviour, ecology, and interactions with crops, traditional weed control methods are becoming less effective. Factors such as increased atmospheric CO_2, rising temperatures, and changes in precipitation patterns promote the spread of invasive, herbicide-resistant species, which complicate management efforts and threaten long-term food sustainability. CSWM integrates climate resilience into existing weed management practices, offering a holistic approach to address these challenges. It builds on the principles of integrated weed management (IWM), combining cultural, mechanical, biological, and chemical weed control methods to reduce weed pressure while maintaining crop productivity. Precision agriculture technologies, such as remote sensing, GPS-guided machinery, and data analytics, are essential tools in CSWM, enabling farmers to implement site-specific weed control measures, minimize herbicide usage, and reduce environmental harm. In addition to technological advancements, CSWM emphasizes sustainable farming practices like crop rotation, cover cropping, and conservation tillage. These practices improve soil health, enhance water retention, and suppress weed growth, increasing the overall resilience of agricultural systems. Biological controls, including the use of natural weed predators or competitive crops, further reduce reliance on synthetic herbicides, helping to lower greenhouse gas emissions and biodiversity loss. Climate-smart weed management also incorporates predictive modeling and climate forecasting to anticipate weed emergence and shifts in weed-crop competition due to climate change. This enables farmers to adjust management strategies proactively, ensuring timely interventions that safeguard crop yields. Moreover, the selection of crop varieties that are more competitive against weeds and better adapted to climate stressors is a key component of CSWM, helping to mitigate weed impacts while supporting sustainable food production. By integrating these adaptive strategies, CSWM contributes to sustainable agricultural intensification, ensuring that food production systems remain productive under changing climatic conditions. As climate change continues to accelerate, the widespread adoption of CSWM practices is crucial for mitigating yield losses, lowering production costs, and promoting global food security, particularly in regions most vulnerable to climate change impacts.

Poster 3

Climate-smart weed management

Shivani Thakur*, Kusum Sharma, Sakshi Mundra, Jagjeet Panthi and Prem Prakash Parihar

Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India

**Email: shivani1900dangi@gmail.com*

Climate change has an immediate influence on agriculture due to rising atmospheric CO_2. Warmer temperatures, and altered rainfall patterns, all of which have a significant impact on crop and weed physiology and growth. Unlike other pests, weeds compete with agricultural plants for vital resources and are at a comparable trophic level, which results in significant losses in crop productivity. Variations in rainfall patterns also present issues for weed management and increased crop-weed competition, even though CO_2 and temperature are the main causes of climate change. The competitive balance between crops would be shifted and certain xerophytic weed species would benefit from reduced water availability brought on by frequent droughts. The goal of climate-smart weed management (CSWM) is to improve environmental health and food security by combining climate resilience with sustainable agriculture methods. Components of integrated weed management (IWM) include crop rotation, summer tillage, optimum fertilizer scheduling, weed prevention, altered land preparation, changing crop geometry, seed rate, and sowing time, stale seedbed technique, use of weed competitive cultivars, residue, allelopathy, *etc* (Tomar *et al.* 2023). This strategy is crucial for lowering the selection pressure that leads to the emergence of resistance to any one weed management technique. These approaches not only prevent weed growth but also strengthen the soil and retain more water, which increases agricultural resilience (Tiwari *et al.* 2023). It is best to avoid using herbicides and heavy machinery. Today, herbicide resistance in certain weed biotypes is a serious issue. that needs to be addressed. However, new developments in weed control technologies have the potential to increase food production, decrease input requirements, and lessen environmental harm, all of which will inevitably lead to the creation of more sustainable agricultural systems. Smart farming technologies are becoming more prevalent in modern agriculture to help maximize agricultural output and reduce expenses and waste. Examples of these Technologies include smart sensors, satellites, air vehicles, remote sensing, and the Internet of Things (IoT). The idea behind precision farming, also known as site-specific crop Management is the ability to sense and observe crop variability in both space and time, then adjust crop management accordingly. Climate change vis-à-vis continuous and indiscriminate usage of herbicides poses several adverse effects on biodiversity, environment, and human health. Integrated weed management (IWM) components including weed prevention, optimal fertilizer schedule, summer tillage, crop rotation, modified land preparation, altering crop geometry, seed rate and sowing time, stale seedbed technique, use of weed competitive cultivars, cover crops, residue, allelopathy, *etc*., which complement reduced and judicious herbicide application should be promoted to combat weed problems under changing climate.

Poster 4

Climate-smart weed management

Pushpa Meena* and Arvind Verma
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: puspameena146@gmail.com*

Climate-smart weed management is essential for sustainable agriculture in the face of changing environmental conditions. This approach integrates ecological principles and innovative practices to enhance resilience and productivity while minimizing the ecological footprint of weed control strategies. By utilizing a combination of crop rotation, cover cropping, integrated pest management, and precision agriculture techniques, farmers can effectively reduce weed pressures while improving soil health and biodiversity. Additionally, the adoption of organic and low-impact herbicides, alongside mechanical control methods, offers viable alternatives to chemical-intensive practices. There is need for interdisciplinary research and farmer education to develop region-specific weed management practices that are adaptable to climate variability. Ultimately, climate-smart weed management not only supports agricultural productivity but also contributes to broader environmental goals, including carbon sequestration and habitat preservation. Ensuring future food and nutritional security, while reducing poverty are significant global challenges. This is especially true in the Asian-Pacific region, characterized by rapid population growth, food shortages and land use changes. The region is already affected by a changing climate with increased periods of droughts and rainfall in some countries. Efforts to increase crop productivity and reduce existing crop yield gaps are critically-important to meet the targeted food and nutritional security goals in the region. This requires identifying and addressing constraints, such as the changes in weed flora and alleviating the negative effects of weed abundance in cropping fields with sustainable technologies. Climate-Resilient Integrated Weed Management (CRIWM) is a new term that has emerged to assist in this effort. Climate resilient weed management is a way to reduce the negative effects of weeds on crops while adapting to changing climate conditions. It is an intensely-focused approach that aims to increase crop productivity sustainably, while simultaneously reducing the adverse effects of weeds and greenhouse gas emissions of agricultural practices. Climate change influences crop–weed interactions by favoring C4 weeds in the increased temperature scenario and poses serious yield penalties. Since majority of the competitive weeds like *Cyperus*, *Amaranthus, etc*. are C4 plants, these would cause increased problem in future. Although CO_2 and temperature are the major contributing factors for climate change, shifts in rainfall patterns also pose weed management challenges and increased crop–weed competition. Researches must explore new combinations of already well-established methods such as conservation farming, regenerative agriculture, soil health and cultural weed control practices, as well as biological and chemical weed control with an eye for options to reduce reliance on any one technique alone. Precision weed control robotics and other 'climate-smart' innovations (such as the use of solar-powered equipment) appear crucial in planning for more effective weed management under climate change.

Climate resilient weed management strategies for sustainable agriculture

Tripti Pandey*
Institute of Environment Science and Sustainable Development, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India.
**Email: triptipandey1822k@gmail.com*

Weeds account for about one-third of the total agricultural losses caused by pests. They degrade the quality of produce, raise production costs, and act as alternate hosts for several insect pests and diseases. With India's population projected to reach 1.7 billion by the year 2050, and food demand expected to rise to nearly 400 million tonnes, effective weed management is crucial for increasing crop productivity and mitigating the negative impacts of weeds across various ecosystems. In India, weed management faces significant challenges such as small farm sizes, limited availability of labor and mechanical tools, insufficient information on weed biology, shifts in weed flora, and herbicide resistance. Moreover, there is a lack of understanding regarding the impact of climate change on weeds and their control. Ensuring safe herbicide use to avoid harm to human health and the environment, while preventing the development of herbicide-resistant weeds and managing invasive alien species, remains a significant challenge in Indian agriculture. Climate-smart weed management, which integrates both mitigation strategies and adaptive capacities, has the potential to play a key role in sustainable agricultural production and food security under climate change scenarios. This approach involves practices such as the introduction of stress-tolerant crop cultivars, development of resilient crop varieties through plant breeding (both conventional and molecular), and site-specific changes in cropping patterns to adapt to local environmental conditions. It also emphasizes the adoption of an ecosystem-based farming approach and the promotion of Integrated Weed Management (IWM). IWM combines various weed control methods, such as weed prevention, optimized fertilizer schedules, summer tillage, crop rotation, and the use of weed-competitive cultivars, to reduce the need for excessive herbicide applications. Techniques such as modified land preparation, altering crop geometry, adjusting seed rates and sowing times, and the stale seedbed technique are also vital components of IWM. In addition, the use of cover crops, crop residues, and allelopathy (where certain plants suppress weed growth through natural chemical release) can further complement reduced herbicide use. The goal is to reduce reliance on chemical interventions by integrating mechanical, biological, and cultural weed control methods. Furthermore, climate-smart weed management advocates for the use of ecosystem-based approaches to enhance biodiversity, improve soil health, and maintain natural weed suppression mechanisms. These strategies not only address current challenges in weed management but also help build resilience in agricultural systems, making them better equipped to handle future climate uncertainties. In summary, climate-smart weed management focuses on a holistic approach that combines adaptive farming practices with sustainable weed control techniques. It aims to mitigate the effects of climate change on agricultural productivity while ensuring the long-term sustainability of farming systems. By incorporating stress-tolerant crops, integrated weed management practices, and ecosystem-based approaches, farmers can combat weed-related challenges more effectively while safeguarding food security and environmental health. This comprehensive strategy is essential for meeting the growing food demands of a rising population while protecting ecosystems and maintaining agricultural productivity in the face of a rapidly changing climate.

Poster 6

Weed management practices under climate change scenario – A review

Rakhee Priya Baruah*
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
Email: rakheepriyabaruah@gmail.com

Climate change is emerging as one of the major challenges influencing the productivity and success of agriculture. Various threats of climate change such as drought, flood, cold wave, heat wave, pest population explosions and other extreme climatic events are causing severe impact on global food security. One of the key reasons of climate change is the increase in atmospheric concentration of greenhouse gases (GHGs) leading to an alarming rate of global warming. With the current emission trends, atmospheric CO_2 concentration is expected to reach 600-700 ppm by the end of the 21st century, which is about 422 ppm currently and was only about 280 ppm during pre-industrial era. Weeds are the unwanted plants growing out of place and time, causing direct or indirect adverse effects on crop production. Climate change directly influences the geographic distribution and population dynamics of both crops and weeds. Increasing concentration of atmospheric CO_2 leads to change in temperature and rainfall patterns, which impacts both growth pattern and management practices of weeds. It is reported that elevated CO_2 is beneficial for the plants having C3 photosynthetic pathway as compared to C4 plants. It will provide competitive advantages to C3 crops over C4 weeds but will also benefit C4 weeds. Also, increased CO_2 favours the growth of weeds when both crops and weeds possess same photosynthetic pathway. Moreover, C4 weeds will have a competitive advantage over staple food crops (mostly C3) under high temperature conditions. With the changing climate, weed population is expected to increase due to their genetic makeup and high adaptive capacity to grow under adverse environments. Management of weed is a key challenge under climate change scenario. Agriculture sector is not only vulnerable to climate change but also it is one of the major contributors of climate change. Different agricultural practices, *viz.* excessive soil disturbance, use of fossil fuel, agrochemicals *etc*. lead to the emission of GHGs. Weed management practices adopted under climate change scenario should favour crop competitive ability over weeds along with mitigating the causes of climate change. It is possible through the integrated use of different weed control methods starting from preventing measures to minimal use of herbicides. Mechanical methods combined with sensors such as electric powered robot, which can detect weed patches efficiently will lead to less combustion of fossil fuel. Conservation agricultural practices such as zero tillage also increase the vulnerability of annual weed seeds to predation by birds or any other agents by keeping them in the surface of soil. Precision farming tools such as use of drones to spray herbicides will also reduce the amount of herbicide required. Along with technological innovations, nature-based practices such as use of mulch, cover crops, crop rotation and other components of integrated weed management (IWM) such as use of biological control agents *etc*. will provide a climate resilient approach of weed management in the face of climate change.

Poster 7

Effect of climate-smart weed management strategies on weeds, productivity and soil organic carbon under rice-wheat cropping system in Eastern Uttar Pradesh

Riju Pratap Singh* and Pratik Sanodiya
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: riju0.23@gmail.com*

The rice-wheat cropping system (RWCS), one of the world's largest agricultural systems, spans 26 million hectares across the Indo-Gangetic Plains (IGP) of South Asia, feeding over 20% of the global population. In the IGP, 13 million hectares are devoted to this system, with 10 million hectares in India alone. However, RWCS faces growing challenges from climate change, weeds, and conventional farming practices. Weeds cause up to 40% of yield losses globally, surpassing the combined impact of pests and diseases. Conventional weed management exacerbates problems like soil degradation, reduction in soil organic carbon (SOC), loss of biodiversity, and higher greenhouse gas emissions, highlighting the need for climate-smart weed management (CSWM) as part of sustainable agriculture. To evaluate CSWM's effectiveness compared to conventional methods, a study was conducted at the Institute of Agricultural Sciences, Banaras Hindu University, Varanasi in year 2023-24. The experiment included six treatments with four replications in a randomized block design. Weed density and dry weight were recorded at 30 and 50 days after sowing (DAS) and at the flowering stages of both rice and wheat. Measurements were taken from two randomly selected spots within the net plot area using a 100 cm x 100 cm quadrat. The study demonstrated that adopting full conservation agriculture (CA) practices, such as zero-till direct-seeded rice-wheat-mungbean (CE6: ZTDSR-ZTW-ZTMB), substantially reduced both weed density and dry weight in rice. Weed density decreased by 30%, 33.7% and 35% at 30 DAS, 50 DAS, and the flowering stage, with dry weight reductions of 32%, 27.4%, and 41.3% respectively. These improvements led to a 34.6% increase in rice yield and a significant increment in net returns compared to conventional till rice-wheat (CE1: CTR-CTW). Similarly, in wheat, CE6 produced 17% more grain yield and boosted net returns by 34.7% compared to conventional tillage (CE1). Weed density reductions in wheat were 22.4%, 26.5%, and 32.5% at 30 DAS, 50 DAS and the flowering stage, respectively, with dry weight decreases of 23%, 25%, and 17.6%. The total system productivity of CE6 (0.026 t/ha/day) surpassed CE1 (0.020 t/ha/day), leading to greater farmer profits and an improved benefit-cost (B:C) ratio of 1.89. Weed management strategies under Climate-Smart Weed Management (CSWM) in the rice-wheat cropping system (RWCS) are particularly significant for enhancing soil organic carbon (SOC). Conventional tillage depletes SOC through soil oxidation, while CSWM practices help sequester carbon by maintaining soil cover, reducing tillage-induced CO_2 emissions, and encouraging root biomass growth. Additionally, incorporating leguminous crops into the rice-wheat rotation under CA-based systems further boosts SOC levels by fixing nitrogen and adding organic inputs. Studies show that CE6 increases SOC, available nitrogen, phosphorus, and potassium by 34, 29.1, 19.4 and 9.4%, respectively, compared to CE1. These enhancements improve soil fertility, water retention, and the system's resilience to climate variability. In conclusion, Climate-Smart Weed Management, within a broader conservation agriculture framework, provides a promising alternative to conventional weed management in the RWCS. By reducing weed pressure, boosting soil organic carbon, and promoting sustainable intensification, CSWM contributes to long-term agricultural productivity and environmental sustainability.

Eco-friendly solutions: Climate-smart weed management practices

Anchal Singh*[1], Shweta Gupta[2], Ankur Tripathi[3] and Devrani Gupta[1]

[1]*Banda University of Agriculture & Technology, Banda, Uttar Pradesh 210001, India*

[2]*Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh 208002, India*

[3]*Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya, Uttar Pradesh 224229, India*

**Email: anchalsinghbuat123@gmail.com*

Climate Smart Weed Management (CSWM) represents a proactive and adaptive approach designed to tackle the challenges posed by climate change in agricultural systems through sustainable and integrated weed control methods. As climate conditions evolve, the emergence and resistance of various weed species can escalate, jeopardizing crop productivity and farmers' economic stability. CSWM focuses on implementing practices that enhance agricultural resilience, lower greenhouse gas emissions, and promote ecological diversity. Key strategies within CSWM include the integration of cover crops, crop rotation, and agroecological techniques that naturally suppress weed growth. Additionally, the use of precision agriculture technologies enables farmers to optimize herbicide applications, thereby reducing chemical use and its associated environmental impacts. CSWM also emphasizes the importance of knowledge-sharing and collaboration among farmers, researchers, and extension services to foster innovative solutions tailored to local contexts. This comprehensive approach not only aims to manage weeds effectively but also contributes to the sustainability and resilience of farming systems in the face of a changing climate. By prioritizing environmental health and agricultural productivity, CSWM ultimately seeks to support food security and the livelihoods of farming communities. As climate change poses significant challenges to agriculture, effective weed management becomes increasingly essential for sustainability. Traditional practices often rely heavily on chemical herbicides, which can harm the environment and lead to herbicide-resistant weed populations. Climate-smart weed management integrates ecological principles with innovative technologies. It emphasizes practices that enhance soil health, conserve water, and protect biodiversity. Key strategies include utilizing cover crops, implementing crop rotation, and adopting reduced tillage techniques. Cover crops, such as legumes, effectively suppress weed growth and improve soil fertility by fixing nitrogen and increasing organic matter. Crop rotation disrupts weed life cycles and decreases dependence on chemical herbicides, fostering a more resilient agricultural ecosystem. Additionally, the use of biocontrol agents—natural predators and pathogens—provides a sustainable alternative to chemical solutions. These agents can effectively manage weed populations while minimizing ecological disruption. Precision agriculture technologies, such as remote sensing and data analytics, enable farmers to monitor weed populations and implement targeted interventions, thereby reducing herbicide usage. By leveraging these technologies, farmers can make informed decisions that align with climate-smart practices, ultimately bolstering their resilience against climate variability. In conclusion, embracing eco-friendly, climate-smart weed management practices is vital for developing resilient agricultural systems capable of addressing the challenges of climate change.

Poster 9

Evolution of herbicide resistance in weeds of the rice-wheat cropping system in South Asia: Challenges, implications, and management strategies

Charul Chaudhary*, R.S. Chhokar and Ratan Tiwari
ICAR-Indian Institute of Wheat and Barley Research, Karnal, Haryana 132001, India
**Email: c.charul19@gmail.com*

The pressing issue of herbicide resistance in weeds affecting the region's dominant agricultural system, the rice-wheat cropping system (RWCS). This system plays a crucial role in ensuring food security for South Asia, covering over 13.5 million hectares. However, weeds pose a significant biotic challenge to both crop yield and quality, exacerbated by the shift from traditional tillage methods to conservation agriculture practices. The introduction of herbicides has provided an economically viable and efficient method of weed control, but their overuse has led to a proliferation of herbicide-resistant weed species, particularly in India, Pakistan, and Sri Lanka. Weeds such as *Phalaris minor*, a major weed species in the RWCS, have developed resistance to common herbicides like isoproturon, posing significant challenges for weed management. Herbicide resistance in weeds is primarily driven by the repeated and injudicious use of herbicides, which applies selection pressure on weed populations, favoring the survival of resistant biotypes. The most prevalent forms of resistance in South Asia include cross-resistance and multiple resistance, with resistance being most problematic in India, where herbicide-resistant weed biotypes are causing widespread concern. Manual and cultural weed management practices, such as crop rotation and the use of competitive crop varieties, are discussed as essential components of an integrated weed management (IWM) strategy. However, labor shortages and rising costs make manual weeding less feasible, pushing farmers towards greater reliance on herbicides. This has resulted in increased resistance, necessitating alternative methods such as targeted fertilizer placement and mechanized weeding systems. The mechanisms behind herbicide resistance, dividing them into target-site resistance (TSR) and non-target-site resistance (NTSR). TSR occurs when a mutation alters the herbicide's molecular target, reducing its efficacy. NTSR involves mechanisms such as enhanced herbicide metabolism or reduced herbicide translocation. To understand these mechanisms is key to designing new strategies to manage resistant weed biotypes. A comprehensive IWM strategy, including herbicide rotation, use of herbicide mixtures, and non-herbicide control measures. Additionally, cultural practices like adjusting crop rotation, sowing time, and tillage methods, as well as monitoring weed populations, are recommended to delay the development of resistance. Finally, there is need for further research and the development of new herbicide molecules to combat herbicide-resistant weeds. With the population of South Asia projected to increase dramatically by 2050, it is crucial to optimize RWCS practices to sustain food security. We need a foundational understanding of herbicide resistance in the RWCS and offers practical solutions for its management.

Poster 10

Enhanced chemical weed management efficiency through induced herbicide resistance in crop plants

P Halesha*[1], Ram Narayan Meena[1], Lakey Radha[1], Kareti Harika[1] and Ved Prajapati[2]
[1]*Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*
[2]*Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan 313001, India*
**Email: haleshp85@bhu.ac.in*

Weeds are one of the most significant challenges in agricultural productivity, competing with crop plants for resources and herbicides, as chemical agents, play a crucial role in weed management strategies by inhibiting or disrupting weed growth, thus enhancing crop yields. However, the efficiency of herbicide-based weed management is often limited by factors like non-target effects, environmental concerns and the evolution of herbicide-resistant weed species. In the realm of agricultural advancement, the incorporation of herbicide resistance in crop plants represents a transformative approach towards achieving increased weed management efficiency by counterfeiting these challenges. By genetically or biochemically modifying crop plants to tolerate specific herbicides, the selectivity of weed control can be improved, reducing the competition from weeds while ensuring the safety of the crop. The utilization of genetic engineering and selective breeding has opened avenues for the development of crop varieties that can withstand herbicides, thereby allowing for more effective and precise weed control. Advancements in these fields have paved the way for the introgression of herbicide-resistant genes into crop genomes. Breakthroughs in CRISPR-Cas9 technology and RNA interference have further expanded the toolkit available for creating herbicide-tolerant plants such as those conferring resistance to glyphosate, glufosinate or ALS (acetolactate synthase)-inhibiting herbicides, making the technology more precise, affordable and accessible. For instance, crops like corn, soybean and cotton have been successfully engineered to express herbicide-resistant genes, enabling the use of herbicides that would otherwise harm these plants. Case studies on genetically modified organisms (GMOs), such as Roundup Ready soybeans and Bt cotton, were extensively discussed for their role in revolutionizing weed management practices, demonstrating significant enhancements in crop resilience and yield. Additionally, the potential of natural herbicide-tolerant mutants, identified through plant breeding programs, is explored as a means of enhancing herbicide resistance without the need for transgenic modifications. Breeding strategies that focus on selecting herbicide-tolerant crop varieties offer an environmentally sustainable alternative, with fewer regulatory and societal hurdles compared to genetically engineered crops. Safeners, as another approach, are examined for their role in protecting crops by enhancing the plant's metabolic ability to degrade herbicides or sequester toxic compounds, thereby preventing damage while allowing the herbicide to target weeds selectively. Despite the benefits of inducing herbicide resistance in crops, this approach is not without challenges. There are ecological concerns related to the potential for herbicide-resistant weeds to emerge due to gene flow or the overreliance on certain herbicides. Thus, it is of utmost importance to adopt integrated weed management (IWM) practices that combine herbicide-tolerant crops with mechanical, cultural and biological weed control measures to mitigate the risk of resistance development. In conclusion, inducing herbicide resistance in crop plants presents a viable solution to improve weed management efficiency, reduce crop-weed competition and enhance agricultural productivity. However, it must be implemented alongside sustainable weed management practices to ensure long term efficacy and ecological safety.

Poster 11

Emerging challenges for weed management in herbicide-resistant crops

Devasheesh Kumar* and Vipul Kumar Rawal
Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan 313802, India
**Email: devasheeshkumar85@gmail.com*

Herbicide resistance in weeds is a significant challenge in modern agriculture, threatening crop yields and sustainability. This phenomenon arises when weed populations evolve mechanisms to survive applications of herbicides that were previously effective. The widespread and often indiscriminate use of herbicides has accelerated the development of resistance, with over 500 species now documented as resistant to one or more herbicides. This review examines the mechanisms of herbicide resistance, the impacts on crop production, and the economic implications for farmers. Effective management strategies for herbicide-resistant weeds include the adoption of Integrated Weed Management (IWM) practices, which incorporate cultural, mechanical, and biological methods alongside chemical control. Cultural practices such as crop rotation, cover cropping, and diverse planting systems can disrupt weed life cycles and reduce reliance on herbicides. The mechanisms behind herbicide resistance, including target-site mutations and enhanced metabolic pathways, and discusses the implications for crop production and agricultural sustainability. The economic impact of herbicide-resistant weeds is substantial, leading to increased management costs and reduced crop yields, which ultimately affect food security Mechanical approaches, such as targeted tillage and mowing, can physically remove weeds and prevent seed bank replenishment. Additionally, emerging technologies like precision agriculture and the use of herbicide mixtures can enhance the effectiveness of weed control while minimizing resistance development. Effective management strategies are essential to combat herbicide resistance. Integrated Weed Management (IWM) is a proactive approach that combines cultural, mechanical, biological, and chemical methods to mitigate resistance development. Cultural practices such as crop rotation, cover cropping, and intercropping disrupt weed life cycles and reduce herbicide dependency. Mechanical strategies, including precision tillage and targeted mowing, can significantly reduce weed seed banks. Additionally, the incorporation of biological control agents and the use of herbicide mixtures can enhance control efficacy and delay resistance. The critical need for a multifaceted approach to manage herbicide resistance in weeds, ensuring sustainable crop production and protecting agricultural ecosystems. Continued research and farmer education are essential to develop adaptive management strategies that respond to the evolving challenge of herbicide resistance.

Evaluation of herbicide resistance in *Phalaris minor* populations and its management in wheat

Paras Kamboj*, SS Punia, DB Yadav, Todarmal Poonia and Ankur Chaudhary

Department of Agronomy, Regional Research Station, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125004, India

**Email: paras.thind@gmail.com*

Phalaris minor is most troublesome weed of wheat crop, mainly in rice-wheat cropping system. The menace of *P. minor* has worsened after the evaluation of herbicide resistance against the recommended herbicides. For the implementation of management strategies against the troublesome weed, the pot and field studies were planned and conducted during *Rabi* 2018-19 and 2019-20. The pot study was conducted in the screen house of Department of Agronomy and field study was conducted at research farm, Department of Agronomy, CCSHAU, Hisar. In Pot study, the level of resistance of fifteen *P. minor* populations to the graded doses (0 (control), 0.5x, x (recommended dose), 2x and 4x) of clodinafop, sulfosulfuron, mesosulfuron + iodosulfuron (RM) and pinoxaden was assessed. For the pot study, populations were collected during *Rabi* 2017-18 from the farmer's field on the basis of the problem reported by the farmers. In field study, pendimethalim 1500 g/ha, aclonifen + diflufenican (RM) 1000+200 g/ha, pyroxasulfone+ pendimethalin (TM) 127.5 + 1500 g/ha, mesosulfuron + iodosulfuron (RM) 14.4 g/ ha, sulfosulfuron metsulfuron (RM) 32 g/ha, pinoxaden + metsulfuron (TM) 64 g/ha, clodinafop + metribuzin 60+175 g/ha applied in mixtures and sequences against resistant *P. minor* was evaluated. P. mimor populations Kachhwa and Chanarathal populations were found highly resistant to clodinafop (ACCase inhibitor) and sulfosulfuron (ALS inhibitor) whereas Sitamai evolved highly resistant to clodinafop (ACCase inhibitor), sulfosulfuron and mesosulfuron + iodosulfuron (RM) (ALS inhibitor). Pre-emergence application of pyroxasulfone+ pendimethalin 127.5+ 1500 g/ha *fb* sequential application of pinoxaden + metsulfuron 64 g/ha followed by post-emergence application of mesosulfuron+ iodosulfuron 14.4 g/ha was the most effective weed control treatment and provided 279 per cent control of total weeds, these treatments had lower weed index, among the herbicide treatment thus reflecting less loss in crop yield.

Combating herbicide resistance in agricultural weeds and crops

Pawan Ahari*, Rajendra Choudhary and Vishakha Sharma
Department of Agronomy College of agriculture, Udaipur, Rajasthan 313802, India
Email: pawanahari176@gmail.com

Herbicide resistance in weeds and crops poses a significant challenge to global agricultural productivity and sustainability. This phenomenon occurs when weed species evolve to survive applications of herbicides that previously controlled them, leading to reduced efficacy of these chemicals and increased difficulty in managing weed populations. The development of herbicide resistance is driven by various factors, including the repeated and exclusive use of herbicides with the same mode of action, genetic variability among weed populations, and environmental conditions that favour resistant biotypes. Currently, there are over 500 unique cases of herbicide resistance reported globally, affecting more than 250 weed species. These resistant biotypes exhibit various mechanisms of resistance, such as target site mutations, enhanced metabolic detoxification, and sequestration of herbicides. The widespread occurrence of herbicide-resistant weeds necessitates the adoption of integrated weed management (IWM) strategies that combine chemical, cultural, mechanical, and biological control methods. Effective management of herbicide resistance involves several key practices. Rotating herbicides with different modes of action can help prevent the selection of resistant biotypes. Implementing crop rotation and diversification disrupts weed life cycles and reduces the selection pressure for resistance. Mechanical control methods, such as tillage and mowing, can physically remove resistant weeds. Biological control, including the use of cover crops and competitive crops, can suppress weed growth through natural competition and allelopathy. Additionally, the development and use of herbicide-resistant crop varieties can provide an alternative means of managing resistant weed populations. However, this approach must be carefully managed to avoid the potential for cross-resistance and the emergence of new resistant biotypes. Monitoring and early detection of herbicide resistance are crucial for timely intervention and effective management. In conclusion, herbicide resistance in weeds and crops is a complex and evolving challenge that requires a multifaceted approach. By integrating diverse weed management practices and promoting sustainable agricultural practices, it is possible to mitigate the impact of herbicide resistance and ensure long-term agricultural productivity and environmental health. Continued research and innovation in weed science are essential to develop new strategies and technologies for managing herbicide resistance effectively.

Impact of different formulations of pendimethalin on weed control efficiency and seed production capacity of *Echinochloa colona* in dry direct-seeded rice under different soil moisture contents

Pijush Kanti Mukherjee*, Aman Malhotra and V.K. Choudhary
ICAR-Directorate of Weed Research, Maharajpur, Jabalpur, Madhya Pradesh 482004, India
**Email: pkm_agronomy@yahoo.co.in*

The present investigation was conducted during *kharif* season of 2023 at research farm of ICAR-Directorate of Weed Research Jabalpur, M.P under ICAR-IRRI collaborative project. There were seven treatments, six treatments for each formulation of pendimethalin (30 EC and 38.7 CS) and one was weed free plot. The treatments were constituted based on soil moisture contents at the time of application of pendimethalin. The treatment pendimethalin 30 EC 1000 g/ha at 119.50 hours after sowing (HAS) at soil moisture content 33.1% recorded the maximum reduction in weed dry biomass of 0.0, 25.9, 89.3, 178.3 and 384.0 g/m^2 and highest weed control efficiency of 100%, 88%, 66%, 53% and 38% at 20, 40, 60, 80 days after sowing (DAS) and at harvest, respectively. Treatments of lower soil moisture contents registered higher population and dry weight of grasses, whereas treatments of higher soil moisture contents recorded higher population and biomass of broadleaf weeds. At the lower soil moisture contents, grasses like *Echinochloa colona* recorded higher density, whereas at higher soil moisture contents broadleaf weeds like *Alternanthera paronychioides* and *Ludwigia parviflora* showed aggressive growth and accumulated high dry matter. *Dinebra retroflexa* appeared both in lower and higher soil moisture contents; however, because of the intense competition from the broadleaf weeds, the values of dry matter accumulation were lower at higher soil moisture contents. Among the others weeds, *Cyperus iria* emerged throughout the soil moisture contents and *Trianthema portulacastrum* specifically preferred to emerge at higher soil moisture content. The treatment pendimethalin 30 EC 1000 g/ha at 92.25 HAS at soil moisture content 29.6% recorded highest seed production capacity of *Echinochloa colona* (3168, 35100 and 28080 seeds/m^2 at 60, 80 DAS and at harvest, respectively), whereas lowest seed production capacity (1050, 9926 and 8640 seeds/m^2 at 60, 80 DAS and at harvest, respectively) was registered at soil moisture content of 37.4% at 166.25 HAS. The treatment pendimethalin 38.7 CS 678 g/ha at 92.25 HAS at soil moisture content 27.2% recorded highest seed production capacity (8512, 39600 and 34320 seeds/m^2 at 60, 80 DAS and at harvest, respectively), whereas lowest seed production capacity (1080, 11880 and 9900 seeds/m^2 at 60, 80 DAS and at harvest, respectively) was recorded at soil moisture content 34.8% at 166.25 HAS. The treatments of increasing soil moisture content shown the negative trend of seed production capacity of *E. colona.* From the experiment, it could be concluded that the efficacy of pendimethalin at 30 EC formulation was comparatively higher than 38.7 CS formulation. Pendimethalin in both the formulations registered highest weed control efficiency at optimum moisture contents of 30.6% for 38.7 CS and 33.1% for 30 EC and below and beyond that moisture contents the efficacy values showed declining trend. The 30.6% and 33.1% moisture contents conferred higher efficacy for controlling weeds, comparatively higher yield and higher economic returns in case of pendimethalin 38.7 CS and 30 EC formulation, respectively.

Impact of tillage system and weed management practices on weed dynamics, crop growth and yield of direct seeded upland rice under the foothill of Nagaland

T. Malemnganbi and A.P. Singh*

Department of Agronomy, SAS, Nagaland University, Medziphema, Nagaland 797106, India

**Email: apsinghnagalanduniversity.ac.in*

A field experiment was conducted at the experimental farm of School of Agricultural Sciences (SAS), Nagaland University, Medziphema campus during the *Kharif* seasons of 2021 and 2022 to study the effect of different tillage system and weed management practices on rice (*Oryza sativa* L.) growth, yield and weed suppression. The treatment consisted of three tillage system, *viz*. zero tillage, minimum tillage and conventional tillage in the main plot and six weed management practices *viz*., stale seedbed *fb* bispyribac sodium 25 g/ha (PoE) at 25 DAS, pyrazosulfuron-ethyl 0.02 kg/ha (PE), stale seedbed *fb* pyrazosulfuron-ethyl 0.02 kg/ha (PE) *fb* cyhalofop-butyl 90 g/ha (PoE) at 25 DAS, pendimethalin 1.0 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha (PoE) at 25 DAS, weed free and weedy check in the sub-plot. The experiment was laid out in split plot design (SPD) with three replications. The result of pooled data revealed that conventional tillage system recorded the lowest weed population (278.33), weed dry weight (266.29 g/m^2), highest weed control efficiency (72.27%), plant height (76.04 cm), number of tillers/m^2 (233.92), dry matter accumulation (13.22 g/m^2), panicle length (17.87 cm), panicle weight (2.15 g), number of grains/ panicle (85.99), harvest index (40.96%) and grain yield (4086.57 kg/ha) as compared to the other tillage systems. Among the weed management practices, the lowest weed population (72.67), weed dry weight (86.14 g/m^2), highest weed control efficiency (91.33%), plant height (76.83 cm), number of tillers/ m^2 (247.50), dry matter accumulation (14.01 g/m^2), panicle length (18.17 cm), panicle weight (2.35 g), number of grains/panicle (89.77), harvest index (42.06%) and grain yield (4487.92 kg/ha) were recorded with application of pendimethalin 1 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha (PoE) at 25 DAS during both the years. Hence, it was concluded that application of pendimethalin 1 kg/ha (PE) *fb* bispyribac sodium 25 g/ha (PoE) at 25 DAS under conventional tillage was most effective in suppressing overall weeds recording the highest yield attributes and grain yield of direct seeded rice under foothill of Nagaland.

Poster 16

Effect of soil mulch practice and herbicides on weed growth, productivity and profitability of direct seeded rice-yellow sarson cropping sequence in lateritic soil of West Bengal

Ruchi Bharti*[1], B. Duary[1] and Virender Kumar[2]

[1]*Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal 713216, India*

[2]*International Rice Research Institute, Los Banos, Philippines*

**Email: ruchibharti73@gmail.com*

A field experiment was carried out at the Agricultural Farm of the Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal during *Kharif* 2022 and *Rabi* 2022- 2023 to evaluate the effect of soil mulch practice and herbicides on weed growth and productivity of direct seeded rice (DSR), cultivar 'MTU 1010' and its effect on succeeding yellow sarson cultivar, 'B- 9' in DSR- yellow sarson cropping sequence. Two soil mulch practices, *viz*. sowing of DSR after pre-sowing irrigation (soil mulching) and sowing followed by irrigation (no mulching) were allocated in the main plot and five herbicide treatments, *viz*. pre-emergence (PE) oxadiargyl 90 g/ha; post-emergence (PoE) bispyribac-sodium 25 g/ha; oxadiargyl 90 g/ha *fb* bispyribac-sodium 25 g/ha; premix triafamone 20% + ethoxysulfuron 10% 60 g/ha and unweeded control in the sub-plot in a split plot design replicated thrice. Yellow sarson was sown under zero tillage dividing each sub plot into two – one as control to study the effect of treatments applied in DSR and in another plot recommended herbicide pendimethalin at 0.75 kg/ha was applied as pre-emergence. The predominant weed species in DSR were *Digitaria sanguinalis*, *Echinochloa colona*, *Leptochloa chinensis* and *Paspalum notatum* among the grasses, *Cyperus iria* among the sedge and *Alternanthera sessilis* among the broad-leaved. *Digitaria sanguinalis* and *Cynodon dactylon* among the grasses and *Spilanthes calva*, *Polygonum plebeium* and *Gnaphalium indicum* among the broad-leaved weeds were predominant in yellow sarson. Density and biomass of *D. sanguinalis*, *E. colona*, *L. chinensis, P. notatum, A. sessilis* and *C. iria* were 44.5 and 44.4%, 38.9 and 49.3%, 38.7 and 47.3%, 28.5 and 46.6%, 27.2 and 29.6% and 49.7 and 53.3% lower, respectively, under the soil mulch sowing over no mulching Soil mulch sowing registered 22.2% more rice grain yield and Rs. 15170/ha more net return than no mulch. Among herbicide treatments, PE oxadiargyl 90 g/ha *fb* PoE bispyribac-sodium 25 g/ha recorded significantly lower density and biomass of different weeds species, more rice grain yield and net return (Rs. 56752/ha). Soil mulching in DSR registered lower density and biomass of grasses, broad-leaved and total weeds to the tune of 38.68 and 43.47%, 54.27 and 47.84%, and 47.35 and 45.2%, respectively in yellow sarson also with 10.56% higher seed yield and Rs. 8118/ha more net return than no mulching. The PE oxadiargyl 90 g/ha *fb* PoE bispyribac-sodium 25 g/ha in DSR and PE pendimethalin at 0.75 kg/ha in yellow sarson recorded significantly lower weed density and biomass of grasses, broadleaved and total weeds, higher seed yield and net return (Rs. 57785/ha). Thus, soil mulching with sequential application of PE oxadiargyl 90 g/ha *fb* PoE bispyribac sodium 25 g/ha in DSR and PE pendimethalin at 0.75 kg/ha in yellow sarson with zero tillage appeared to be promising for effective management of complex weed flora, higher productivity and profitability in dry DSR– yellow sarson cropping sequence in lateritic soils of West Bengal.

Weed management in direct seeded rice under conservation agriculture based rice-yellow sarson-greengram cropping system

S. Maity, B. Duary, A. Pradhan* and M. Bauri

Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal 731236, India

**Email: avishekpradhan31@gmail.com*

Field experiment was carried out during the *Kharif* 2020 at Agriculture farm, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal to study the effect of tillage and weed management practices on weed growth and productivity of direct seeded rice (DSR) grown as sixth year's crop in a conservation agriculture based rice-yellow sarson-greengram cropping system. The experiment was laid out in strip plot design with three replications. Four tillage practices comprising of Conventional tillage (CT) (DSR) — CT (yellow sarson) — CT (greengram), CT (DSR) — Zero tillage (ZT) (yellow sarson) — ZT (greengram), ZT (DSR) — ZT (yellow sarson) — ZT (greengram), ZT + Residue (R) (DSR) — ZT + R (yellow sarson) — ZT + R (greengram) were allocated to the horizontal strip and three weed management practices *viz*. Recommended herbicides (pendimethalin at 1.0 kg/ha followed by bispyribac sodium at 25 g/ ha in DSR, pendimethalin at 0.75 kg/ha each in yellow sarson and greengram), Recommended herbicides + manual weeding at 35 DAS and Unweeded control were assigned to the vertical strip. Eleven weed species were observed in the experimental field out of which *Echinochloa colona* and *Digitaria sanguinalis* among grasses, *Cyperus iria* and *Fimbristylis miliacea* among sedges, *Ludwigia parviflora*, *Sphenoclea zeylanica* and *Murdania nudiflora* among broadleaved were the predominant under all tillage practices. *Cynodon dactylon* and *Panicum repens* were also present as dominant grassy weeds under zero (ZT-ZT-ZT) and conservation tillage (ZT+R-ZT+R-ZT+R). Conventional tillage system registered lower values of weed density and biomass and higher values of yield attributes and yield of DSR. After five cycle of year round tillage conventional tillage (CT-ZT-ZT) produced 19.10% higher grain yield over conservation tillage in rice. The highest grain yield was recorded under conventional tillage (CT-ZT-ZT), having no significant difference with CT-CT-CT and the lowest grain yield was recorded under zero tillage. Among the weed management practices recommended herbicides and hand weeding at 35 DAS registered significantly the lowest weed density and biomass and highest values of yield attributes of DSR. Application of recommended herbicides + one hand weeding at 35 DAS registered 24.8% higher grain yield over sole application of recommended herbicide. Conventional tillage with integrated use of recommended herbicides + one hand weeding in rice recorded lower values of weed density and biomass and higher values of yield attributes and yield. Thus, after five years of year-round tillage conventional tillage when practiced with integrated use of recommended herbicide and one hand weeding appeared to be effective for management of complex weed flora and higher productivity of DSR in direct seeded rice- yellow sarson – green gram cropping system in lateritic belt of West Bengal.

Poster 18

Effect of herbicidal weed management on weed dynamics, crop growth yield and economics of direct-seeded rice

Nagendra Kumar Verma*, Shrikant Chitale, Nitish Tiwari and Manisha
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India
**Email: nagendraigkv@gmail.com*

Direct-seeded rice (DSR) considered as cost-effective, water saver and environment-friendly method of rice cultivation, it managed with least weed infestation. Pre and post emergence herbicides role in weed management in DSR. However, it is very difficult to control the complex weed flora observed in DSR with a single application of pre or post-emergence herbicides. Though many pre-emergence herbicides are available, the need for postemergence herbicides is often realized to combat the emerged weeds during later stages of crop growth. Effect of pre- *fb* post-emergence application of herbicide combinations were evaluated in Raipur (Chhattisgarh) on crop growth, weed suppression and rice yield in direct-seeded rice (DSR) system during 2022 and 2023. The dominant weeds of the experimental field were *Alternanthera sessilis*, *Cyanotis axillaris*, *Echinochloa colona*, *Cyperus iria* and *Celosia argensia*. Results revealed that combination of pendimethalin 1000 g/ha as PE *fb* tank mix of bispyribac-sodium 25 g/ha + (metsulfuron methyl + chlorimuron ethyl) (RM) 4 g/ha PoE (25-30 DAS) identified for wide spectrum weed control and highest weed control efficiency to the tune of 91.0 and 91.3% respectively at 40 DAS. Pendimethalin 1000 g/ha PE *fb* penoxsulam + cyhalofop-butyl (RM) 135 g/ha PoE (25-30 DAS) and hand weeding twice at 30 & 60 DAS also found comparable. Spray of post-emergence tank mix application of {bispyribac sodium + (metsulfuron-methyl + chlorimuron ethyl) (RM)} as systemic herbicide, controlled grasses, sedges and broadleaf weeds (*Alternanthera sessilis, Cyperus iria, Echinochloa colonum*). The crop growth characters *viz*. plant height, crop dry matter accumulation, number of tillers, leaf area and yield attributing characters *viz*. panicle length, panicle weight, filled grains panicle^{-1}, and maximum grain yield, highest gross return, net return and B:C ratio also computed under weed management treatment of pendimethalin 1000 g/ha as PE *fb* tank mix of bispyribac-sodium 25 g/ha + (metsulfuron methyl + chlorimuron-ethyl) (RM) 4 g/ha PoE (25-30 DAS) during both the year.

Herbicide strategies for climate-smart weed management in direct-seeded rice under diverse agro-ecosystems

Badal Verma*, Manish Bhan, A.K. Jha, K.K. Agrawal and M.L. Kewat
Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: badalv82282@gmail.com*

Rice is the most widely cultivated cereal and a primary food source for over half of the global population. In the face of growing climate challenges, direct-seeded rice (DSR) is emerging as a climate-smart alternative to traditional puddled transplanted rice. This method offers significant benefits, including reduced water usage, lower labour demand, and the potential to mitigate greenhouse gas emissions, which is critical in reducing agriculture's environmental footprint. However, DSR presents a major challenge i.e. increased vulnerability to weed infestations, which can significantly reduce yield and undermine the system's environmental and economic advantages. Weeds are a persistent problem in DSR because of the absence of standing water, suppressing their growth in conventional rice systems. To manage this issue effectively and sustainably, use of herbicides has become essential. Herbicide-based weed control is not only more economical but also less labour-intensive than manual or mechanical methods. However, single herbicide applications may have a narrow control spectrum, making them insufficient to manage the diverse weed populations that thrive in changing environmental conditions. To address this, a field experiment was conducted in 2019 during the *Kharif* season at the Research Farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.), to assess the efficacy of different herbicides for weed control in DSR across two agro-ecosystems: rainfed and irrigated. The experiment was structured using a split-plot design with three replications, where eight weed control treatments were tested, including herbicide applications (bispyribac sodium at 25 g/ha, fenoxaprop-p-ethyl at 60 g/ha, fenoxaprop-p-ethyl + penoxsulam at (60 + 26.7) g/ha, cyhalofop + penoxsulam at (135 + 26.7) g/ha, bispyribac-sodium + (metsulfuron-methyl + chlorimuron-ethyl) at (25+4) g/ha, triafamone + ethoxysulfuron at (40+20) g/ha), manual weeding and weedy check. The dominant weeds in the experimental fields were *Echinochloa colona*, *Alternanthera sessilis*, *Cyperus rotundus* and *Cynodon dactylon* being the most widespread in both agro-ecosystems. Among the herbicidal treatments, bispyribac sodium at 25 g/ha demonstrated the highest weed control efficiency of 89.5% at 90 days after sowing (DAS). This herbicide effectively controlled grasses, sedges, and broadleaf weeds, contributing to better rice growth parameters, such as plant height and tiller/m^2. Furthermore, rice yield attributes, including the number of effective tillers, number of panicles and grains per panicle, were significantly improved with bispyribac sodium treatment compared to other treatments. Although manual weeding at 20 and 40 DAS achieved the highest grain and straw yields, bispyribac sodium produced comparable results under irrigated conditions, with grain and straw yields of 1.85 t/ha and 2.96 t/ha, respectively. This study highlights the importance of integrating herbicide-based weed management into a climate-smart agricultural framework. By adopting effective weed control strategies, DSR systems can enhance productivity while promoting sustainability, water conservation and lower greenhouse gas emissions, contributing to climate resilience in rice production.

Effect of tillage and weed management on weed dynamics and productivity of direct-seeded rice in east and south eastern coastal plain zone of Odisha

S. Samantaray*[1], G.C. Malik[1], R. Dash[2], M. Banerjee[1] and S. Lenka[2]
[1]*Palli Siksha Bhavana (Institute of Agriculture), Visva Bharati, Sriniketan, West Bengal 731236, India*
[2]*Odisha University of Agriculture & Technology, Bhubaneswar 751003, India*
**Email: subhashree.samantaray43@gmail.com*

An experiment was conducted at the Agronomy Main Research Farm, College of Agriculture, Odisha University of Agriculture & Technology, Bhubaneswar during the *Kharif* season of 2022-2023 to study the effect of tillage and weed management on weed dynamics and rice productivity in direct seeded rice. The experiment followed a split-plot design, with four main plot treatments and three sub-plot treatments, each replicated three times. The main plot treatments consisted of four different tillage methods: conventional tillage (CT), conventional tillage with residue mulching at 5 t/ha (CT+R), zero tillage (ZT) and zero tillage with residue mulching at 5 t/ha (ZT+R). The sub-plots featured three weed management practices: W1 (pendimethalin 678 g/ha at 2 DAS followed by bispyribac-sodium 25 g/ha at 20 DAS), W2 (pendimethalin 678 g/ha at 2 DAS followed by bispyribac sodium 25 g/ha at 20 DAS and one hand weeding at 40 DAS) and W3 (weedy check). Among the main plot treatments, conventional tillage with residue mulching at 5 t/ha significantly reduced weed density and weed dry weight compared to other tillage methods. Similarly in the sub-plot treatments, application of pendimethalin 678 g/ha at 2 DAS followed by bispyribac sodium 25 g/ha at 20 DAS and one hand weeding at 40 DAS was the most effective in controlling weed density and weed biomass compared to other weed management practices. In conclusion, study indicated that conventional tillage with residue mulching at 5 t/ha followed by pre-emergence application of pendimethalin 678 g/ha at 2 DAS + post-emergence application of bispyribac-sodium 25 g/ha at 20 DAS + one hand weeding at 40 DAS provided optimal weed control and enhanced productivity of direct-seeded rice in the east and south eastern coastal plain zone of Odisha.

Weed management in dry direct-seeded rice grown under different tillage systems in lateritic soil of West Bengal

Bonthala Madhukar*[1], B. Duary[1] and D.K. Jaiswal[2]

[1]*Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, Birbhum, West Bengal 731236, India*

[2]*College of Horticulture and Research Station, Sitapur, Surguja, Chhattisgarh 497111, India*

**Email: maadhukarb117@gmail.com*

A field experiment was conducted during the *Kharif* season of 2021 at the Agricultural Farm of the Institute of Agriculture, Visva-Bharati, Sriniketan, Birbhum, West Bengal to study the weed population dynamics and productivity of dry direct seeded rice (DSR) grown with different tillage and weed management practices as third year crop. The experiment was laid out in split plot design with three replications. Two tillage systems comprising of zero tillage and conventional tillage were allocated to main plots and eight weed management practices, *viz*. pre-emergence (PE) oxadiargyl followed by *(fb)* post-emergence (PoE) bispyribac-sodium, pre-mixed PoE penoxsulam + cyhalofop-butyl, oxadiargyl *fb* penoxsulam + cyhalofop-butyl, tank-mixed PoE fenoxaprop-p-ethyl with safener + ethoxysulfuron, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron, pendimethalin *fb* bispyribac-sodium, weed free check and unweeded control to sub plots. Experimental findings revealed that *Digitaria sanguinalis*, *Cynodon dactylon* and *Paspalum notatum* among the grasses; *Cyperus iria* and *Fimbristylis miliacea* among sedges; *Eclipta alba*, *Spilanthes calva*, *Ludwigia parviflora* and *Oldenlandia corymbosa* among broad-leaved were predominant weeds. Grassy weed density and biomass were significantly higher in conventional tillage over zero tillage to the tune of 11-64% and 20-70%, respectively. But broad-leaved and total weed density and biomass was higher (45-50% and 28-32% and 43-63% and 26-30%, respectively) in zero tillage as compared to conventional tillage. Among weed management practices, oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron and oxadiargyl *fb* penoxsulam + cyhalofop-butyl recorded the highest weed control efficiency of DSR to the tune of 82-94%. There was only 41-53% reduction in density of total weed in the plots treated with penoxsulam + cyhalofop-butyl and fenoxaprop-p-ethyl + ethoxysulfuron alone. Tillage had no significant effect on growth attributes, yield attributes and yield of DSR. But the sequential application of oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron or oxadiargyl *fb* penoxsulam + cyhalofop-butyl recorded the highest growth and yield attributes and yield of DSR. Although the cost of cultivation was lower in zero tillage but gross return, net return and return per rupee invested of DSR didn’t vary significantly between tillage practices. Higher economic return was fetched with oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron and oxadiargyl *fb* penoxsulam + cyhalofop-butyl. Thus, zero or conventional tillage along with oxadiargyl *fb* fenoxaprop-p-ethyl + ethoxysulfuron or oxadiargyl *fb* penoxsulam + cyhalofop-butyl appeared to be promising approaches for effective weed management and obtaining higher yield and profitability of dry direct seeded rice in lateritic soil of Eastern India.

Evaluation of weed management strategies in direct seeded rice in West Central Table Land Zone of Odisha

Ipsita Kar*, Sanjukta Mohapatra, Rini Pal, Atanu Seni and Sarita Barla
All India Coordinated Rice Improvement Project, Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology, Chiplima, Odisha 768025, India
**Email: ipsitakar@ouat.ac.in*

Rice farming is confronting a perfect storm of challenges, including a severe labor shortage, water scarcity, and aggressive weed growth, which underscores the urgent need for innovative and effective agronomic solutions to maintain crop yields and viability. Keeping in view the problems of labor- and water- shortage, recent shift in rice production technology towards direct seeding rice (DSR) has been made. Different establishment methods of DSR are Dry-DSR, Wet-DSR and Semi Dry method. Dry-DSR involves planting seeds in fields with optimal moisture conditions, facilitating increased germination before the onset of monsoon, thereby ensuring timely establishment and, higher productivity. Wet-DSR primarily entails planting sprouted seeds using a drum seeder on puddled beds, offering benefits such as decreased labor costs and drudgery while ensuring timely and improved crop establishment, and it necessitates a meticulously levelled field and efficient weed management for successful implementation. Semi dry system also known as “dry converted wet” means converting dry sown rice to flooded paddy after 30 -40 days of sowing. It is an alternative source for increasing productivity under command areas. Globally, weeds are responsible for a notable decline in rice yields. Potential yield losses due to weeds can be substantial, ranging from 48% in transplanted rice to 53% in Wet-DSR and up to 74% in Dry-DSR. In semi dry system, due to the absence of standing water in the initial 30-40 days, weed management is essential. Hence, to evaluate the most appropriate method for controlling weeds in DSR, the current research was undertaken at All India Coordinated Rice Improvement Project, Regional Research and Technology Transfer Station, Odisha University of Agriculture and Technology, Chiplima, Odisha during *Kharif* 2021 and 2022. The experiment was replicated thrice in split-plot design with three crop establishment methods allocated to main plots, *viz*. broadcasting, Wet-DSR and Semi Dry System and four weed management practices, *viz*. three hand weedings at 20,40 and 60DAS, pre- *fb* post-emergence herbicide, pre-emergence herbicide *fb* 2 hand weedings (HW) at 20 and 40DAS and pre- *fb* post-emergence herbicide applied twice at 20and 40DAS. Pendimethalin 1000g/ha was used as pre-emergence herbicide applied at 1 day after sowing and Bispyribac sodium 25g/ha as post-emergence herbicide applied at 20DAS. The rice variety used was MTU-1156. The soil at the experimental site was clayey loam with low in organic carbon (0.45%) and available N, P and K were 240, 9.1 and 152kg/ha. The major weed flora in the experimental field comprised of grasses, *viz. Echinochloa crus-galli*, *Echinochloa colonum*, *Digitaria sanguinalis*, *Dactyloctenium aegytium*, *Panicum repens*; broad-leaved weeds like *Ludwigia parviflora, Eclipta alba, Ammania baccifera, Sphenoclea zeylanica, Commelina benghalensis* and sedges like *Cyperus difformis*, *Fimbristylis miliacea*. Significantly lower weed density and weed biomass at tillering stage and panicle initiation stage was observed in Wet-DSR and among the weed management practices, in pre- *fb* post- emergence herbicide applied twice at 20 and 40 DAS. Weed density and biomass showed significantly negative correlation with grain yield. There was significant effect of establishment methods and weed management practices on panicles/m2, test weight and grain yield obtained under pre-emergence *fb* 2 HW and pre- *fb* post- emergence herbicide applied twice were at par. Significantly higher grain yield of 5.47t/ha was obtained with application of pre- *fb* post- emergence herbicide twice at 20 and 40 DAS under Wet-DSR. Therefore, it was concluded that for enhancing the rice yield by managing the weeds efficiently, Wet-DSR with application of Pendimethalin 1000g/ha *fb* Bispyribac sodium 25g/ha is not only productive but is also remunerative and is a good recommendation for West Central Table Land Zone of Odisha.

Weed growth and productivity of direct seeded rice under different tillage and weed management practices

Ipsita Padhi*, Koushik Sar and S.K. Mohanty

Department of Agronomy, FAS, Siksha 'O' Anusandhan, Bhubaneswar, Odisha 751029, India

**Email: ipsitapadhi04@gmail.com*

Attaining food security and alleviating poverty while sustaining agricultural systems under the current scenario of depleting natural resources, negative impacts of climatic variability, spiraling cost of inputs are the major challenges before most of the Asian countries. In addition to these challenges, the principal indicators of non-sustainability of agricultural systems includes: soil erosion, depletion of soil organic matter, salinization *etc*. Therefore, alternative strategy shifting in farming practices through eliminating unsustainable parts of conventional agriculture (ploughing/tilling the soil, removing all organic material, monoculture) is crucial for future productivity gains while sustaining the natural resources. Conservation agriculture aims at improving biological functions of agro-ecosystem by minimum soil disturbance, continuous organic cover and crop diversification to achieve Agricultural sustainability. From global warming point of view, conservation agriculture offers both mitigation of climate change by reducing the emission of greenhouse gases and adaptation to its effects of water shortage, as well as the weak and erratic nature of monsoon conditions. The present experiment on weed management in direct seeded rice under conservation agriculture based direct seeded rice (DSR)-mustard - green gram cropping system was conducted during 2022 and 2023, respectively at Agriculture Farm, Chatabar, Faculty of Agricultural Sciences, SOADU, Bhubaneswar. The main objective was to study the effect of tillage and weed management practices on weed growth and productivity of direct seeded rice under conservation agriculture based DSR-mustard- -green gram cropping system. The soil of the experimental field was sandy loam in texture. The experiment was laid out in strip plot design with three replications. Four tillage practices comprising of conventional tillage (CT), zero tillage (ZT), ZT+30% R and ZT+60% R were allocated to the horizontal strip and three weed management practices, such as recommended herbicides (RH), recommended herbicides + one hand weeding (HW) at 35 days after sowing (DAS) and unweeded control were assigned to the vertical strip. However, on system basis the herbicide use for rice was pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ ha and pendimethalin at 0.75 kg/ ha for mustard and green gram. The experimental field was infested with 12 different weed species, belonging to three (3) categories (5 grasses and 5 broad leaved and 2 sedges). The dominance of weeds varied across different tillage and weed management practices. Weed flora in the weedy check plots consisted of all the twelve species. The infestation of perennial weeds like C. dactylon was more under Zero (ZT) and conservation tillage (ZT+30% R and ZT+60% R) than conventional tillage (CT). Results showed that in both the years conventional tillage with recommended herbicide (RH) (Pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ha) + one hand weeding (HW) recorded the lowest value of total weed density and dry weight at 60 DAS in both the years. Conventional tillage with recommended herbicide (RH) (Pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ha) + one hand weeding (HW) also registered maximum grain yield along with higher yield attributing characters than other treatments.

Weed dynamics and yield response of direct seeded summer rice to chemical weed management practices under east coast plains of India

Swagat Shubhadarshi*, Ankita Priyadarshini, Subhaprada Dash and Sankarsana Nanda

Department of Agronomy, Faculty of Agricultural Sciences, IAS, Siksha 'O' Anusandhan, Bhubaneswar, Odisha 751003, India

**Email: swagat.babloo.123@gmail.com*

Weeds are frequently the most serious issue as they reduce productivity and profitability in direct-seeded rice (DSR). Though manual weeding is an expensive and time-consuming activity, the traditional method of managing rice weeds has various limitations. Therefore, a field investigation was conducted during summer of 2022, at the Agricultural Research Station, Binjhagiri, SOA University, Bhubaneswar with twelve chemical weed management treatments were taken and laid out in a randomized block design with three replications. The pH of the sandy loam soil at the experimental site was 6.28. The experimental site has 293.2, 18.6, and 238.4 kg/ha of available N, P2O5, and K2O, respectively. Lines of the test variety 'Pratibha' were sowed on January 24, 2022, and harvested on May 17, 2022. The predominant weeds in the experimental area were *Ludwigia parviflora*, *Cyperus iria*, *Cyperus rotundus*, *Echinochloa colona*, *Melochia corchorifolia* and *Digitaria sanguinalis*. During the cropping period, the application of triafamone + ethoxysulfuron (PoE) resulted in reduced weed density and dry weight, which was at par with pretilachlor (PE) *fb* carfentrazone-ethyl (PoE). Triafamone + ethoxysulfuron (PoE) had the lowest weed index (WI) of 5.70% and the best weed control efficiency (WCE) of 79.80% at harvest stage when compared to other chemical weed control treatments. It was followed by pretilachlor (PE) *fb* carfentrazone-ethyl (PoE). The highest grain yield was achieved by the weed-free treatment, 4.92 t/ha, while the lowest grain yield was reported by the weedy check, 0.43 t/ha. The application of triafamone + ethoxysulfuron (PoE) produced a considerably greater grain yield of 4.64 t/ha among the various herbicidal treatments; this yield was comparable to that of the application of pretilachlor (PE) *fb* carfentrazone-ethyl (PoE) with grain, also noted the highest test weight (24.8 g), the largest number of productive tillers/ m2 (250), and the highest number of viable grains/panicle (75). Crop growth rate and LAI both show comparable trends. Triafamone + ethoxysulfuron produced the highest net return of (Rs. 38,301/ha) with a B:C ratio of 2.08. This was followed by pretilachlor (PE) *fb* carfentrazone-ethyl (PoE), which produced a net return of (Rs. 35,287/ha) and a B:C ratio of 1.96. However, the application of triafamone + ethoxysulfuron (PoE) resulted in the maximum N, P, and K absorption (83.77, 21.83, and 97.60 kg/ha) by the crop at harvest, and the lowest N, P, and K depletion (6.11, 0.75, and 7.24 kg/ha) by weeds. These practices help to improve DSR cultivation yield while also suppressing weeds. In conclusion, triafamone + ethoxysulfuron are highly effective chemical weed management strategies in DSR. These treatments promote optimal crop growth, maximize yield, and enhance profitability, making them suitable options for sustainable DSR cultivation while minimizing weed competition.

Poster 25

Comparative analysis of weed dynamics and crop productivity of direct-seeded rice under integrated weed management strategies to enhance soil health

Ankita Priyadarshini*, Subhaprada Dash and Swagat Shubhadarshi
Department of Agronomy, Faculty of Agricultural Sciences, IAS, Siksha 'O' Anusandhan, Bhubaneswar, Odisha 751003, India
**Email: ankitapriyadarshini10697@gmail.com*

Weeds are the major biotic stress affecting direct seeded rice (DSR) production, economic viability, and sustainability. The effectiveness of DSR is dependent on effective weed management practices. On the other hand, growth and production in DSR are greatly decreased by heavy weed infestation. Therefore, the field experiment was conducted to evaluate the impact of integrated weed management (IWM) practices on weed suppression and productivity enhancement. A field experiment was conducted with ten treatments and laid out in a randomized complete block design with three replications at the Agricultural Research Station, SOA, Bhubaneswar, in the *Kharif* season of 2023, which included a combination of pre- and post-emergence herbicides, mulching, stale seed beds, brown manuring, and hand weeding. The dominant weeds in the experimental area were *Ludwigia parviflora*, *Melochia corchorifolia*, *Cyperus iria*, *Fimbristylis miliacea*, *Echinochloa colona*, and *Digitaria sanguinalis*. Among all the treatments, The maximum grain yield (3.90 t/ha) was observed by weed-free check, which showed similar result with the stale seed bed with the sequential application of pendimethalin at 1 kg/ha at 1 days after sowing (DAS) *fb* bispyribac-Na at 25 g/ha at 20 DAS significantly reduces the weed density and biomass at 40 and 60 DAS with a weed control efficiency of 98.78% and 97.57%, respectively, resulting in a grain yield of 3.89 t/ha, which was a 32.5% increase in grain yield compared to weedy check 2.83 t/ha. Mulching with herbicides also lowered down the weed biomass and produced the grain yield (3.64 t/ha). Significant effects of the treatments were also seen in the dehydrogenase and FDA activities, which reflect soil microbial activity. At 45 DAS, the weed free treatment showed the greatest dehydrogenase activity (285.40 µg TPF/g/d), *fb* brown manuring (301.56 µg TPF/g/d). The two treatments that showed the maximum FDA activity at harvest were 1.66 µg fluorescein/g/hr and 1.613 µg fluorescein/g/hr, respectively. At harvest, MBC was highest in the brown manuring treatment (293.15 µg/g), indicating that the treatment had a favourable effect on the health of the soil microbial population. The most profitable weed management techniques for direct-seeded rice were found to be using stale seed beds treated sequentially with pendimethalin at 1 kg/ha at 1 DAS *fb* bispyribac-Na at 25 g/ha at 20 DAS, and these treatments yielded the highest net returns and returns per rupee invested with benefit: cost ratio 2.17. So, the stale seed bed with sequential application of pendimethalin *fb* bispyribac-Na is the most effective weed management practice in DSR, while brown manuring and hand weeding also showed considerable potential for enhancing the weed control and crop productivity as well as enhance the soil health through increasing the soil microbial and enzyme activities. These IWM strategies contribute to both weed suppression and improved soil biological health, ensuring sustainable DSR cultivation.

Poster 26

Effect of weed management and water regimes on direct-seeded rice

D.K. Roy

Department of Agronomy, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar 848125, India

Email: dkroywc@gmail.com

A field experiment was conducted to evaluate the effect of weed management and water regimes on direct seeded rice (*Oryza sativa* L.) at crop research centre, Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar. Under sub plots, the highest grain yield of rice (3.62 t/ha) was recorded by weed free treatment (3 hand weedings at 20, 40, 60 DAS) which was statistically at par with Pendimethalin 1 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha at 20 DAS (3.43 t/ha) only. However, the highest net return (Rs. 28,256/ha) was recorded by the treatment pendimethalin 1.0 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha at 20 DAS which was statistically at par with Pendimethalin 1.0 kg/ha (PE) *fb* chlorimuron + metsulfuron 4 g/ha at 20 DAS (Rs. 27,698/ha) and chlorimuron + metsulfuron 4 g/ha at 20 DAS (Rs. 25,487/ha). The highest B:C ratio (1.94) was also recorded by pendimethalin 1.0 kg/ha (PE) *fb* chlorimuron + Metsulfuron 4 g/ha at 20 DAS which was statistically at par with Pendimethalin 1 kg/ha (PE) *fb* bispyribac-sodium 25g/ha at 20 DAS (1.92) and chlorimuron + metsulfuron 4 g/ha at 20 DAS (1.91). Days after disappearance of pounded water under different water regimes and application of pendimethalin 1.0 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha at 20 DAS or Pendimethalin 1.0 kg/ha (PE) *fb* chlorimuron + metsulfuron 4 g/ha at 20 DAS or chlorimuron + metsulfuron 4 g/ha at 20 DAS was found equally effective for reducing the weed count and weed dry weight and producing similar rice yield and fetching higher net return and B:C ratio to that of weed free (HW at 25 and 45 DAS) under direct seeded condition.

Effectiveness of post-emergence herbicides in direct seeded rice in Indian Sundarbans

Takbir Ali*[1], Chandan De[1], Koushik Brahmachari[1], Rajib Kundu[1] and Sukamal Sarkar[2]

[1]*Department of Agronomy, Faculty of Agriculture, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, Nadia, West Bengal 741252, India.*

[2]*Division of Agronomy, School of Agriculture and Rural Development, Ramakrishna Mission Vivekananda Educational and Research Institute, Narendrapur, Kolkata, West Bengal 700103, India*

**Email: takbirali123@gmail.com*

Rice (*Oryza sativa* L.) has the distinction of being the second most cultivated crop in the world in terms of area and production after wheat. But a huge amount of yield loss up to an extent of 15-20% was caused by weeds which is even greater in direct seeded rice. Therefore, taking these facts in consideration management of weeds to the optimum threshold level usually we go for the manual, mechanical or chemical treatment. But now-a-days due to shortage of labour and high wages farmers go for the chemical treatment with new broad spectrum post-emergence herbicide. But most of the herbicides are weed genera specific. Sometimes some herbicides show phytotoxicity to crops with little higher doses. Thus, introduction of such herbicides having broad-spectrum bio-efficacy, flexibility in time of application with less phytotoxicity on crops is the demand for the day. To address this issue a field experiment was conducted in remote island of Gosaba Block of Indian Sundarbans during *Kharif* season of 2021-22 to assess the efficacy of different post-emergence herbicides *viz*. pyribenzoxim at 25 g/ha, Pyribenzoxim at 30 g/ha, pyribenzoxim at 35 g/ha, pyribenzoxim at 60 g/ha, fenoxaprop-p-ethyl 6.7% EC at 56.06 g/ha, oxadiagryl 80% WP at 100 g/ha, Hand weeding, Un-weeded check in rice and its phytotoxicity effect. Experimental results revealed that, growth and yield parameters of rice were significantly influenced by different weed management practices. Effectiveness of different board spectrum herbicide against mixed weed flora also observed over cultural weed management practices. But, the application of two hand weeding at 15 and 35 DAS followed by application of pyribenzoxim at 35g/ha brought about the maximum weed suppressions leading to highest yields of rice and net returns than other treatments without showing significant phytotoxicity. In a nut shell it may be opined that, direct seeded rice shows the significance of judicious use of post-emergence herbicide in augmenting rice yield, net return and better weed management in coastal saline zone of West Bengal.

Poster 28

Impact of tillage system and weed management practices on weed dynamics, crop growth and yield of direct seeded upland rice under the foothill of Nagaland

T. Malemnganbi and A.P. Singh*

Department of Agronomy, School of Agricultural Sciences, Nagaland University, Medziphema, 797106 Nagaland, India

**Email: apsingh@nagalanduniversity.ac.in*

A field experiment was conducted at the experimental farm of School of Agricultural Sciences (SAS), Nagaland University, Medziphema campus during the *Kharif* seasons of 2021 and 2022 to study the effect of different tillage system and weed management practices on rice (*Oryza sativa* L.) growth, yield and weed suppression. The treatment consisted of three tillage system *viz*., zero tillage, minimum tillage and conventional tillage in the main plot and six weed management practices, *viz*. stale seedbed *fb* bispyribac-sodium 25 g/ha (PoE) at 25 DAS, pyrazosulfuron-ethyl 0.02 kg/ha (PE), stale seedbed *fb* pyrazosulfuron-ethyl 0.02 kg/ha (PE) *fb* cyhalofop-butyl 90 g/ha (PoE) at 25 DAS, pendimethalin 1.0 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha (PoE) at 25 DAS, weed free and weedy check in the sub-plot. The experiment was laid out in split plot design (SPD) with three replications. The result of pooled data revealed that conventional tillage system recorded the lowest weed population (278.33), weed dry weight (266.29 g/m^2), highest weed control efficiency (72.27%), plant height (76.04 cm), number of tillers/m^2 (233.92), dry matter accumulation (13.22 g/m^2), panicle length (17.87 cm), panicle weight (2.15 g), number of grains/panicle (85.99), harvest index (40.96%) and grain yield (4086 kg/ha) as compared to the other tillage systems. Among the weed management practices, the lowest weed population (72.67), weed dry weight (86.14 g/m^2), highest weed control efficiency (91.33%), plant height (76.83 cm), number of tillers/m^2 (247.50), dry matter accumulation (14.01 g/m^2), panicle length (18.17 cm), panicle weight (2.35 g), number of grains/panicle (89.77), harvest index (42.06%) and grain yield (4487.92 kg/ha) were recorded with application of pendimethalin 1.0 kg/ha (PE) *fb* bispyribac-sodium 25 g/ha (PoE) at 25 DAS during both the years. Hence, it was concluded that application of pendimethalin 1.0 kg/ha (PE) *fb* bispyribac sodium 25 g/ha (PoE) at 25 DAS under conventional tillage was most effective in suppressing overall weeds recording the highest yield attributes and grain yield of direct seeded rice under foothill of Nagaland.

Poster 29

Integrated weed management with new generation herbicides in direct-seeded rice to improve the yield of rice

Shilpa Saini*, Tej Pratap, M.S. Pal, S.P. Singh, D.K. Singh and A.P. Singh

College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand 263145, India

**Email: 59298@gbpuat.ac.in*

Direct-seeded rice (DSR) is gaining popularity as a water-efficient and labor-saving alternative to traditional transplanted rice systems. However, one of the major challenges in DSR cultivation is the increased prevalence of weeds. In the absence of puddling the growing environment of DSR favors the prevalence of weed and due to alternate wetting and drying specially during the initial phase of the crop. A shortage of moisture and poor land leveling and environment prevailing during the course of crop cultivation are the other factors reducing the efficacy of applied herbicides. Therefore, a comprehensive weed management strategy would be more appropriate to overcome the limitations observed with conventional practices. Conventional weed control strategies, such as the exclusive use of herbicides, are increasingly ineffective due to the evolution of herbicide-resistant weed populations, environmental concerns, and the need for sustainable agricultural practices. This necessitates the adoption of integrated weed management (IWM) strategies that combine various control methods to reduce weed pressure, enhance rice yields, and sustain long-term soil health. A field experiment was conducted during the *Kharif* season of 2023 at N. E. Borlaug Crop Research Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand on sandy loam soil to study the integrated weed management with new generation herbicides in DSR to improve the yield of rice. The field experiment was laid out in split plot design (SPD) and replicated thrice. The study explored the effectiveness of integrated weed control methods in DSR systems, focusing on cultural, mechanical, and chemical strategies with three sowing dates, *viz*. D1-1st June, D2-10th June and D3-20th June were evaluated as main plot treatments and five weed control treatments were assigned to the sub plot, *viz*. W1- pendimethalin 678 g/ha pre-emergence *fb* penoxsulam + cyhalofop-butyl RM 135 g/ha post-emergence, W2- pendimethalin + pyrazosulfuron RM 785 g/ha pre-emergence *fb* penoxsulam 93.7 g/ha *fb* one hand weeding, W3- penoxsulam + pendimethalin RM 625 g/ha pre-emergence *fb* bispyribac-sodium 25 g/ha post-emergence, W4- weed free and W5- weedy check. The result of the experiment showed that there is no significant difference between the treatments of date of sowing. While taking into consideration the weed control treatments apart from hand weeding pendimethalin + pyrazosulfuron RM 785 g/ha pre-emergence *fb* penoxsulam 93.7 g/ha *fb* one hand weeding (W2) was found highly significant in the yield with respect to other treatments. Increment of 5.6% in yield was observed in W3, 15% in W1 and 50% in W5.

Bensulfuron-methyl 60% DF: A suitable option for controlling weeds in transplanted rice

Neeraj Hada*, Amit Kumar, D.S. Sarangdevot, Nisha Singh, Janmajay Sharma and Varsha Gupta

Rajmata Vijayaraje Scindia Krishi vishwa vidyalaya, Raja pancham Marg,
Gwalior, Madhya Pradesh 474002, India
**Email: nhada2021@gmail.com*

A field experiment was conducted at instructional farm of RVSKVV, Krishi Vigyan Kendra, Baroda, Sheopur during *Kharif* 2019. Soil of experimental field was clay loam, pH 7.8 with 0.72% organic carbon, 252.8 kg/ha available N, 27.2 kg/ha available P and 185.6 kg/ha available K. The experiment comprising seven treatments was laid out in a randomized block design with three replications for evaluation of bio efficacy of herbicides *viz*. bensulfuron-methyl 60% DF 40 g ai/ha at 3 days after transplanting, bensulfuron methyl 60% DF 60 g/ha at 3 days after transplanting, bensulfuron-methyl 60% DF 40 g/ha at 20 days after transplanting, bensulfuron-methyl 60% DF 60 g ai/ha at 20 days after transplanting, pendimethalin 30% EC 1500 g ai/ha, hand weeding (35, 50 and 65 days after transplanting) and untreated control (weedy check). Rice variety PB-1121 was sown in nursery and after 21 days transplanted in plots. Fertilizer was used at the rate of N:P:K :: 100:60:40 kg/ha through DAP, Urea and MOP. Half of nitrogen, full dose of phosphorus and full dose of potashium were applied at the time of transplanting and remaining N through urea was applied in two splits, first at 30 days after transplanting and 2nd at panicle initiation. Herbicides were applied as per treatments. Plant protection measures and other agronomic practices were applied as per university recommendations. Weed species observed in rice crop in experimental area are *Echinochloa* spp., *Cyperus iria, Cyperus difformis, Fimbristylis miliacea, Marsilea quardifolia, Eclipta alba, Ammania baccifera* and *Ludwigia parviflora*. Among the different doses of bensulfuron methyl 60% DF tested as pre-emergence and post-emergence herbicide in transplanted rice, application of bensulfuron-methyl 60% DF 60 g/ha applied as pre or post-emergence was found to be optimum dose for controlling of all type of sedges and broad leaf weed flora in rice crop. As such there was no phyto-toxic effect noticed on any of tested doses of bensulfuron-methyl 60% DF on rice crop or on succeeding crop. There was no adverse effect on the microbial population in the Rhizosphere region of the experimental soil of transplanted rice. Highest grain yield of rice was obtained in plots where bensulfuron-methyl 60% DF 60 g ai/ha was applied. On the basis of findings, it can be concluded that bensulfuron methyl 60% DF at 60 g/ha is a suitable option for controlling weeds in transplanted rice.

Efficacy of fenoxaprop-p-ethyl 69 EC against weeds in transplanted rice

Sanjeev Kumar*, Prateek Kumar, Ambuj Kumar Singh and Amit Kumar Yadav
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: skbhu117@gmail.com*

Weeds significantly impact global rice production, particularly in transplanted systems, resulting in yield losses estimated at 20–50%. Competition for resources such as light, water and nutrients affects rice growth, especially in regions with high weed density. Additionally, changing climatic conditions alter weed dynamics and potentially increase the prevalence of invasive species. Addressing these challenges is critical to increasing rice productivity and ensuring food security, highlighting the urgent need for effective weed control methods. Chemical weed control in rice cultivation plays a crucial role in increasing productivity by effectively controlling weed populations. When used correctly, herbicides can significantly reduce the labour and time required for manual weed control. This method enables timely intervention against aggressive weeds and ensures that rice plants can thrive unrivalled in critical growth phases. In addition, the use of selective herbicides minimizes damage to the rice crop while maximizing the effectiveness of weed control. Overall, chemical weed control results in higher yields and improved economic returns for rice farmers. Keeping in view the effectiveness of herbicidal weed management, a field experiment was conducted on Efficacy of fenoxaprop-p-ethyl 69 EC against weeds in transplanted rice (*Oryza sativa* L.) during *Kharif* season of the year 2019 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The experiment was laid out in randomized block design (RBD) and replicated thrice. Post-emergence application of herbicide was compared with the weed-free and weedy check. Major weed flora observed in the experimental field were *Ammannia baccifera* (L.), *Echinochloa* spp., *Paspalum* spp., *Sagittaria* spp. The findings of experiment revealed that among the herbicidal treatments, weed-free treatment observed significantly lower weed density and dry matter as compared to the weedy check, and it was closely followed by post-emergence application of fenoxaprop-p-ethyl 86.25 g/ha, at all dates of observation. The observation on the growth and development of crops and weeds were recorded and the result was summarized. On the basis of investigation, it can be concluded that under eastern Uttar Pradesh, the application of fenoxaprop-p-ethyl 86.25 g/ha effectively manage weeds, *viz.* produce higher crop growth, yield attributes and yield of transplanted rice.

Weed management in transplanted rice under natural farming

V.S.G.R. Naidu*, M. Sheshu Madhav and J.V.R. Satyavani
Krishi Vigyan Kendra, ICAR-Central Tobacco Research Institute, EAST Godavari, Andhra Pradesh 533105, India
**Email: naidudwsr@gmail.com*

A field demonstration on natural farming practices in transplanted rice was conducted during *Kharif* 2023-24 under the programme 'Out scaling of Natural Farming through KVKs". Pre-Monsoon Dry Sowing (PMDS) of green manure seeds (a mixture of 13 different seeds) was done in the 2rd week of May in the demonstration plot. After 45 days the green manure crop was incorporated through puddling. Three weeks old seedlings of Rice variety RNR-15048 were transplanted at a spacing of 30 x 30 cm in both demonstration (natural farming) and farmers' practice/check (conventional farming) plots. Recommended dose of fertilizers and need based pesticides were applied in check plot. Whereas, in demo plot Azolla was applied at 7 DAT, Jeevamritham & Biocultures were applied at 15 days interval. Common weeds observed were *Echinochloa colona*, *Echinochloa crus-galli*, *Cyperus iria*, *Cyperus difformis*, *Iscahemum rugosum*, *Ammania baccifera* and *Ludwigia parviflora*. Pre-emergence application of dry sand treated with Pretilachlor (50% EC) 1250 mL/ha at 3 days after transplanting (DAT), post-emergence application of bispyribac sodium (10% SC) 250 mL/ha at 15 days after transplanting followed by one hand weeding at 45 DAT were used for weed management in control plots. While for weed management in demo plot, weeds in between the rows were trampled by running Push type Cono weeder at 15 DAT followed by one hand weed at 30 DAT. Yield data was not compared because not only weed control practices but also other crop management practices were different in check and demo. Only, weed control efficiency was recorded. Dry weight of weeds was recorded in check and demo plots at periodical intervals *i.e.*, 30, 60, 90, 120. The weeds were uprooted from the 1.0 m2 area selected randomly each time and were oven dried to a constant weight at 60°C and the dry weight was recorded (g/m2). Average weed dry weight recorded was 16.8 g/m2 in demo plot and 4.9 g/m^2 in farmers' practice. The WCE was negative (-242%) and it is indicative of yield reduction in demo plot (natural farming) due to weeds.

Bio-efficacy and phytotoxicity evaluation of pre- and post-emergence application of bensulfuron-methyl 60% DF on transplanted *Kharif* Rice

Mahua Banerjee, Manisa Sinha and G.C.Malik*

Dept. of Agronomy, Palli Siksha Bhavana, Visva-Bharati, Sriniketan, West Bengal 731204, India

**Email: ganeshchandra.malik@visva-bharati.ac.in*

A field experiment entitled “Bio-efficacy and phytotoxicity evaluation of pre- and post-emergence application of bensulfuron methyl 60% DF on transplanted *Kharif* Rice” was conducted at the agricultural farm during the *Kharif* season of 2021. The experiment consisted of 10 treatments in RBD and replicated thrice, bensulfuron-methyl 60% DF 50 g/ha at 2 DAT, bensulfuron-methyl 60% DF 100 g/ha at 2 DAT, bensulfuron-methyl 60% DF 150 g/ha at 2 DAT, bensulfuron-methyl 60% DF 50 g/ha at 20DAT (foliar spray), bensulfuron-methyl 60% DF 100 g/ha at 20 DAT (foliar spray), bensulfuron-methyl 60% DF 150 g/ ha at 20 DAT (foliar apray), bensulfuron-methyl 0.6%+ pretilachlor 6% GR 10 kg/ha within 2 DAT, pretilachlor 50% EC 1500 mL/ha within 2 DAT, hand weeding (25 DAT and 45 DAT), control (weedy check), weed free. The experiment field was infested with three categories of weeds. The study found that weed management practices show positive and effective results in controlling broad-spectrum weed flora in the rice field. bensulfuron-methyl 60% DF 150 g/ha effectively reduces the population and dry weight of grass, broad-leaved and sedge. In the case of broadleaved and sedge, it was at par with the weed-free treatment. Among the treated plot highest weed control efficiency was achieved at bensulfuron-methyl 60% DF 150 g/ha applied as pre-emergence at 2 DAT. Among the treated plot lowest weed index was also recorded under bensulfuron-methyl 60% DF 150 g/ha, followed by bensulfuron-methyl 60% DF 100 g/ ha. The highest grain yield was recorded under hand weeding, which was statistically at par with bensulfuron-methyl 60% DF 150 g/ha and bensulfuron-methyl 60% DF 100 g/ha. The highest return per rupee invested was also higher in bensulfuron-methyl 60% DF 150 g/ha, followed by bensulfuron-methyl 60% DF 100 g/ha.

Bio-efficacy and phytotoxicity of pre-emergence herbicide mixtures on weed growth and yield in transplanted rice

Shrijan Kafle, M.K. Singh*, Virendra Choudhary, Udaya Lakshmi and Anil Kumar Meena

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University,
Varanasi, Uttar Pradesh 221005, India
**Email: mksingh194.m@gmail.com*

Rice is an important food crop extensively grown in India. Several factors are responsible for reducing the yield of transplanted rice. However, weed infestation is the major threat to productivity of transplanted rice. Rice is grown mainly as a wetland crop by transplanting seedlings into puddled fields. Conventional transplanting is the most common practice of rice cultivation in South and South East Asia. Weeds grow profusely in the rice fields and are the major factor reducing grain yield in transplanted rice. Weed flora under transplanted condition is very much diverse and consists of grasses, sedges and broad-leaved weeds causing yield reduction of rice. A comprehensive study on the bio-efficacy and phytotoxicity of pre-emergence herbicide mixtures on weed growth and yield in transplanted rice (*Oryza sativa* L.) was conducted during the *Kharif* season of 2023 at Agricultural Research Farm, Banaras Hindu University, Varanasi. The study aimed to assess the impact of various pre-emergence herbicide mixtures on weed control, rice yield, phytotoxicity and economic analysis. The experiment was conducted in randomized complete block design with 9 herbicide treatments including control. The study was conducted in a Gangetic alluvial soil having a sandy clay loam texture with soil pH of 7.4 with moderately fertile, being low in organic carbon, available nitrogen 180 kg/ha, medium in available phosphorus 24.8 kg/ha and potassium 142 kg/ha. The crop field was infested with complex weed flora consist of grassy weeds, *Cynodon dactylon*, *Echinochloa colona*, *Paspalum distichum*, *Cyperus rotundus*, *Fimbristylis miliacea* and *Cyperus difformis* was observed among the sedges and *Ipomea aquatica, Sagittaria guayanensis, Marsilea quadrifolia, Eclipta prostrate* and *Rotala densiflora* found among broad-leaved weeds. In the field, grassy weeds were the most common weed species, followed by sedges and broad-leaves. The treatments having herbicide mixtures consisted of metsulfuron-methyl 0.02% + chlorimuron-ethyl 0.02% + pretilachlor 7.54% GR having doses 452.4, 603.2, 754.0, 942.5 and 1508 g/ha, pretilachlor 30% + pyrazosulfuron-ethyl 0.75% WDG 615 g/ha, bensulfuron-methyl 0.6% + pretilachlor 6% GR 660 g/ha and oxidiazon + pretilachlor (520 + 150) mL/ha. Key findings of study revealed that the herbicide combination of oxidiazon + pretilachlor at (520 + 150) mL/ha significantly reduced weed density, weed dry weight, demonstrating superior weed control efficiency and highest grain yield compared to other pre-emergence herbicide mixtures, despite causing notable phytotoxicity symptoms in rice which was at par with metsulfuron methyl + chlorimuron-ethyl + pretilachlor 1508 g/ha and metsulfuron-methyl + chlorimuron-ethyl + pretilachlor 754 g/ha. However, economic analysis indicated that oxidiazon + pretilachlor at (520 + 150 mL/ha) provided the highest net return and benefit-cost ratio, making it the most economically effective option for weed management in transplanted rice.

Poster 35

Puddling intensities effect on weed dynamics and soil health in transplanted rice

Souvik Bag, Sunita Meher*, Supradip Sarkar, Rajesh Shriram Kalasare and Arunabha Pal
M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha 761211, India
Email: sunita.meher@cutm.ac.in

Weed infestation in rice fields varies considerably with the intensity of puddling, a process involving repeated ploughing of flooded fields to create a soft, water-saturated soil layer. Puddling affects weed growth by changing the soil structure, water availability and nutrient access for both weeds and rice plants. To assess the optimum level of puddling based on weed pressure control, an experiment was conducted during *Kharif* 2023, entitled ”Impact of puddling intensity on the performance of different rice (*Oryza sativa* L.) genotypes” at Post Graduate Research Farm, Agronomy, (18.81N latitude, 84.18E longitude, 61 m MSL) of MSSSoA, CUTM, Paralakhemundi. The experiment was laid out in a strip plot design with three horizontal plot factors and four vertical plot factors, conducted with three replications. The horizontal plots featured three genotypes: (i) V_1: BidhanSuruchi, (ii) V_2: SRD 999 and (iii) V_3: Shatabdi, while the vertical plots included four levels of puddling intensities: (i) P_0:no puddling, (ii) P_1: One pass of power tiller rotavator (low-intensity puddling); (iii) P_2: Two passes of power tiller rotavator (moderate-intensity puddling) and (iv) P_4: Four passes of power tiller rotavator (High-intensity puddling). Weed dynamics were assessed on 15, 30, and 45 DAT using the quadrat method. The major weed species observed included *Echinochloa colona, Sporobolus diander, Cyperus* spp., *Ludwigia octovalvis, Ammannia baccifera, and Physalis minima,* with grasses dominating floristic composition. At all observation periods, among the grasses, sedges and broad leaf weeds, the percentage composition followed a trend of grasses>broadleaf>sedges. At 15 DAT, among the grasses, sedges and broad leaf weeds, the percentage composition was 46%, 32% and 22%, respectively. Similarly at 30 DAT, it was 43%, 32% and 25%, respectively and at 45 DAT, grasses composition was 42%, sedges 34% and broadleaf weed accounted for 24%. Hence, this gave rise to total weed flora composition of 9%, 38% and 53%, respectively at 15DAT, 30 DAT and 45 DAT. Other weed species found in rice field were *Cyanodon dactylon*, *Digitaria sanguinalis*, *Eleusine indica*, *Brachiaria ramosa*, *Monochoria vaginalis*, *Caesulia axillaris*, *Phyllanthus niruri, Spilanthes acmella, Cynanotis axillaris* etc. Regarding weed density and dry weight, no significant differences were observed among the genotypes, except for broadleaf weed density and sedge dry weight.The study showed that puddling intensity had a significant impact on weed dynamics. While weed density and dry weight did not significantly vary among rice genotypes, differences were observed in broadleaf weed density and sedge dry weight. The highest puddling intensity, P_4 (four passes), was most effective in controlling weeds, leading to the lowest weed dry weight. In contrast, P_0 (no puddling) had the highest weed density and dry weight. Overall, higher puddling intensity (P_4) significantly reduced total weed density by disrupting the weed seed bank and limiting weed emergence. However, fields with no puddling (P_0) experienced the highest weed density due to insufficient soil disturbance. While the P_4 intensity resulted in the least weed pressure, it also produced a higher soil bulk density than P_2 (two passes). Therefore, rice genotypes grown under P3 are suggested for farmer recommendations, balancing effective weed control with favourable soil conditions.

Season-long weed management in upland rice through rice husk-biochar nano-carrier based 2,4-D herbicide

V.S. Susha* and Lisha Jose Kappen
Department of Agronomy, College of Agriculture, Vellayani, Kerala Agricultural University, Kerala 695522, India
**Email: susha.vs@kau.in*

Management of perennial weeds like *Cyperus rotundus* (L.) and *Limnocharis flava* (L.) Buchenau in upland rice is a difficult task. Timely management of these weeds with conventional herbicides are not effective. Herbicide 2, 4-dichlorophenoxy acetic acid is one among the most widely used selective herbicide for the control of broad leaf weeds and sedges. But when 2, 4-D is applied in higher dose it will only cause the killing of foliage and the underground parts remain intact. Sustained slow release of 2, 4-D is required to ensure its effective translocation to the underground propagules. In the study, rice husk and rice husk-biochar were evaluated as nano-carriers for enhancing bio-efficacy of herbicide 2, 4-D. Rice husk and rice husk-biochar nano-carriers synthesized by planetary ball milling were loaded with herbicide 2, 4-D at two different weight ratios 1:0.25 and 1:0.10. The synthesized nano-carriers were characterized by scanning electron microscopy (SEM), Fourier transform infrared (FT-IR) spectroscopy, X-ray diffraction (XRD), Brunauer-Emmett-Teller (BET) surface area analysis, Barrett-Joyner-Halenda (BJH) pore size and pore volume analysis. The bio-efficacy of the synthesized nanoformulations were tested in target weeds L. flava and C. rotundus. Following this, a field study was carried out to assess the bio-efficacy of this nano-carrier based herbicide for weed management in upland rice. The study identified based 2, 4-D in the weight ratio (1:0.25) applied at 0.8 kg/ha as the most effective formulation for the management of L. flava and C. rotundus in terms of weed control efficiency and lower weed regeneration count. At 40 DAS, higher weed control efficiency of 71.60 per cent was noted in rice husk- biochar nano-carrier based 2, 4-D in weight ratio (1:0.25) applied at 0.8 kg/ha which was comparable with HW at 15 DAS and 30 DAS (84.95 per cent). The formulation was found to enhance the bio-efficacy of 2, 4-D for weed management in upland rice resulting in enhanced yield compared with conventional 2, 4-D.

Comparative efficiency of different nozzles for drone based post-emergence herbicide spray in transplanted rice

Ch. Vijay Sree*, P. Spandana Bhatt, K. Bhanu Rekha and T. Ram Prakash
Department of Agronomy, College of Agriculture, Professor Jayashankar Telangana Agricultural University, Rajendranagar, Hyderabad, Telangana 500030, India
**Email: chopdevijaysree36@gmail.com*

Adopting advanced technology in agriculture is inevitable to address challenges faced by farmers and also to enhance profitability and sustainability. Unmanned aerial vehicle (UAV) being a modern technology can be one of the solutions for farmers. Agricultural drones provide relief for the modern-day farmer to reduce drudgery and to act timely for crop needs. The development of drone technologies for agrochemical application is essential for the efficient management of scarce resources with energy, yield and remunerative returns. In UAV based herbicide spraying for the uniform distribution of spray fluid on the target plant and minimization of drift losses the selection of appropriate nozzle plays a crucial role. To address this problem, a field experiment was conducted during the *Kharif* 2023 at Military Farm, Agriculture Research Institute (ARI) Main farm, Rajendranagar, Hyderabad to study the comparative efficiency of different nozzles for drone based post-emergence herbicide spray in transplanted rice (*Oryza sativa* L.). The experiment included eight weed management treatments laid out in randomized block design and replicated thrice. The treatments consisted of Triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE using drones with extended range flat spray (XR11002VP) nozzle, Triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using drones with air induction extended range flat spray (AIXR110015VS) nozzle, Triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using drones with drift guard flat spray (DG 110015VS) nozzle, Triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using drones with drift guard even flat spray (DG95015EVS) nozzle, Triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using drones with multiple solid stream (SJ7A015VP) nozzle, Triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using knapsack sprayer with nozzle (flat fan nozzle), Hand Weeding (20 and 40 DAT) and Unweeded check. Higher weed control efficiency and lower weed density, weed dry matter was noticed in hand weeding (20 and 40 DAT) followed by triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE knapsack sprayer with nozzle (flat fan nozzle) and it was statistically comparable with triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE using drones with multiple solid stream (SJ7A015VP) nozzle, triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE using drones with air induction extended range flat spray (AIXR110015VS) nozzle. Grain yield, straw yield and harvest index were significantly higher with hand weeding (20 and 40 DAT) was statistically at par with herbicide application using knapsack sprayer and it was statistically comparable with triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE using drones with multiple solid stream (SJ7A015VP) nozzle, triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha PoE using drones with air induction extended range flat spray (AIXR110015VS) nozzle, triafamone 20%+ ethoxysulfron 10%WG 44+22.5g/ha PoE using drones with drift guard even flat spray (DG95015EVS) nozzle. It can be concluded that, post-emergence herbicide triafamone 20%+ ethoxysulfron 10%WG 44+22.5 g/ha can be applied by drones with multiple solid stream (SJ7A015VP) nozzle offered effective weed control besides higher grain yield and economics in transplanted rice.

Assessment of tillage and weed management practices on weed control, yield and profitability in long-term rice-wheat-greengram cropping system under conservation agriculture

Alpana Kumhare*[1,2], V.K. Choudhary[1] and D.S. Sasode[2]

[1]*ICAR-Directorate of Weed Research Jabalpur, Madhya Pradesh 482004, India*

[2]*Rajmata Vijayraje Schindhia Krishi Vishwavidyalaya Gwalior, Madhya Pradesh 474002, India*

**Email: rani.jnkvv@gmail.com*

The rice-wheat-greengram cropping system is a crucial component of food security, contributing to nutritional, health, economic security, and environmental sustainability. This cropping system is a widespread pattern used in many parts of the world, especially in areas with favourable weather conditions and irrigation facilities. In rice–wheat-greengram cropping system, conservation agriculture (CA) practices, including zero tillage (ZT) with or without previous crop residue retention, are being promoted to address emerging problems such as shortages of labour and water, deterioration of soil health, declining factor productivity, and climate change. Despite the numerous benefits of these CA practices, weed control remains a major challenge to its adoption, resulting in more dependence on herbicides for weed control. Hence, a long-term field experiment was initiated at ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh, India during *Kharif* 2012 for assessment of tillage and weed management practices on weed control, yield and profitability in long-term rice-wheat-greengram cropping system under conservation agriculture. The experiment was laid out in a split-plot design and replicated thrice on rice, wheat and greengram where tillage was assigned to main plots [conventional tillage (CT)-CT-CT and ZT with full crop residues (ZTR)-ZTR-ZTR] and weed management practices in sub-plots [weedy check (control), recommended herbicide (RH), integrated weed management (IWM) and herbicide rotation (HR)], altogether, there were eight treatment combinations. The findings of rice-wheat-greengram cropping system during 2022-24 are presented where *Echinochloa colona* (L.), *Digitaria sanguinalis* (L.), *Alternanthera sessilis* (L.), *Cyperus rotundus* (L.), *Dinebra retroflexa* (Vahl) Praz., *Eleusine indica* (L.), *Phyllanthus urinaria* (L.), *Oldenlandia corymbosa* (L.), *Eclipta alba* (L.), in rice, *Medicago denticulate* (L.), *Sonchus oleraceus* (L.), *Chenopodium album* (L.), *Mecardonia procumbens* (Mill.), *Convolvulus arvensis* (L.), *Alternanthera sessilis* (L.) in wheat, and *E. colona* (L.), *Physalis minima* (L.), *Trianthema portulacastrum* (L.), *Portulaca oleracea* (L.), *Amaranthus viridis* (L.), *Alternanthera sessilis* (L.), *Dinebra retroflexa* (L.), *Cynodon dactylon* (L.) and *Digitaria sanguinalis* (L.) *etc*. in greengram were common weeds In general, poor weed control reduces rice yield by 10-100%, wheat by 10-60%, and greengram by 10-45%. Integrated weed management (IWM) is the best approach, in which chemical and non-chemical weed control practices are used in a compatible manner to reduce the weed population and keep it below the threshold level that causes economic injury. IWM not only reduces weed pressure but also promotes sustainable agricultural practices, leading to improved yields and ecosystem resilience in the rice-wheat-greengram system. The results revealed that lower weed density and weed biomass were obtained under CT-ZTR-CT system in rice-wheat-greengram. Integrated weed management practices significantly reduced weed density (by 84% in rice, 97.4% in wheat and 89% in greengram) and weed biomass (92.8% in rice, 98.2 in wheat and 93.6% in greengram) resulted in significantly higher grain yield over weedy check. System productivity was higher [8.58 t/ha of rice equivalent yield (REY)] in the CT system but was comparable to ZTR system (8.51 t/ha). Among weed management practices, integrated weed management [pretilachlor+ pyrazosulfuron at 615 g/ha as pre-emergence followed by *(fb)* hand weeding (HW) at 40 days after sowing (DAS) in rice – clodinafop+metsulfuron 60+4 g/ha *fb* HW at 45 DAS in wheat- pendimethalin 678 g/ ha *fb* HW at 30 DAS in greengram] obtained highest system productivity [11.37 t/ha of REY]. Based on the findings, it can be concluded that adoption of CA (ZT with full crop residue retention in rice-wheat-greengram system) with integrated weed management provided excellent weed control, higher yield and profit.

Evaluation of the efficacy of post-emergence herbicides against weed flora in rice

O.P. Khavanekar, M.S. Jadhav, T.N. Thorat*, D.N. Jagtap, G.K. Mote, S.H. Lohale and K.S. Raut

Department of Agronomy, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri, Maharashtra 415712, India

**Email: tnthorat@dbskkv.ac.in*

The field investigation was carried out to study the efficacy of different post-emergence herbicides against weed flora in rice (*Oryza sativa* L.) during *Kharif*, 2022 at Department of Agronomy; College of Agriculture; Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli; Ratnagiri (M.S.). The experiment was laid out in randomized block design with ten treatments which were replicated thrice. The details of the treatments were, (T1) pyribenzoxim 3% + penoxsulam 2% EC at 500 mL/ha; (T2) pyribenzoxim 3% + penoxsulam 2% EC at 750 mL/ha; (T3) pyribenzoxim 3% + penoxsulam 2% EC at 1000 mL/ha; (T4) pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha; (T5) pyribenzoxim 5% EC at 600 mL/ha; (T6) penoxsulam 2.67% OD at 1000 mL/ha; (T7) bispyribac-sodium 20% + pyrazosulfuron-ethyl 15% WDG at 100 g/ha; (T8) triafamone 20% + ethoxysulfuron 10% WG at 225 g/ha; (T9) hand weeding at 30 and 60 DAT and (T10) weedy check (untreated). The gross and net plot size were 7.80 m x 3.0 m and 7.20 mx 2.60 m, respectively. The rice seedlings of variety Karjat 2 were transplanted at the age of twenty-one days by adopting the spacing of 20 cm × 15 cm. The recommended dose of fertilizer i.e. 100:50:50 N:P2O5:K2O kg/ha was applied uniformly to all the treatments including control. The major weed species observed in the rice crop were grasses like *Isachne globusa, Digitaria sanguinalis, Brachiaria mutica*; broad leaved weeds like *Sesbania* sp., *Corchorus trilocularis* and *sedge viz. Cyperus iria*. The results of the experiment revealed that weed count and weed dry matter accumulation was significantly reduced with application of pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha. Hence, the highest weed control efficiency at harvest (89.32%) was also obtained with the same treatment followed by treatments T9 and T3 during the course of investigation. Also, application of pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha has positive effect on growth attributes of rice crop, which was followed by treatments T3, T2 and T9 at 60 DAT, 90 DAT, 120 DAT and at harvest. Significantly higher yield attributes such as number of panicles/hill (9.13), panicle length (21.80 cm), panicle weight (2.23 g), number of filled grains/panicle (133.93), weight of filled grains/panicle (2.13) were obtained with pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha over remaining treatments and treatments T3, T2 and T9 were statistically at par with treatment T4. Significantly higher grain yield (4050.55 kg/ha) and straw yield (5524 kg/ha) was observed with application of pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha which was followed by treatment T3, T2 and T9. Economic analysis also showed that higher net returns (Rs. 13793.40/ha) and B:C ratio (1.17) was obtained with treatment T4. Thus, the results suggested that higher yield, weed control efficiency and B:C ratio can be obtained with post-emergence application of pyribenzoxim 3% + penoxsulam 2% EC at 1500 mL/ha in rice crop.

Sustainable weed control in rice cultivation

Saurabh Raj Pandey*, Ram Kumar Singh, Pawan Kumar Verma, Vineet Kumar Shukla, Ambikesh Tripathi and Sanju Choudhary

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India.

**Email: saurabhagr@bhu.ac.in*

Integrated Weed Management (IWM) is an essential strategy in rice cultivation combining with cultural, mechanical, biological and chemical methods to manage weed populations in a sustainable and environmentally friendly manner. Weeds pose a significant threat to rice crops and compete for nutrients, water, light, and space that lead to substantial yield losses. IWM provides a balanced and adaptive framework that reduces the over-reliance on herbicides and minimizes the development of herbicide-resistant weed species. In rice fields cultural practices such as early sowing, maintaining optimal plant density and transplanting methods (like the System of Rice Intensification) play a vital role in suppressing weed growth. Proper water management including maintaining a shallow water layer during early growth stages can help inhibit the germination of certain weed species. Mechanical techniques like manual weeding, rotary hoeing and water management practices such as intermittent irrigation are crucial especially in small-scale and organic rice farming systems. In large-scale rice production herbicides remain a critical tool for weed management. However, over-reliance on herbicides can lead to the development of herbicide-resistant weed species which pose a serious threat to long-term agricultural productivity. To prevent this, IWM advocates for the careful selection and rotation of herbicides with different modes of action. By rotating herbicides, farmers can reduce the likelihood of weeds developing resistance to a specific chemical. Precision spraying techniques are another key component of IWM. In this method, precision spraying ensure that the herbicides are applied only where necessary. This targeted approach minimizes the amount of chemical input required and reduces the environmental impact of herbicide use. Additionally, by using herbicides in conjunction with other weed control methods, farmers can avoid the excessive use of chemicals, preserving their efficacy for future use. This targeted approach not only reduces the amount of chemicals used but also minimizes the risk of environmental contamination, protecting surrounding ecosystems and water sources. Biological control methods such as the introduction of weed-suppressing cover crops and the use of natural weed predators or pathogens are gaining attention as sustainable alternatives. These biological methods are integrated into the IWM framework to reduce dependency on chemicals and maintain ecological balance. By integrating these diverse methods IWM in rice cultivation effectively manages weeds, improves crop health and promotes long-term agricultural sustainability. This approach not only ensures optimal yields but also preserves environmental quality and enhancing the resilience of rice farming systems to weed pressures and climatic challenges.

Poster 41

Weed management in rice-wheat-legume cropping system under conservation agriculture

S.P. Singh*, Tej Pratap, Vishal Vikram Singh, Dharmendra Kumar and Shilpa Patel
Department of Agronomy, College of Agriculture, Govind Ballabh Pant University of Agriculture and Technology Pantnagar, Udham Singh Nagar, Uttarakhand 263145, India
**Email: spdrsingh@gmail.com*

A field experiment was conducted during the *Kharif* season of 2022 and 2023 at G. B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India to develop an appropriate establishment method for rice-wheat-legume cropping system along with weed management practices under irrigated condition. The experiment was laid out in split plot design with four establishment methods in main plot, *viz*. DSR (CT) -wheat (CT) -GM (CT), DSR (CT+R)- wheat (CT+R)- GM (CT+R), DSR(ZT)- wheat (ZT) -GM (ZT), DSR (ZT+R)- wheat (ZT+R) -GM (ZT+R) and three weed control treatments were in sub plot *viz*. pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS), pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) *fb* weed seed harvest and partially weedy (weeds removed after critical period 60 DAS) with three replications. Rice variety 'PUSA 1509' was sown under zero and conventional till systems. Herbicides were applied with knapsack sprayer fitted with flat-fan boom nozzle using 500 litre water/ha. Major weeds recorded under weedy situation are *Echinocloa colona*, *E. crus-galli*, *Eleusine indica*, *Panicum maximum*, *Leptochloa chinensis*, *Caesulia axillaris*, *Eclipta alba*, *Alternanthera sessilis*, *Ammania baccifera*, *Mollugo* spp, *Cyperus iria, Cyperus difformis* at 60 DAS. Among establishment methods; DSR (CT+R)-wheat (CT+R)-GM (CT+R) recorded the lowest weed density and dry weight. Integrated weed management treatment, pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) was most effective against weeds in all the weed management methods. Among establishment methods, DSR (ZT+R)- wheat (ZT+R) -GM (ZT+R) recorded highest rice grain yield (3.3 t/ha), highest net return (Rs. 45348.0/ha) and benefit cost ratio (2.09) over rest of establishment methods while, different weed management methods, highest net return (Rs. 61230/ha) and benefit cost ratio (2.34) was recorded under pendimethalin 678 g/ha (2 DAS) *fb* bispyribac sodium 25 g/ha (20 DAS) *fb* hand weeding (40 DAS) (weed seed harvest at 60 DAS).

Poster 42

Effect of irrigation and weed management practices on the growth, yield attributes and yield of drum-seeded rice

Digvijay Singh*, Ratnesh Kumar Jha, Harshita Singh and Anil Kumar Singh
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India
**Email: dvrs0411@gmail.com*

A field experiment was conducted during the *Kharif* season of 2021 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, (U.P.). The experiment was conducted in a split plot design with 15 treatment combinations which comprised of 3 moisture regimes (main plot) 6 cm at 1 DADPW, 6 cm at 4 DADPW, and 6 cm at 7 DADPW and 5 weed management practices (Subplot), *viz*. weed free, Organic mulch (rice straw 3 t/ha), pretilachlor (PE) 0.75 kg/ha + bispyribac-sodium 10% SC 200 ml/ha (PoE), two hand weeding (at 20-25 DAS and 40-45 DAS), and weedy check. The result reveals that the lowest weed density, dry weight of weeds, and weed control efficiency were recorded with weed-free and 6 cm at 1 DADPW. All the growth parameters and yield attributes were significantly influenced by different treatments. Weed-free treatment recorded significantly the highest value of growth, yield attributes, and yield followed by two-hand weeding. The highest cost of cultivation of Rs. 70629/ha was recorded under the treatment combination of I_3W_1 followed by I_2W_1 (Rs. 68217/ha). The maximum gross return (Rs. 130672/ha) was recorded with the treatment combination I_1W_1 and the net return (Rs. 80783/ha) was recorded with the treatment combination of I_1W_3. The highest benefit-cost ratio (Rs./Re 1.94) was obtained under I_1W_3 (6 cm at 1 day after the disappearance of ponded water with Pretilachlor (PE) 0.75 kg/ha + bispyribac-sodium 10% SC 200 ml/ha (3.0 kg/ha mm).

Poster 43

Expansion of seasonality of *Echinochloa colona* in rice-wheat-greengram cropping system

Sonali Singh*[1], Pijush Kanti Mukherjee[2] and Anamika Pandey[3]

[1]Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior, Madhya Pradesh 474011, india
[2]ICAR-Directorate of Weed Research, Maharajpur, Jabalpur, Madhya Pradesh 482004, india
[3]Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya pradesh 482004, india
**Email: sonalisingh14ss@gmail.com*

The experiments were conducted at ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh, India with the objective to study the ecology of *Echinochloa colona* in rice-wheat-greengram cropping system. The experiment was comprised by 7 treatments of sequential application of different herbicidal combinations, partially weedy check and hand weeding twice in dry direct-seeded rice (DSR) that were replicated thrice in a randomized block design, followed by zero tilled wheat crop where each plot is divided into two equal parts; half of the area was treated with clodinafop-propargyl + metsulfuron-methyl 64 g/ha as post-emergence (PoE) and other half was kept untreated. In zero tilled greengram after wheat, half of the area was treated with pendimethalin 678 g/ha as pre-emergence (PE) and remaining half was kept untreated. In first year of experimentation, expansion of seasonality of *Echinochloa colona* was recorded in untreated plots (without herbicide) of zero tilled wheat and it produced total seeds of 1,122/m^2 during the heading stage of wheat. It also appeared and produced 37,084 seeds/m^2 in untreated (without herbicide) zero tilled greengram during summer season. Zero tilled wheat grown in sequence in second year revealed the appearance of *E. colona* both in treated and untreated plot at the initial stage of wheat and it developed inflorescences within 17 days after sowing (DAS) of wheat and produced 328 to 412 seeds/m2 within 20-25 DAS of wheat. Dropping of the seeds was recorded within 25-30 DAS of wheat before application of clodinafop-propargyl + metsulfuron-methyl. In zero tilled wheat, among the treated plots, highest average seed production capacity of 5414 seeds/m^2 was recorded in partially weedy check treatment of DSR and among the untreated plots 1329 seeds/m^2 was recorded in in partially weedy check treatment of DSR at 60 DAS. Expansion of seasonality of *E. colona* was also studied in pot experiment, which was started on 17th November 2022 and 20th November 2023. In 2022, initial 33% emergence was recorded from 12 to 35 days after sowing (DAS); however, complete mortality was observed during the month of January 2023. Further 2% emergence each was recorded at 89 and 149 DAS; however, mortality was observed at 4 to 5 leaf stage. Further 11% emergence at 162 to 181 DAS and 2% emergence at 192 DAS were recorded and the seedlings were reached to the vegetative stage. Pot experiment conducted in 2023 revealed 61% emergence from one year old seeds from surface soil, whereas 26% emergence was recorded in two flushes up to 160 DAS from current seed from surface soil. Emergence of inflorescences and dropping of seeds were started at 89 and 130 DAS of one year old seeds, respectively. From these results, it can be concluded that *Echinochloa colona* had started to appear in other seasons *i.e.* winter and summer season in rice-wheat-greengram cropping system apart from its appearance in rice crop during rainy season.

Weed dynamics and weed management under different crop establishment methods in rice

Richa Chaudhary*, Nikhil Kumar Singh and Abhishek Malav
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India.
**Email: richac1998@gmail.com*

As water resources decline, the traditional flooded rice system is losing sustainability, prompting a need for alternatives. Direct seeding of rice (DSR) has emerged as a viable solution over the past two decades, enhancing plant density, yield and water productivity in water-scarce areas. However, DSR faces significant challenges, particularly from heavy weed infestation. To ensure its success, effective and economical weed management strategies must be developed to support farmers in sustainable rice cultivation. A field experiment was carried out during the rainy (*Kharif*) season of 2021–22 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, to study the effect of weed management practices under different crop establishment methods of rice (*Oryza sativa* L.). The experiment was laid out in a split-plot design with three main-plot treatments and four sub-plot treatments replicated thrice. The main-plot treatments were comprised of three different crop establishment methods, *viz.* M1-manual transplanting, M2- puddled direct seeding by drum seeder and M3-unpuddled dry direct seeding and sub-plot treatments were comprised of four weed management practices, *viz.* W1-weed free (hand weeding was carried out at 15, 30, 45, 60 and 75 days after sowing), W2- weedy check, W3-mechanical weeding (using weeder) and W4-chemical weed control (pre emergence application of pendimethalin at 1.0 kg/ha *fb* post-emergence application of bispyribac-sodium at 0.025 kg/ ha). Early rice variety with fine grain quality 'HUR-3022' 'Malaviya Dhan-2' with yield potential 4.5-5.0 t/ha and maturity period of 110 days was sown in the last week of June. Weed free treatment was maintained by repeated manual weeding and weedy check did not receive any herbicide or manual weeding. Thorough study of the findings indicated that in comparison to manually transplanted rice (M1), there were more grasses (53%), sedges (10%) and broad leaf weeds (50%) in unpuddled dry-seeded rice (M3). The highest total weed density (230 plants/m2), total weed biomass (320 g/m2) were recorded in unpuddled dry-seeded rice (M3) while the lowest (106 plants/m2 and 75 g/m2) in manual transplanted rice (M1). When compared with the weedy-check (W2) plots, the treatment consisting of chemical weed control (W4) provided excellent weed control having the highest weed control efficiency (71.94%). Unpuddled dry-seeded rice and puddled direct seeding by drum seeder increased the growth and yield attributes of rice. This treatment also recorded the maximum uptake of nutrients, *viz.* nitrogen, phosphorus and potassium. The weed-free plots and herbicide treatments produced higher rice grain yield than the weedy plots. The maximum benefit: cost ratio was also recorded under puddled direct seeding by drum seeder in combination with chemical weed control.

Growth and yield of aerobic rice as influenced by weed management practices

D.K. Patel* and K.P. Patel
Cotton Wilt Breeding Station, Navsari Agricultural University, Hansot, Gujarat 393030, India
**Email: dkpatelagro@nau.in*

Rice (*Oryza sativa* L.) is one of the staple food crops of approximately half of the world population. The rice grain is termed as the Global grain. It is the most important crop of the country and second most important crop of the world. It is a prime need of time to maximize the production of rice forever increasing population where weeds pose serious problems being naturally hardy, competitive and self-sown plants. Direct-seeded rice is becoming popular, as it is cheaper alternative to transplanting. However, crop weed competition in this system is more severe, reducing the yield by 20-95% (Gogoi 1995). Field experiment was conducted at College Farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. The experiment consisted total twelve treatments combinations, *viz.* butachlor 1.25 kg/ha as pre-emergence (T1), pendimethalin 1.00 kg/ha as pre-emergence (T2), pretilachlor 0.75 kg/ha as pre-emergence (T3), aniloguard 0.5 kg/ha as pre-emergence (T4), 2, 4-D (ethyl ester) 1.00 kg/ha as post-emergence at 20 to 25 DAS (T5), T1 + hand weeding at 40 DAS (T6), T2 + hand weeding at 40 DAS (T7), T3 + hand weeding at 40 DAS (T8), T4 + hand weeding at 40 DAS (T9), T5 + hand weeding at 40 DAS (T10), Un weeded control (T11), Weed free condition by hand weeding at 20, 40 and 60 DAS (T12) were evaluated in randomized block design with 3 replications. The predominant weed flora observed in the experimental field were monocot weeds, *viz. Echinochloa crus-galli, Echinochloa colunum, Cynodon dactylon, Eichhornia crassipes, Dactyloctenium agegyptium* and *Bracharia* spp. major dicot weeds, *viz. Alternanthera sessilis*, *Digera arvensis*, *Euphorbia hirta* and *Physalis minima*. The results revealed that almost all the growth and yield attributes, *viz.* plant height, number of tillers/plant, number of panicles m2 and number of grains/panicle were significantly influenced by various weed management treatments. Higher values of all the growth and yield attributing characters ultimately resulting in the highest grain (43.83 q/ha) and straw (57.49 q/ha) yields recorded in weed free condition by hand weeding at 20, 40 and 60 DAS (T12) and being at par with T1 + hand weeding at 40 DAS (T6), T2 + hand weeding at 40 DAS (T7) and T3 + hand weeding at 40 DAS (T8).

Weed management in organically grown aromatic rice-tomato cropping system

Manisha*[1], Nitish Tiwari[2] and Nagendra Kumar Verma[1]
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India
**Email: nishadhurve251@gmail.com*

A field investigation entitled Weed management in organically grown aromatic rice-tomato cropping system was conducted during the *Kharif* season of 2022 and 2023 at Research cum Instructional Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The experiment was laid out in randomized block design (RBD) with three replications and nine treatments, *viz*. hand weeding (HW) twice at 20 and 40 DAT, motorized weeder twice (single row type) at 20 and 40 DAT, motorized weeder twice (single row type) + one intra row HW at 20 and 40 DAT, mechanical weeding through Ambika paddy weeder at 20 and 40 DAT, mechanical weeding through Ambika paddy weeder + one intra row HW at 20 DAT, green leaf manuring (incorporation at puddling) + one HW at 20 DAT, 10 days delayed planting with incorporation of emerged weeds, dense planting (closer spacing of 15 × 10 cm) and Weedy check, scented rice variety “CG Devbhog” was taken during the investigation. The results of experiment revealed that treatment of hand weeding (HW) twice at 20 and 40 DAT (3.65 t/ha), mechanical weeding through Ambika paddy weeder at 20 DAT + one intra row HW (3.53 t/ha) and motorized weeder twice (single row type) + one intra row HW at 20 and 40 DAT (3.51 t/ha) increased the grain yield of rice, respectively over the weedy check. Other than hand weeding twice at 20 and 40 DAT Among mechanical weed control treatments, practice through Ambika paddy weeder at 20 DAT + one intra row HW, recorded the lowest weed density, weed index and weed dry matter. Weed control efficiency at harvest was highest under the mechanical weeding through Ambika paddy weeder at 20 DAT + one intra row HW and it was at par with the HW twice at 20 and 40 DAT. The most dominant weed was *Echinochloa colona, Cyperus iria, Alternanthera sessilis* and *Cyanotis axillaris* in the experimental site based on the summed dominance ratio value. The maximum net return and B:C ratio was noted under Ambika paddy weeder at 20 DAT + one intra row HW and minimum net return and B:C ratio was recorded under weedy check treatment.

Poster 47

Consequence of post-emergence herbicides on productivity of clusterbean

Ram Niwas Choudhary* Shweta Gupta, Seema Sharma, Bheem Pareek, Pratibha Singh, Anju Kanwar Khangarot and Kavita Bhadu

Rajasthan Agricultural Research Institute, Sri Karan Narendra Agriculture University, Jobner, Durgapura, Jaipur, Rajasthan 302018, India

**Email: rnchoudhary.agro@sknau.ac.in*

A field experiment was conducted under All India Coordinated Research Project on Arid Legume during *Kharif* - 2023 at Research Farm, Rajasthan Agricultural Research Institute, SKNAU, Durgapura, Jaipur, Rajasthan to study the "Effect of post-emergence herbicides on growth and yield of clusterbean. The experimental site was located at 26°512 N latitude and 75°472E longitude and at an altitude of 390 m above mean sea level. The soil of the experimental site was well-drained loamy sand and coarse in texture. Nine treatments of weed management were tested in randomized block design with three replications. Eight treatments of weed management were tested in randomized block design with three replications. The treatments consisted of T_1: Unweeded check; T_2: weed free; T_3: imazethapyr 10% SL 100 g/ha at 15-20 DAS.; T_4: imazethapyr 10% SL 75 g/ha at 15-20 DAS T_5: propaquizafop 2.5% 33.3 g/ha + imazethapyr 3.75 ME 50 g/ha (ready mix) at 15-20 DAS; T_6: acifluorfen sodium 16.5% EC 140 g/ha + clodinafop-propargyl 8% (ready mix) 750 ml/ha at 15 - 20 DAS; T_7: acifluorfen-sodium 16.5% EC 140 g/ ha + clodinafop-propargyl 8% (ready mix) 1000 ml/ha at 15 - 20 DAS.; T_8: fomesafer 11.1% 220 g/ha + fluazifop-p-butyl 11.1% 220 g/ha (ready mix) at 15 - 20 DAS. The results of the experiment revealed that T_2 (weed free) treatment gave significantly higher seed yield (1426 kg/ha) which is found at par with T_4: (imazethapyr + imazamox 75 g/ha at 15-20 DAS) treatment (1315 kg/ha) over control treatment (T_1- Unweeded check). In case of weed control efficiency, highest weed control found with T_2 and T_4 treatment whereas weed index was fond low with T_2 and T_4 treatment over control. Significantly lowest weed density was recorded with T_2 and T_4 treatment over control.

Bio-efficacy of new generation herbicides on productivity of summer cowpea

G. Prameela*, Suchismitha Tripathy and Rabiratna Dash
College of Agriculture, Odisha University of Agriculture and Technology,
Bhubaneshwar, Odisha 751003, India
**Email: vgsespo143@gmail.com*

The experiment was conducted at Agronomy Main Research Farm, Odisha University of Agriculture and Technology, Bhubaneswar during the summer season of 2022. The cowpea variety taken in the trial was "Kashi Kanchan". It was laid out in a randomized block design (RBD) consisting of eight treatment combinations with three replications, *viz*. T1: pendimethalin 0.678 kg/ha as pre-emergence application (PE) at 2 DAS, T2: oxyfluorfen 23.5 EC 50 g/ha as PE at 5 DAS , T3: pendimethalin 30 EC+ imazethapyr 2 EC (RM) 750 g/ha as PE at 2 DAS, T4: propaquizafop 2.5% + imazethapyr 3.75% ready mix (RM) 75 g/ha as post-emergence application (PoE) at 20 DAS, T5: (fluazifop-p-butyl + fomesafen ready mix (RM) 125g/ha as PoE at 20 DAS, T6: one hand weeding at 20 DAS, T7: weedy check (control), T8: weed-free (3 hand weedings at 15, 30 and 45 DAS). The soil of the experimental site was sandy loam in texture, acidic in reaction (pH- 6.35), low in organic carbon (0.41%), low in available nitrogen (110 kg/ha), high in available phosphorus (23. 89 kg/ha) and medium in available potassium (123.78 kg/ha) content. The experimental field was dominated by diverse weed flora like *Cynodon dactylon, Cyperus rotundus, Dactyloctenium aegyptium* and *Eleusine indica* among grasses; *Cyperus iria* among sedge and *Commelina benghalensis, Vigna tribolata, Euphorbia hirta, Amaranthus viridis* among broad-leaved weeds. It was observed that weed free (T8) treatment recorded minimum weed density (56.40 no./m^2), weed dry weight (4.62 gm^{-2}), weed index and maximum weed control efficiency (89.62%) but was at par with T3. Weed-free treatment also recorded better plant characters such as plant height (58.66 cm), seed yield (997.68 kg/ha) and stover yield (2218 kg/ha) but was at par with T3. However, T3 resulted in highest net return (Rs.43763 /ha) and B: C (2.61) and was followed by T5, with B:C of 2.34. But in weed-free treatment B: C was less (1.69). Hence, T3: pendimethalin 30 C+ imazethapyr 2 EC Ready mix (RM) 750 g/ha as pre-emergence application at 2 DAS proved to be the best weed control method followed by post-emergence application of T5, Fluazifop-p-butyl + fomesafen Ready mix (RM) 125 g/ha at 20 DAS and thus can be advocated for growing summer cowpea in East and Southeastern coastal plain zone of Odisha.

Management of weeds in pulses: A review

S.B. Singh*[1], S.K. Verma[2] and Amit Kumar Singh[3]

[1]Belatal, Mahoba (Banda University of Agriculture and Technology, Banda)
[2]Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
[3]Department of Agronomy, College of Agriculture, RLBCAU, Jhansi
**Email: sbsinghiari@gmail.com*

Pulses gain the importance next to cereals as the easiest and cheapest source of protein in the human diet. The production of pulses remained stagnant for a long period of time in the post-green revolution period due to several abiotic and biotic factors. Of the several biotic factors, maximum and severe yield loss is caused by weeds. Due to slow growth of pulses in the beginning phase, weeds come out first and get an advantage to become dominant over the crops and exhibit smothering and suppressing effects on crops. Furthermore, the major acreage of pulses (about 85%) is under dryland conditions and grown as intercropping or mixed cropping with non-legume crops. As a consequence, it is subjected to a variety of abiotic and biotic stresses. Weeds are not only responsible for reducing the yield but also create difficulties in performing agricultural activities, and not only this, they also serve as alternate hosts for various kinds of insects and diseases. For quality and maximum grain/seed yield, it is important to keep the weed population below the threshold level. The literature regarding the significance of weed management in pulses, weed flora, the critical period of crop weed competition, and different weed management methods of weed control is collected and presented in this article. Due to slow growth of crops in the beginning, weeds become the predominant biological constraint in growing pulses. Strategies of weed management are made on the basis of the degree of weed competition, types of weeds, and weed control methods adopted. In general, up to 30 days are critical period of weed competition for short duration pulses and up to 60 days for long duration pulses. It has been observed that the major three types of weeds, *viz.* grasses, broadleaf, and sedges, are found in very close association with pulse crops. The intensity of weed infestation differs with the agro-ecological conditions and crop management practices adopted. A holistic move towards weed management is essential to maintaining the weed population below the economic threshold level and thereby reducing the yield loss. Integrated weed management approach proved to be more effective than any of the single method of weed management in pulses.

Poster 50

Weed control efficiency and phytotoxicity of certain post-emergence herbicides in chickpea

D. Subramanyam*, S. Pratibha Sree[1] and P. Amara Jyothi[2]

**S.V. Agricultural College, Tirupati, Andhra Pradesh 517502, India*

[1, 2]Integrated Weed Management Unit, Regional Agricultural Research Station, Lam, Guntur-522 034, Andhra Pradesh, India

**Email: subbuagro37@gmail.com*

Chickpea (*Cicer arietinum* L.) is one of the most important *Rabi* pulse crops of India grown both under conserved soil moisture and irrigated conditions. Due to increased labour cost and scarcity of labour, manual weed control has become a difficult task in chickpea. Chickpea, being slow in its early growth and short stature plant, is highly susceptible to weed competition and causes 75% yield loss (Chaudhary *et al*., 2005). Most of the farmers failed to apply pre-emergence herbicides at the time of sowing due to non-availability of laboursfor spraying and want of sufficient moisture. We have certain aryloxyphenoxypropionates for control of grassy weeds in chickpea, but there is no selective and safe post-emergence herbicide for control of broad-leaved weeds in chickpea. In this connection, the present experiment was conducted to know the performance of certain post-emergence herbicides for broad-spectrum weed control in chickpea. A field experiment was conducted at Regional Agricultural Research Station, Guntur located at geographic coordinates of $16^0 18^1$N, $80^0 29^1$ E with mean sea level of 33 m. The climate is sub-tropical with mean annual rainfall of 950 mm. The soil of experimental field was clay loam in texture, slightly alkaline in reaction (pH 8.5), non-saline and medium in available N (312.5 kg/ha), high in P_2O_5 (185.4 kg/ha) and high in K_2O (1016 kg/ha). The experiment was conducted with 10 treatments comprising of topramezone 15 and 20g/ha, fomesafen + fluziafop-p-butyl 165 and 220 g/ha, atrazine + mesotrione 656 and 875 g/ha, imazethapyr + propaquizafop 94 and 125 g/ha, imazethapyr 50 g/ha and unweeded check in randomised block design with three replications during *Rabi* 2022-23. All these post-emergence herbicides were applied at 25 DAS with the help of knapsack sprayers. The test variety, *NBeG-452* was sown on 29 october 2023 and harvested on 15 February 2023.The major weed flora associated with chickpea were *Denebra retroflexa, Echinocloa colona, Chloris barbeta, Trianthema portulacastrum, Chrozophora rotteleri*, *Digera arvensis, Cleome viscosa, Phyllanthus madaraspatensis, Commelina benghalensis, Daturas strumarium, Celosia argentea, Physalis minima* and *Cyperu srotundus.* Among the post-emergence herbicides tested, atrazine + mesotrione at both the doses showed severe phytotoxicity of 7.0 to 7.5 at 7 days after herbicide application (DAHA) and further increased the phytotoxicity rating of 9.0 at 14 DAHA in chickpea, but these treatments registered lower weed density, weed dry weight and higher weed control efficiency. The percent stand loss in these treatments was very high up to 90 percent. Post-emergence application of fomesafen + fluziafop at both the doses showed phytotoxicity rating of 4.0 and 3.5 in 0-10 scale on crop. The lowest phytotoxicity rating on crop was observed with topramezone 15 g/ha and imazethapyr + propiquizafop 94 g/ha and imazethapyr 50 g/ha with 0, 1 and 1, respectively in 0-10 scale. Among all the herbicides tested, topramezone 15 g/ha resulted in higher seed yield (1955 kg/ha) which was on par with topramezone 20 g/ha (1846 kg/ha) followed by imazethapyr+ propaquizafop 94 g/ha (1725 kg/ha). The reduction in seed yield due to weed competition in chickpea was 35.75percent compared to beat weed management practice i.etopramezone 15g/ha. These results are in-line with the findings of Nath *et al*., (2021). The present field experiment reaveld that topramezone 15 g/ha resulted in higher seed yield which was on par with topramezone 20 g/ha followed by imazethapyr + propaquizafop 94 g/ha with minimum phytotoxicity on chickpea. Ready mix herbicides*viz*., atrazine + mesotrioneand fomesafen + fluziafop showed severe phytptoxicity on chickpea.

Integrated weed management in chickpea : strategies for sustainable crop production

Sharda Sharan*, Chandra Bhushan, Ambikesh Tripathi, Brijesh Kumar and Prajjwal Agnihotri

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: shardasharan163@gmail.com*

Chickpea (*Cicer arietinum*) belongs to Fabaceae family and a vital legume crop in India, serving as a primary source of protein in the Indian diet. It is essential to the nutrition of thousands of people in the developing world but at present its productivity is extremely low in India. There are various reasons for low productivity. Among the various factors that contribute to the low production losses resulting from weeds, one of the most significant one's accounts for 30–54% of the total loss. Understanding the weed populations in the field in full detail is necessary to determine when to manage weeds. Due to their slow development and growth rate, chickpea is a poor crop competitor with weeds. Up to 60 days after sowing, it competes with chickpea weeds due to its few branches and little leaf area. Integrated Weed Management (IWM) provides a comprehensive solution by combining cultural, mechanical, biological, and chemical methods to control weeds while minimizing environmental impact. The latest advances in IWM techniques specific to chickpea production are optimizing agronomic practices such as crop rotation, intercropping, and the use of cover crops along with herbicides and bioherbicides in reducing weed pressure without harming beneficial organisms. Field trials have demonstrated that integrating these approaches can significantly enhance weed control efficiency, improve chickpea yields, and reduce reliance on chemical herbicides. This also provides valuable insights for farmers and agricultural stakeholders, advocating for the adoption of integrated approaches in weed management to ensure long-term crop sustainability and environmental health.

Poster 52

Weed management of chickpea with IDM in Chhattisgarh

B.P. Tripathi*[1], N.K. Mishra[2] and B.S.Parihar[3]

[1,3]Krishi Vigyan Kendra, Kabirdham, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India

[2]Dr. Ramchandra Singh College of Agriculture & Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India

**Email: bp_tripathi2007@yahoo.co.in*

Pulses are an important component of the predominantly vegetarian Indian diet. These are not only important for sustainable agriculture because they enrich the soil through biological nitrogen fixation, but they also fit in various cropping systems without interfering with the main cereal or oilseed crops. Among the pulses, chickpea, or Bengal gram (*Cicer arietinum* L.), is a nutritionally dense crop that contains 21 percent protein, 61.5 percent carbohydrates, and 4.5 percent fat. It is also high in calcium, iron and niacin and it has medicinal properties. It is a rabi-season crop that is primarily grown as a rainfed crop in many parts of the state. The poor competition ability of chickpea opens the door for weeds to cause a serious yield loss. Weed management is a critical part of chickpea production because weeds can reduce crop yields by 40–87%. Considering the importance, the experimental field is conducted to evaluate the integrated effects of pre-emergence herbicides and hand-weeding on weed control, yield components, yield, and their economic feasibility for cost effective weed control in chickpea was carried out to assessment of IDM module through pre emerging chemical herbicides like pendimethalin 30% EC 1.00 kg a.i./ha in check pea through on field trials (OFT) against in Kabirdham district of Chhattisgarh. The experiment was conducted in two consecutive years *Rabi* season 2021-22 and 2022-23 with 12 treatment replications arranged at different location of farmer’s field compared with farmer practices by supervision of Krishi Vigyan Kendra, Kabirdham (Chhattisgarh) as an on-farm trial for control the check pea weeds The application of pendimethalin 30% EC 1.00 kg/ha used as pre emergence increased yield by 25.79% with reduced weed infestation by 72.38% compared to farmer practices. Therefore, in case labour is constraint and pendimethalin 30% EC 1.00 kg/ha herbicide is timely available, its application should be the alternative to preclude the yield loss and to ensure maximum benefit. Herbicides application is an integral part of farmer’s crop management in modern agriculture systems.

Poster 53

Influence of various chickpea based intercropping systems under different organic modules on weed management

N. Charitha*[1], Rathod Sridhar[2], A. Sai Kishore[3], L. Shravika[4], A.N. Paslawar[5] and V.V. Goud[6]

[1]*Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India*

[2]*School of AGRICULTURAL Sciences, Nagaland University, Medziphema Campus, Dimapur, Nagaland 797106, India*

[3]*Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana 500 030, India*

[4]*Dept of Agronomy, University of Agricultural Sciences, Raichur, Karnataka 584104, India*

[5,6]*Dept of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India*

**Email: charithanalla26@gmail.com*

A field investigation for evaluating productivity, economics and soil health of chickpea based intercropping systems under different organic modules was conducted during *Rabi* season of 2022-23 and 2023-24 at Centre for Organic Agriculture Research and Training, Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola, Maharashtra. The experiment was laid out in strip plot design with four cropping systems and three organic nutrient modules and four replications with 2:2 ratio to find out the effect of chickpea based intercropping system. The crop and variety were chickpea (JAKI- 9218), linseed (NL-260), coriander (ACR-1) and sorghum (PKV Kranthi). Treatment details were intercropping system *viz*. sole chickpea, chickpea + coriander (2:2), chickpea + linseed (2:2), chickpea + sorghum (2:2) and three organic nutrient management *viz*. N1 – organic farming, N2 – natural farming and N3 – integration of both organic and natural farming, and grown on broad bed furrow for better aeration and conservation of moisture and easy application of Jivamrut in furrows. During both the seasons, general weed flora observed belongs to nine taxonomic families of which three species were grasses, one species was sedge and eleven species were broad leaved weeds. The predominant weed species associated with chickpea were *Cyperus rotundus*, *Digitaria sanguinalis*, *Commelina benghalensis*, *Phyllanthus niruri*, *Cleome viscosa*, Boerhavia diffusa, *Dactyloctenium aegyptium*, *Brachiaria reptans*, *Euphorbia hirta*, *Digera arvensis*, *Celosia argentea*, *Physalis minima*, *Amaranthus viridis*, *Datura stramonium* and *Parthenium hysterophorus*. Weed density, fresh weight and dry matter production were recorded to be minimum in chickpea + coriander than all other intercropping systems which was on par with sole chickpea during both the seasons. Weed control efficiency was recorded to be highest with the chickpea + coriander intercropping system which was on par with sole chickpea and how ever the weed index was considered to be highest with the sole chickpea which was on par with chickpea + coriander intercropping system.

Efficacy, energy budgeting and carbon footprints of herbicidal weed management in chickpea

Anamika Nepali* and J.K. Singh

Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: anamika@bhu.ac.in*

Weed infestation is a significant constraint in chickpea (*Cicer arietinum* L.) production, causing substantial yield reductions by competing for resources like nutrients, water and light. Herbicidal weed management has emerged as an effective solution to minimize these losses by controlling weed growth. However, there is a growing concern about the energy consumption and environmental impacts associated with herbicide use, particularly regarding energy budgeting and carbon footprints. This study assesses the efficacy, energy requirements and carbon emissions associated with various herbicidal weed management strategies in chickpea cultivation. The experiment was conducted using different herbicidal treatments, including pre-emergence and post-emergence herbicides, hand weeding, compared against a control (no herbicide use) to evaluate their effectiveness in weed suppression and impact on chickpea yield. Energy budgeting was conducted by accounting for energy inputs required for herbicide production, transportation, and application. These inputs were compared to the energy output (yield) of chickpea, allowing for a comprehensive analysis of the energy efficiency of each herbicidal method. Simultaneously, carbon footprints were estimated based on greenhouse gas (GHG) emissions associated with energy inputs such as fuel consumption for herbicide application and the production of the chemicals themselves. The results indicated that herbicidal weed management significantly reduced weed density and enhanced chickpea yield compared to the untreated control. Pre-emergence herbicides provided better early-season weed control, preventing weed establishment, while post-emergence herbicides were effective at managing late-season weed flushes. Both types of herbicides demonstrated high efficacy in minimizing weed competition, leading to improved resource availability for the crop. In terms of energy budgeting, herbicidal treatments required considerable energy inputs, primarily due to the production and application of herbicides. Among the different treatments, pre-emergence herbicides showed slightly better energy efficiency than post-emergence applications, as they required fewer follow-up interventions. Despite the energy-intensive nature of herbicide production and application, the energy output from increased chickpea yields helped offset some of these inputs. However, herbicidal weed management methods were found to be less energy-efficient compared to manual or integrated approaches. Regarding carbon footprints, herbicidal treatments contributed significantly to GHG emissions due to the high energy consumption involved in the production and transportation of chemicals. The carbon emissions were higher for post-emergence herbicides, primarily due to additional application rounds, compared to pre-emergence treatments. However, the yield increase achieved through herbicide use somewhat mitigated the per-unit carbon cost of chickpea production.

Effect of weed management practices on weed dynamics and growth and yield of chickpea

Pradeep Kumar*, V.P. Usadadiya, H.M. Virdia, Gharsiram and Y. Nefla
Krishi Vigyan Kendra, Jhunjhunu, Rajasthan 333001, India
**Email: pradeepsevta11@gmail.com*

The effect of sugarcane trash with weed management practices was assessed during 2021-22 and 2022-23 in two year experimentation at Navsari Agricultural University, Navsari, Gujarat, India. Both experiments were planned to lay in randomized plot design with factorial concept arrangement, each treatment replicated three times. Two levels of treatments were in mulching practice, *viz.* No mulch (M0) and Sugarcane trash mulch 5 t/ha (M1) as first factor treatment and six levels of treatment of weed management practices, *viz.* pendimethalin 450 g/ha PE, Pendimethalin 450 g/ha PE *fb* hand weeding at 30 DAS, quizalofop-ethyl 40 g/ha PoE, pendimethalin 450 g/ha PE *fb* quizalofop-ethyl 40 g/ha PoE, Interculture *fb* hand weeding at 20 and 40 DAS and Weedy check treatment as involved in second factor of experiment. Significant variation was recorded among the no mulch and sugarcane trash mulch treatment. The lowest narrow leaf, broad leaf and total weed density and dry weight of weeds were observed in sugarcane trash mulch 5 t/ha treatment at 45 and 60 DAS after sowing as compared to no much treatment. Moreover, the results indicated a significant effect of the applied treatments (factor second) as on narrow leaf, broad-leaf and total weed density. Interculture *fb* hand weeding at 20 and 40 DAS recorded significantly lower weed density and dry weight followed by pendimethalin 450 g/ha PE *fb* hand weeding at 30 DAS treatment. Growth parameters of chickpea dry matter accumulation/plant, crop growth rate and relative growth rate at 30 and 60 days after sowing and seed and stover yield were observed significantly higher in M1 treatment over the no mulch treatment. While, Interculture *fb* hand weeding at 20 and 40 DAS weed management practices significantly enhanced the growth and yield attribute. In conclusion, for weed management in chickpea, the sugarcane trash 5 t/ha with interculture *fb* hand weeding at 20 and 40 DAS are the most suitable for cultuivation in Navsari district of Gujarat.

Climate-resilient weed management through mulching for enhanced chickpea yield and soil health under dryland conditions

Kareti Harika*, Sudhir Kumar Rajpoot, S.K. Prasad, P. Halesha, Udaya Lakshmi and Lakey Radha

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: harikakareti392@gmail.com*

Crops grown in dryland regions face significant challenges as soil moisture and nutrients are often limited and weeds aggressively compete for these critical resources. In the realm of environmental and ecological farming, there is growing attention towards weed management which does not involve or reduce the use of herbicides. Mulching represents one of the viable alternatives for weed control and helps retain soil moisture that in turn improves resource management as a whole. A field experiment was carried out during the *Rabi* season of 2022-23 at the Dryland Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh to study the effect of different mulches on Chickpea (*Cicer arietinum* L.) under dryland conditions. The experiment was laid out in a randomized complete block design with 7 treatments replicated thrice. The treatments used were dust mulch at 25 days after sowing (DAS), paddy straw at 5 t/ha, maize stover at 5 t/ha, Leucaena twigs at 5 t/ha, paddy straw at 2.5 t/ha +Leucaena twigs at 2.5 t/ha, maize stover at 2.5 t/ha + Leucaena twigs at 2.5 t/ha and one with no mulch. The weed flora found in the experimental field of Chickpea were grasses (*Cynodon dactylon*), broad-leaved weeds (*Asphodelus tenuifolius, Medicago denticulata, Vicia sativa, Anagallis arvensis*, *Parthenium hysterophorus*, *Chenopodium album*). Based on thorough study of the findings, it can be concluded that the treatment of paddy straw mulching at 5t/ha proved to be the best treatment for lowering weed density (60/m2, 164/m^2) and biomass (28 g/m2, 55.36 g/m^2) in 60 DAS and 90 DAS respectively. Although dust mulching recorded significantly lower weed population (8/m^2) and dry matter (1.44 g/m^2) in 30 DAS, it was ineffective in the further crop growth period due to the rapid flush and proliferated germination of weeds in further stages. Paddy straw at 2.5 t/ha + Leucaena twigs at 2.5t/ha excelled over all other treatments in terms of growth, yield (1749 kg/ha), and economics. Paddy straw mulching at 5 t/ha was found to be significantly better in conserving soil moisture (16.67%) than other treatments. Maize stover mulch at 2.5 t/ha + leucaena twigs mulch at 2.5t/ha demonstrated the highest soil available nitrogen (259.3 kg/ha), dehydrogenase enzyme activity (18.32 µg TPF/g soil/24 hrs), alkaline phosphatase activity (115.32 µg NP/g soil/hr), soil microbial biomass carbon (178.44 µg of biomass/g of soil), fungal (14.760 cfu/g), bacterial (16.98 cfu/g) and actinomycetes (3.480 cfu/g) population. In contrast, significantly higher soil-available phosphorus (15.23 kg/ha), potassium (185 kg/ha), and organic carbon (0.56%) were recorded under Leucaena twigs at 5 t/ha. These findings offer valuable guidance for farmers and researchers focused on sustainable weed management, optimizing crop yields, and enhancing soil health in dryland conditions for similar crops.

Poster 57

Effect of weed management practices on weed intensity, growth and yield of chickpea

Prashant P. Pawar*, S.C. Wadile, P.D. Sonawane and J.V. Kathepuri

Agronomy section, College of Agriculture, Dhule, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413722, India

**Email: prashantpawar57@gmail.com*

An experiment was conducted during *Rabi* 2021 at P.G. Research Farm, Agronomy Section, College of Agriculture, Dhule. Experiment consisted of ten treatments laid out in randomized block design with three replications. The different weed management treatments were significantly influenced the weed population, growth and yield of chickpea. Weed flora, weed intensity and weed dry weight were significantly reduced due to weed free treatment. Amid different weed management treatments, the application of oxyfluorfen 0.1 kg/ha (PE) *fb* tank mix imazethapyr (50%) + quizalofop-ethyl (50%) (PoE), shows less number of total weed population when compared to other weed management treatments but which was found at par with pendimethalin 1.0 kg/ha (PE) *fb* tank mix imazethapyr (50%) + quizalofop-ethyl (50%) (PoE), pendimethalin 1. kg/ha at PE *fb* one hand weeding and oxyfluorfen 0.1 kg/ha at PE *fb* one hand weeding. The significant effect on growth character of plant was noticed due to different weed management treatments which resulted in enhanced yield contributing character, *viz*. number of pods/plant, number of seeds/pods, grain yield/plant, 100 seed weight, grain and straw yield (q/ha). The highest grain and straw yield of chickpea (27.21 q/ha and 66.42 q/ha, respectively) were in weed free treatment. Among the different weed management treatments, application of oxyfluorfen 0.1 kg/ha (PE) *fb* tank mix imazethapyr (50%) + quizalofop-ethyl (50%) (PoE) produced significantly the higher grain and straw yield of chickpea (25.47 and 62.94 q/ha respectively) than the other methods of weed control and it was found at par with application of pendimethalin 1.0 kg/ha (PE) *fb* tank mix imazethapyr (50%) + quizalofop-ethyl (50%) (PoE), pendimethalin 1.0 kg/ha at PE *fb* one hand weeding and oxyfluorfen 0.1 kg/ha at PE *fb* one hand weeding. Similar reports were also stated by Among different herbicidal treatments application of oxyflurofen 0.1 kg/ha (PE) *fb* tank mix imazethapyr (50%) + quizalofop-ethyl (50%) (PoE) showed highest value of gross and net monetary returns (Rs 127345 and 84091/ha) respectively than the rest of the weed management treatments.

Poster 58

Weed dynamics as influenced by date of sowing and varieties in chickpea

Abhjeet Dubey* and Anay Rawat
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: abhijeet121282@gmail.com*

Chickpea is grown during post monsoon in winter season as it requires cool and dry weather conditions for optimum growth and development (Kumar *et al*., 2008). Most of the chickpea area is under rainfed but with the development of high yield input responsive varieties, it can be cultivated under irrigated conditions also. In Madhya Pradesh, the sowing of chickpea in rice-chickpea crop rotation gets late due to delay in harvesting of preceding crop of rice This late sown crop experiences very low temperature at initial stages of crop growth, resulting in poor and slow vegetative growth coupled with infestation of grassy weeds. Whereas, the early sown crop allows excessive vegetative growth, poor settings of pods and greater weeds competition due to germination of weed seeds simultaneously with crop seeds. Suboptimal photo-thermal requirements during growing season are known to have profound effect on productivity (Tripathi et al., 2008). Therefore, selection of sowing time of chickpea is important to exploit the environmental conditions in favour of crop because modified environment resulting from different dates of sowing may influence the crop growth and weed dynamics too.The dry matter accumulation and distribution during different growth stages ultimately affect the yield of crop. Delay in sowing causes early maturity resulting in drastic reduction in yield. The weed dynamics fluctuate as it responds differently due to variation in the environmental and thermal requirements of a date of sowing in a particular agro- climatic conditions. The field experiment was conducted at Research Farm, Department of Physics and Agrometeorology, College of Agricultural Engineering , Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Rabi* 2015-16.The present experiment was carried out on sandy clay loam soil texture, neutral in reaction (6.7 pH) with low electrical conductivity (0.06 D/m), ds/m medium in available N (285 kg/ha), P (17.45 kg/ha), K (260 kg/ha) and organic carbon (0.82). nine treatments comprising of three dates ofsowing (15.11.2020, 30.11.2020 and 15.12.2020) as main plot treatments and seven varieties (JG 14, JGK 1 and JG 36) as sub plot treatments, were laid out in split plot design with three replications. Among the different dates of sowing, the density of *Echinochloa colona*, *Anagalis arvensis*, *Chenopodium album* and *Portuloca oleracea* was higher when chickpea was sown in the third week of November and their density was decreased with corresponding delay in sowing dates in the month of December. On the contrary, the density of *Medicago denticulata* was more in second sowing dates (30/11/2020) but the density of *Cyperus rotundus, Chenopodium album, Cichorium intybus* and *Cynodon dactylon* was higher when chickpea was sown very late in the third week of December (15.12.2020).

Response of greengram to assess the effects of elevated CO_2 and nitrogen levels on available nutrient in soil

Sunil Kumar Upadhyay*, S.K. Singh, Amita Sharma, Devid Kumar Sahu and Monika Raghuwanshi

Jawaharlal Nehru Agriculture University, Jabalpur, Madhya Pradesh 482004, India

**Email: skupadhyay6292@gmail.com*

Mungbean [*Vigna radiata* (L.)] is an important legume providing protein for the rural and urban poor in India. Due to its rapid growth and early maturity, it is adopted in multiple cropping systems in the drier and warmer climates of tropics and sub-tropics. Elevated atmospheric CO_2 concentrations can enhance photosynthetic rates in plants and therefore act as a carbon 'fertilizer' to induce increase in net ecosystem CO_2 exchange and contribute to increase in net primary productivity. ambient CO_2 (350ppm) with elevated CO_2 condition (550 ppm) and found an increased root biomass by 45 per cent, root volume by 44 per cent, number of adventitious roots by 31 per cent and overall root length by 37 per cent in rice plantsThus elevated CO_2 is likely to stimulate the growth of many plant species. It is revealed from results, that the increasing the levels of elevated CO_2 up to 500ppm CO_2 levelincreased the available-N content in post harvest soil but difference was significant only upto450 ppm CO_2 level thereafter difference was not the cross the level of significance during present experimentThe experiment was carried out during *kharif* season of 2019 at the research farm of College of Agriculture, Gwalior; Madhya Pradesh to evaluate the response of green gram to assess the effects of elevated CO_2 and nitrogen levels on available nutrient in soil. The experiment was laid out in Factorial Randomized Block Design. One factor is different level of CO_2 (C0: CO_2 – 380 ppm (Ambient), C1: CO_2 – 425 ppm, C2: CO_2 – 450 ppm and C3 : CO_2 – 500 ppm) and second factor is different level of N2 (N1: Control, N2: 10 kg/ha, N3: 20 kg/ha and N4: 30 kg/ha). Under different levels of elevated CO_2, available NP content significantly and maximum value (211.4 and 12.57 kg/ha) was recorded under 500ppm CO_2 level (C3) and highest K (210.70 kg/ha) found in 450 CO_2 level (C3). The application of nitrogen increased the available-NPK content significantly and maximum value (208.6, 12.58 and 211.72 kg/ha) was recorded with the application of 30 kg N ha-1 (N3) level which was significantly higher as compare to control.

Poster 60

Enhance the weed control efficiency and yield of greengram through appropriate herbicides

R.K. Singh*, Veenapani Srivastav and Kamlesh Ahirwar
Krishi Vigyan Kendra Chhatarpur, (Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur), Chhatarpur, Madhya Pradesh 471001, India
*****Email: rajiv_kvk@rediffmail.com*

Greengram (*Vignaradiata* L.) is the most important and extensively cultivated legume crop grown during the *Kharif* season in India. The potential yield of most of the varieties ranges from 1200-1600 kg/ha, but the productivity is far less than the potential yield. There are many constraints for this low yield i.e. loss caused by weed, cultivation on poor and marginal lands and inadequate fertilization, but weed infestation is one of the main constraints. The reduction ingreengram yield due to weed competition ranges from38-85 %. Besides causing crop losses, weeds are also responsible for reducing crop quality, nutrients status of soil and compete for nutrients, water, light and space with crop plants during early crop growth period. Weeds are also increased production cost, harbor insect-pest and plant diseases. In this situation timely and effectively weed management is prime agronomical practices to improve greengram yield. The conventional methods of weed control (hoeing or hand weeding) are labor intensive, expensive, and insufficient and may cause damage to the crop. Hence, weed control by using chemicals provide greater flexibility and minimize labor cost. Looking the importance of the subject, field experiments were conducted three consecutive years during 2020-21 to 2022-23 at KVK instructional farm and farmers field in rainfed condition to find out suitable herbicides against weed flora in greengram c.v. Sikha. The experiment was comprised of six treatments and laid out in Randomized Block Design with three replications. Among the treatments significantly higher seed (10.8 q/ha) and stover (34.2 q/ha) yield of greengram was found under the application of pendimethlin 30 EC 1.0 kgha (PE) and imazthaper + Imezamox 40 g/ha (PoE) followed by application of imazthaper + imezamox 40 g/ha PoE as compared to other treatments (control plot and imazathaper 100 g/ha PoE- T4) and however, it was found at par with treatments imazthaper + imezamox 40 g/ha PoE, and iendimethalin 1000 g/ha and imazthaper + imezamox 40 g/ha PoE. The higher growth, nodulation, yield attributes and weed control efficiency, weed control efficiency index and lower weed index were also obtained under the treatments pendimethalin 1000 g/ha + imazthaper + imezamox 40 g/ha PoE. While, the lower weed counts (3.0/m^2), weed fresh and dry matter (9.9 and 6.6 g/m^2) and reduce weed infestation along with higher net return (Rs. 29244) and B: C ratio (2.3) was also observed with this treatment (pendimethalin 1000 g/ha + imazthaper + imezamox 40 g/ha PoE). Its can concluded that use of scientific method of weed management can reduce the yield gap up to the considerable extent thus leading to increased productivity of greengram in these districts. The results of demonstrations convincingly brought out that the yield of greengramcould be increased by 88.4 percent with the intervention on appropriate weedicide for proper weed management in the Chhatarpur district of Madhya Pradesh. Favorable cost benefit ratio is self-explanatory of economic viability of the trial and convinced the farmers for adoption of intervention imparted.

Poster 61

Tillage and weed management practices in mustard under conservation agriculture based direct seeded rice – mustard – greengram cropping system

Koushik Sar
Faculty of Agricultural Sciences Siksha 'O' Anusandhan, Bhubaneswar, Odisha 751029, India
Email: koushiksar@soa.ac.in

Weed control in conservation agriculture poses a great challenge than in conventional agriculture because there is no weed seed burial by tillage operations. Crop residue when retained in ZT practice, suppress weed growth, maintain soil temperature, conserve soil moisture and organic matter and control air pollution caused due to residue burning. Achieving agricultural sustainability is significant at present times and this can be possible by improving biological functions of the agro ecosystem through minimum soil disturbance, continuous organic cover and crop diversification and one of the primary aims of conservation agriculture is to do that. Thus conservation agriculture is an alternate solution for today's limited natural resources and changing climate. The present experiment was conducted to study the effect of different tillage and weed management practices on mustard in direct seeded rice – mustard – greengram cropping system during rabi, 2022-23 and 2023-24 at Agriculture research station, Faculty of Agricultural Sciences, SOADU, Bhubaneswar. The experiment was laid out in strip plot design with three replications. Four tillage practices comprising of conventional tillage (CT), zero tillage (ZT), ZT+30% R and ZT+60% R were allocated to the horizontal strip and three weed management practices, such as recommended herbicides (RH) (pendimethalin at 0.75 kg/ha), recommended herbicides + one hand weeding (HW) at 35 days after sowing (DAS) and unweeded control were assigned to the vertical strip. However, on system basis the herbicide use for rice was pendimethalin at 1.0 kg/ha followed by bispyribac-sodium at 25 g/ ha during *Kharif* and pendimethalin at 0.75 kg/ ha for greengram during summer. Results revealed that ZT+60% R recorded significantly lower values of weed density and dry weight at 45 DAS and higher values of yield attributes and yield over other tillage systems. ZT and ZT+30% recorded at par value of seed and stover yield of mustard. Among the weed management practices, recommended herbicides with one hand weeding at 35 DAS registered significantly the lowest weed density and dry weight and highest value of yield attributes and yield of mustard. However, ZT+60% R along with pendimethalin at 0.75 kg/ha at 1 DAS combined with one hand weeding registered the highest seed and stover yield of mustard. The highest gross return, net return and return/ rupee invested was obtained under zero tillage + 60% residue (ZT+60%R). Among the weed management practices application of recommended herbicide + one hand weeding at 35 DAS recorded the highest gross return, net return and return/ rupee invested over other treatments. However, the highest gross return, net return and return /rupee invested was recorded under ZT+60%R along with recommended herbicide + one hand weeding at 35 DAS in both the years. Thus, ZT+ 60% R with recommended herbicides (pendimethalin 0.75 kg/ha) + one hand weeding at 35 DAS was found to be promising for effective weed management, higher productivity and profitability of mustard in rice – mustard - greengram cropping system.

Poster 62

Effect of various herbicides on nutrient content and uptake by weed and gram grown under south Gujarat condition

V.M. Patel*, L.B. Kalasariya, J.V. Patel and B.K. Patel
Department of Agronomy, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat 396450, India
**Email: vinaypatel@nau.in*

Field experiment was conducted during *Rabi* season of 2017 – 18 at N. M. College of Agriculture, NAU, Navsari to study the, “Response of gram to different pre- and post-emergence herbicides under south Gujarat condition”. Ten treatment of weed management practices, *viz.*T1: pendimethalin 0.75 kg/ha as pre-emergence, T2: pendimethaline 0.75 kg/ha as pre-emergence *fb* 1H.W at 20 DAS, T3: pendimethalin 0.75 kg/ha as pre-emergence *fb* imazethapyr 16.5 g/ha at 20 DAS as post-emergence, T4: pendimethalin 0.75 kg/ha as pre-emergence *fb* (imazethapyr 35% + imazamox 35% 20 g/ha) at 20 DAS as post-emergence, T5: pendimethalin 0.75 kg/ha as pre-mergence *fb* propaquizafop 0.75 kg/ha at 20 DAS as post-emergence, T6: pendimethalin 0.75 kg/ha as pre -emergence *fb* (propaquizafop 2.5% + imazethapyr 3.75%) 0.57 kg/ha at 20 DAS as post-emergence, T7: pendimethalin 0.75 kg/ha as pre-emergence *fb* quizalofop-p-ethyl 40 g/ha at 20 DAS as post-emergence, T8: pendimethalin 0.75 kg/ha as pre-emergence *fb* fenoxaprop-p-ethyl 37.2 g/ha at 20 DAS as post-emergence, T9: weed free, T10: Uncontrol (weedy check) were evaluated in randomized block design with three replications. Treatment of weed free condition up to harvest showed its superiority for seed and stover yield of chickpea over other treatments but it remained statistically at par with treatment T8, T7 and T2. Treatment T9, T8, T7 and T2 noted 54.9, 51.2, 50.3 and 49.7 per cent increases in seed yield of gram over treatment T10 (weedy check). Treatment T9 (Weed free) recorded significantly higher content and uptake of nutrient (N, P and K) over other treatments but it remained at par with treatment T8, T7 and T2. Significantly higher content and uptake of major nutrients by weeds were registered under treatment T10 (unweeded control) whereas, significantly lower content and uptake of nutrients by weeds were noted under treatment T9 being at par with treatment T8 and T7. Similarly available nitrogen and phosphorus in soil after harvest of crop were observed significantly higher under treatment T9, but it remained at par with treatment T7 and T8 for available nitrogen and treatment T8, T7, T2 and T1 for available phosphorus. The various weed management treatment has no significant effect on available potassium in soil after harvest of crop.

Effect of non-chemical weed management practices in blackgram

G. Pavithra* and A. Velayutham
Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India
**Email: pavigovind44@gmail.com*

Field experiment was conducted at the wetlands farm of Tamil Nadu Agricultural University in summer, 2023. Blackgram is one of the important pulse crops supplying three times the protein of cereals. The primary objective was to evaluate non-chemical weed management practices in blackgram (*Vigna mungo* L.) under irrigated ecosystem. Blackgram is the fourth most important pulse crop supplying three times the protein of cereals. The experiment followed a randomized block design with ten treatments, each replicated three times. Treatments included leaf extracts of sorghum, castor, papaya each at a concentration of 30% and combination of citric acid (5 per cent) and garlic (0.2 per cent) as pre-emergence spray on 3 DAS *fb* hand weeding at 30 DAS. Additionally, other treatments involved dust mulching, mechanical weeding, hand weeding each at 15 and 30 DAS, along with weed-free, weedy check, and chemical check (pendimethalin at the rate of 1 L/ha). The results revealed that among the different non-chemical practices, sorghum leaf extract resulted in lower weed density (56.33 no./m^2) and dry weight (3.28 g/m^2) at 15 DAS which is higher than chemical check (32 no./m^2 and 2.11 g/m^2, respectively). On 30 DAS dust mulching recorded lowest density (73.67 no./m^2) which was on par with sorghum leaf extract (81.33 no./m^2) while weedy check recorded highest density (326.67 no./m^2). Highest weed index of 38.01 was obtained in weedy check while the lowest weed index of 8.55 and 10.67 was found in chemical check and sorghum leaf extract, respectively. Growth parameters like plant height and plant dry matter production were higher under weed-free check followed by sorghum leaf extract. Highest seed yield was recorded in weed-free (0.98 t/ha) while yield of chemical check (0.90 t/ha) and sorghum leaf extract (0.88 t/ha) was found to be on par with each other. Therefore, using 30% sorghum leaf extract can be an eco-friendly option for non-chemical weed control in blackgram.

Poster 64

Evaluation of post-emergence herbicides in urdbean

Versha Gupta*, Khajan Singh, S.L. Yadav, R.S. Narolia and Rajesh Kumar
Agricultural Research Station, Ummedganj, Agriculture University, Kota, Rajasthan 325001, India
**Email: guptavershakota@gmail.com*

Urdbean is the important *Kharif* pulse crops of Rajasthan which is grown under rainfed conditions during rainy season. A field experiment was conducted during *Kharif* 2020, 2021 and 2022 at Agricultural Research Station, Kota to find out the suitable post-emergence herbicides for urdbean. The experiment consisted of eight treatments, *viz*. unweeded control, weed free, hand weeding at 20 and 40 DAS, Imazethapyr 10% SL 55 g/ha at 20 DAS as post-emergence, fluazifop-p-butyl 13.4% w/w 250 g/ha (ready mix) at 20 DAS as post-emergence, propaquizafop 33.3 g/ha + imazethapyr 50 g/ha (ready-mix) at 20 DAS as post-emergence, acifluorfen-sodium 140 g/ha + clodinafop-propargyl 70 g/ha (ready-mix) at 20 DAS as post-emergence, fomesafen + fluazifop-p-butyl 220 g/ha (ready mix) at 20 DAS as post-emergence. The experiment was laid out in randomized block design with three replications. Soil of the experiment field was clay loam, slightly alkaline, medium in available Nitrogen and potasium and low in available phosphorus and sulphur. Urdbean variety Kota Urd 3 was used as a test crop with seed rate 20 kg/ha and row spacing 30 cm. Results of pooled data revealed that Weed free check recorded maximum and significantly higher grain yield being at par with two hand weeding. Among herbicides fomesafen 11.1% + fluzifop-p-butyl 11.1% 220 g/ha gave maximum grain yield followed by propaquizafop 2.5% 33.3 g/ha + imazethapyr 3.75% ME 50 g/ha and acifluorfen-sodium 16.5% EC 140 g/ha + clodinafop-propargyl 8% EC 70 g/ha over rest of treatments. Maximum and significantly higher net returns and B:C ratio were recorded with the application of propaquizafop 2.5% 33.3 g/ha + imazethapyr 3.75% ME 50 g/ha being at par with fomesafen 11.1% + fluzifop-p-butyl 11.1% 220 g/ha and acifluorfen-sodium 16.5% EC 140 g/ha + clodinafop-propargyl 8% EC 70 g/ha. Minimum and significantly lower weed density, weed dry matter and weed control efficiency was recorded with weed free check followed by two hand weeding. Among herbicides, application of fomesafen 11.1% + fluzifop-p-butyl 11.1% 220 g/ha recorded minimum and significantly lower weed count at harvest being at par with propaquizafop 2.5% 33.3 g/ha + imazethapyr 3.75% ME 50 g/ha and acifluorfen-sodium 16.5% EC 140 g/ha + clodinafop-propargyl 8% EC 70 g/ha over rest of herbicidal treatments. Based on three years data it can be concluded that post-emergence herbicide Fomesafen + fluazifop-p-butyl 220 g/ha (ready-mix) at 20 DAS or propaquizafop 33.3 g/ha + imazethapyr 50 g/ha (Ready mix) at 20 DAS may be used in urdbean crop to control weeds.

Poster 65

Integrated weed management in blackgram

H.H. Patel*, V.M. Kapadiya, T.U. Patel and D.D. Patel
College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat 392002, India
**Email: hhpatel@nau.in*

An experiment on Weed management in blackgram (*Vigna mungo* (L.) Hepper) conducted at College of Agriculture, NAU, Bharuch during *kharif* season. The experiment was set out in randomized block design with twelve weed management treatments *viz.*, weedy check, 2 hand weeding at 15 and 30 DAS (weed free), pendimethalin 38.7 CS 1000 g/ha (PE), imazethapyr 10SL 70 g/ha (PoE) 20 DAS, propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 20 DAS, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* imazethapyr 10 SL 70 g/ha (PoE) 30 DAS, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 30 DAS, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS, imazethapyr 10 SL 70 g/ha (PoE) 20 DAS *fb* hand weeding 40 DAS, propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 20 DAS *fb* hand weeding 40 DAS, stale seed bed (glyphosate), stale seed bed (tillage) and experiment was replicated trice. Significantly minimum weed count at 20 DAS and 40 DAS were observed under treatment 2 hand weeding at 15 and 30 DAS (weed free), which was at par with pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS. Further, lower dry matter of weed at 40 DAS was registered under application of pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS followed by 2 hand weeding at 15 and 30 DAS. While, at harvest significantly lower dry matter of weed observed under pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS being at par with pendimethalin 38.7 CS 1000 g/ha (PE) *fb* propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 30 DAS, propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 20 DAS *fb* hand weeding 40 DAS, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* imazethapyr 10 SL 70 g/ha (PoE) 30 DAS and 2 hand weeding at 15 and 30 DAS. Furthermore, weed control efficiency was maximum with pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS, followed by pendimethalin 38.7 CS 1000 g/ha (PE) *fb* propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 30 DAS. While, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS that also emerge as best treatment in reference to weed index. Application of pendimethalin 38.7 CS 1000 g/ha (PE) *fb* hand weeding 30 DAS recorded significantly higher seed (1612 kg/ha) and stover (2418 kg/ha) yields of blackgram, however, it was found at par with pendimethalin 38.7 CS 1000 g/ha (PE) *fb* propaquizafop 2.5% + imazethapyr 3.75% 2000 g/ha (PoE) 30 DAS, pendimethalin 38.7 CS 1000 g/ha (PE) *fb* imazethapyr 10 SL 70 g/ha (PoE) 30 DAS, 2 hand weeding at 15 and 30 DAS (weed free). Moreover, weedy check reduced the blackgram seed and stover yields.

Weed management in summer blackgram

Amit Nain, Karishma Singh* and Joy Dawson

Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh 211007, India

**Email: singhkarishma746@gmail.com*

A field experiment was conducted during zaid (summer) season of 2023 at Crop Research Farm, Department of Agronomy of Sam Higginbottom University of Agriculture, Technology and Sciences. The experiment consisted of nine treatments laid out in a Randomized Block Design and replicated thrice. The treatments comprised of pre-emergence application of pendimethalin 1000 mL/ha, post-emergence application of imazethapyr 80 mL/ha, post-emergence application of imazamox 50 mL/ha, pre-emergence application of pendimethalin 750 mL/ha with post-emergence application of imazethapyr 40 mL/ha, pre-emergence application of Pendimethalin 750 mL/ha with Imazamox 25 mL/ha, post-emergence application of imazethapyr 40 mL/ha and imazamox 25 mL/ha, hand weeding at 15 and 30 DAS and a weedy check. Blackgram variety '*Shekhar-2*' with recommended dose of nutrients at 20 kg nitrogen, 40 kg phosphorus and 20 kg potash/ha and a seed rate of 20 kg/ha was sown at 30cm x 10cm spacing. Observations on weed density and dry weight were recorded by using a quadrate of 0.5m x 0.5m size. The major weed flora included *Amaranthus viridis*, *Trianthema portulacacastrum*, *Parthenium hysterophorus*, *Dactyloctenium aegyptium*, *Eleusine indica*, *Digitaria sanguinalis*, *Cynodon dactylon* and *Cyperus rotundus*. Weed control through various treatments reduced the weed density over weedy check throughout the crop growth stages. Pre-emergence application of Pendimethalin 750ml/ha in combination with post-emergence of Imazethapyr 40ml/ha was found to be statistically significant as compared to rest of the treatments in reducing weed population and weed dry weight. It also recorded higher number of pods/plant, grains/pod, highest test weight, grain yield and maximum benefit-cost ratio.

Sustainable weed management in pulses

Kanhaiya Singh* and Jainendra Kumar Singh
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradsh 221005, India
**Email: kanhaiyaagro@bhu.ac.in*

Pulses, second only to cereals in importance, provide an affordable source of dietary protein. Despite the Green Revolution, pulse production in India has remained static due to various biotic and abiotic stresses. Among these, weeds are a significant biotic stress causing substantial yield losses. The slow initial growth of pulses allows weeds to emerge first, gaining a competitive advantage and smothering the crop. Additionally, with 84% of pulse cultivation occurring under rainfed conditions and often in combination with non-legume crops, pulses face numerous challenges. Weeds not only directly reduce yields but also impede farm activities and serve as hosts for pests. Effective weed management in pulses is crucial to maintain weed populations below threshold levels, maximizing seed yield and quality. This paper presents a compilation of literature on the significance of weed management in pulses, weed flora, critical periods of crop-weed competition, and various weed control methods. Weeds are considered the primary biological constraint in pulse production due to the crop's slow initial growth. Weed management strategies depend on factors such as weed competition, weed types present, and control methods employed. Generally, the critical period for weed competition is up to 30 days for short-duration pulses and up to 60 days for long-duration pulse crops. The main weed types associated with pulses are grasses, broad-leaved weeds, and sedges. Weed infestation intensity varies based on agroecological conditions and crop management practices. A systematic approach is necessary to maintain weed populations below economic threshold levels, thereby reducing yield losses. Integrated weed management (IWM) has proven more effective than single-method approaches in mitigating weed buildup in pulse crops

Poster 68

Efficacy of herbicides on the productivity of groundnut

Bheem Pareek*, M.R. Yadav, Shweta Gupta, R.N. Choudhary, Seema Sharma, Kavita Bhadu and N.K. Pareek

Rajasthan Agricultural Research Institute (S.K.N. Agriculture University, Jobner,) Durgapura, Jaipur, Rajasthan 302018, India

**Email: bpareek.agro@sknau.ac.in*

A field experiment was conducted under All India Coordinated Research Project on Weed Management of Groundnut for three consecutive years during *Kharif* 2021 to *Kharif* 2023 at Research Farm, Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan to study the "Efficacy of herbicides on the productivity and economics of groundnut". The experimental site was located at 26°512 N latitude and 75°472E longitude and at an altitude of 390 m above mean sea level. The soil of the experimental site was well-drained loamy sand and coarse in texture. Nine treatments of weed management were tested in randomized block design with three replications. The treatments consisted of diclosulam 20 g/ha(PE); diclosulam 25 g/ha(PE); diclosulam 20 g/ha (PE) *fb* HW at 25-30 DAS; diclosulam 25 g/ha (PE) *fb* HW at 25-30 DAS; diclosulam 20 g/ha (PE) *fb* quizalofop 50 g/ha (PoE); diclosulam 25 g/ha (PE) *fb* quizalofop 50 g/ha (PoE); pendimethalin1.0 kg/ha (PE) *fb* quizalofop 50 g/ha (PoE); two manual weeding at 25 and 40 DAS; weedy check. Pooled results over three years showed that the adoption of two manual weeding gave maximum pod (4972 kg/ha) and haulm yield (6062 kg/ha). However, treatment diclosulam 84 WDG 20 g/ha (PE) *fb* HW at 25-30 DAS yielded statistically similar pod (4686 kg/ha) and haulm yield (5619 kg/ha) with that of produced under two manual weeding. Further, treatment diclosulam 84 WDG 25 g/ha (PE) *fb* HW at 25-30 DAS (4614 kg/ha) and diclosulam 84 WDG 25 g/ha (PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 18-20 DAS (4489 kg/ha) yielded statistically similar pod yield with T_3-Diclosulam 84 WDG 20 g/ha (PE) *fb* HW at 25-30 DAS (4686 kg/ha) but remained significantly lower over two hand weeding (4972 kg/ha). The maximum values of weed control efficiency at 60 DAS (90.33%) and at harvest (89.31%) were recorded with two manual weeding. However, treatment diclosulam 84 WDG 20 g/ha (PE) *fb* HW at 25-30 DAS recorded statistically similar weed control efficiency at 60 DAS (86.65%) and at harvest (84.45%) with that of f*etc*hed under two manual weeding.

Poster 69

Bio-efficacy of sethoxydim and non-ionic surfactant as post-emergence herbicide against grassy weeds in groundnut

N. Ananda*, B.K. Desai, A.G. Sreenivas, M.R. Umesh, Rajanna, S.N. Bhat and Vineetha
AICRP on Linseed, University of Agricultural Sciences, Raichur, Karnataka 584104, India
**Email: clkananda@uasraichur.edu.in*

A field experiment was conducted during *Kharif* 2022 and 2023, on black soil of University of Agricultural Sciences, Raichur, coming under North Eastern Dry Zone of Karnataka. The study was conducted to assess the bio efficacy of sethoxydim as post-emergence herbicide against grassy weeds and yield of groundnut in relation to unsprayed control. The experiment was conducted in randomized complete block design with 12 treatments, *viz*. sethoxydim 20% EC at 200, 225, and 250 g/ha as post-emergence (PoE) herbicide and sethoxydim 20% EC at 200,225 and 250 g/ha as PoE + 2ml/L non-ionic (NIC) surfactant, sethoxydim 20% EC at 200,225 and 250 g/ha as PoE along with 4ml/l NIC surfactant, quizalofop-ethyl 5% EC at 50 g/ha as PoE, weed free check, untreated check with three replications. The two years results revealed that application of sethoxydim 20% EC at 250 g/ha as PoE along with 4ml/l NIC surfactant recorded significantly higher yield in 2022 and 2023 (27.93 and 31.52 q/ha, respectively) along with lower weed density, weed dry weight and weed control efficiency at 15, 30 and 45 days after herbicide application and it was found on par with application of sethoxydim 20% EC 250 g/ha as PoE + 2ml/l NIC surfactant (26.71 and 29.00 q/ha, respectively). The decrease in dry weight of weeds is mainly due to effect of sethoxydim herbicide, as it inhibits the activity of acetyl CoA carboxylase synthase, the enzyme responsible for catalyzing an early step in fatty acid synthesis. Weed free check superseded over all the treatments and registered the lower intensity of weeds, weed dry weight and higher yield. However, weedy check recorded significantly lower yield with higher density and dry weight of weeds.

Poster 70

Weed management in groundnut with diclosulam at Puducherry region

S. Ravi*, R. Narasimman and N. Vijayakumar
Perunthalaivar Kamaraj Krishi Vigyan Kendra, Puducherry 605009, India
**Email: drsravijapkkvkp@gmail.com*

Groundnut is important oil, food and forage crop of the country. India is the second largest producer of groundnut in the world. The rapid increase in population growth rate necessitates phenomenal increase in crop productivity. Weed competition is going to be the major constraints in achieving higher productivity. The yield loss due to weeds range from 15 to 30%, due to shortage of labour or scarcity of water and energy, electricity *etc*. At present several herbicidal formulations are available in the market used as pre- and post-emergence herbicides for controlling weed complex. At Puducherry Region under irrigated condition, three field experiments were conducted during 2021-22, 2022-23 and 2023-24 at Perunthalaivar Kamaraj Krishi Vigyan Kendra (PKKVK), in randomized block design with three replications. The treatments consisted of diclosulam 84 WDG 20 g/ha (PE), diclosulam 84 WDG 25 g/ha (PE), pendimethalin 30% EC 1.0 kg/ha (PE), diclosulam 84 WDG 20 g/ha (PE) *fb* inter-cultivation/HW at 30 and 60 DAS, diclosulam 84 WDG 25 g/ha (PE) *fb* Inter-cultivation/HW at 30 and 60 DAS, diclosulam 84 WDG 20 g/ha (PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 30 and 60 DAS, diclosulam 84 WDG 25 g/ha (PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 30 and 60 DAS, pendimethalin 30% EC 1.0 kg/ha(PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 30 and 60 DAS, Hand weeding thrice at 25, 50 and 80 DAS/Weed free check and weedy check. The findings of three seasons pooled data indicated that the application of diclosulam 84 WDG 25 g/ha (PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 30 and 60 DAS recorded significantly the highest pod yield (4432 kg/ha) as compared to over control (3363 kg/ha) but, it was remained at par with application of diclosulam 84 WDG 20 g/ha (PE) *fb* quizalofop-ethyl 5% EC 50 g/ha (PoE) at 30 and 60 DAS (4318 kg/ha). The highest weed control efficiency of 80% before 25 DAS and 88% after 50 DAS was observed and it was remunerative, nearly 31% increase in pod yield over control.

Productivity and weed dynamics under integrated weed management in groundnut

Prerna Hinge*, V.V. Goud and A.P. Karunakar
AICRP on Weed Management, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India
**Email: prernahinge764@gmail.com*

The experiment was carried out to study the relative efficacy of herbicides on weed control in groundnut as well as to study its effect on growth and yield of groundnut during *Kharif* season of 2022 and 2023. The experiment was laid out in Randomized Block Design with three replication and eight treatments. The treatments comprised of diclosulam 84% WDG at 0.026 kg/ha (PE) *fb* IC + HW at 40 DAS, diclosulam 84% WDG at 0.026 kg/ha (PE) *fb* fluazifop-p-butyl 11.1% w/w + fomesafen 11.1% w/w SL at 0.250 kg/ha PoE (2-3 leaf stage of weed), diclosulam 84% WDG at 0.026 kg/ha (PE) *fb* quizalofop-ethyl 7.5% + imazethapyr 15% at 0.098 kg/ha PoE (2-3 leaf stage of weed), diclosulam 84% WDG at 0.026 kg/ha (PE) *fb* propaquizafop 2.5% + imazethapyr 3.75% at 0.125 kg/ha PoE (2-3 leaf stage of weed), pendimethalin + imazethapyr (RM) 0.8 kg/ha (PE) *fb* IC + HW at 40 DAS, sodium acifluorfen 16.5%+ clodinafop-propargyl 8% EC at 0.245 kg/ha (RM) PoE (2-3 leaf stage of weed) *fb* IC + HW at 40 DAS, IC *fb* HW at 20 and 40 DAS and Weedy check (T8) respectively. The soil of experimental field characterized as clayey in texture, having slightly alkaline pH (7.9), moderate organic carbon status (0.46%), low nitrogen content (182.0 kg/ha), medium available phosphorus content (17.30 kg/ha), high potassium status (264.0 kg/ha). Groundnut (TAG 73) was sown on BBF at 45 x 10 cm spacing with 25:50:30 NPK kg/ha and gypsum 300 kg/ha. Predominant weed flora was *Cyperus rotundus*, *Cynodon dactylon*, *Commelina benghalensis*, *Commelina communis*, *Parthenium hysterophorus*, *Digitaria sanguinalis*, *Dactyloctenium aegyptium*, *Alternanthera triandra*, *Portulaca oleracea*, *Euphorbia hirta*, *Phyllanthus niruri*, *Ipomoea* sp., *Psoralea corylifolia*, *Digera arvensis*, *Eragrostis minor*, *Dinebra retroflexa*, *etc*. Weed density, weed dry matter weight (g/m2) and weed control efficiency varied significantly with the stages of the crop. Considering the weed management strategies significantly minimum weed density, weed dry matter accumulation, weed index and relatively maximum weed control efficiency were recorded with farmers practice inter-cultivation *fb* hand weeding at 20 and 40 DAS followed by pendimethalin 30% + imazethapyr 2% EC 0.8 kg/ha (RM) as pre-emergence *fb* inter-cultivation *fb* hand weeding at 40 DAS due to integrated weed management. Among the herbicidal treatments, application of pendimethalin 30% + imazethapyr 2% EC 0.8 kg/ha (RM) as pre-emergence *fb* inter-cultivation *fb* hand weeding at 40 DAS produced higher plant height, dry matter accumulation, leaf area, pod yield and haulm yield (kg/ha). While farmers practice *i.e.* inter-cultivation *fb* hand weeding at 20 and 40 DAS in groundnut recorded highest GMR, however, maximum NMR and B:C ratio were obtained with application of pendimethalin 30%+ imazethapyr 2% EC 0.8 kg/ha (RM) as pre-emergence *fb* inter-cultivation *fb* hand weeding at 40 DAS.

Smart nano-herbicide formulations for weed management in the rainfed groundnut

C.R. Chinnamuthu* and K. Srimathi

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India

**Email: crchinnamuthu@yahoo.com*

Groundnut, a nutritious oilseed crop, is grown widely under rainfed conditions during the monsoon season, with the rest grown under irrigation during the post the monsoon season. However, rainfed yields are 38-42% lower than irrigated yields due to weed infestations which compete for resources and limit the growth and harvest. Weed infestation is a significant bottleneck that reduces production and profit margins. Due to socioeconomic factors, chemical weed management with herbicides is the most common practice. However, rainfed conditions decrease the performance of pre-emergence herbicides due to uncertainty in rainfall and potential losses like photolysis and microbial degradation. Up to 90% of applied pre-emergence herbicides may not reach the target, and post-emergence herbicides are ineffective due to crop injury. Using encapsulated herbicides under rainfed condition, protects the herbicides from immediate volatilization, photo degradation and microbial decomposition. Further, encapsulating with hydrophilic polymers causes the expansion of the polymer with the moisture received from rainfall, leads to release of the herbicide present inside. This release will coincide with the weed seed germination resulting in effective control of weeds. Commercial herbicides like as diclosulam and metolachlor have demonstrated varying levels of efficacy in irrigated groundnut, however they were not advised for rainfed circumstances. This study aims to improve herbicide efficiency in rainfed groundnut using ion-gelation and solvent evaporation methods. In ion-gelation method, different counter ion solutions were used for the formulation of alginate-herbicide beads of both herbicides. Field experiment indicated that encapsulated diclosulam effectively controls weeds up to 45 days after sowing, outperforming commercial formulations of diclosulam, metolachlor and encapsulated complex by ion-gelation method. In conclusion, smart nano herbicide formulations are not only suitable for weed management in rainfed agriculture but also amenable for the use of drones.

Weed dynamics, productivity and profitability of groundnut as affected by weed management practices and fertility levels

Swapnashree Sahoo* and Jainendra Kumar Singh

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: swapnashreesahoo3@gmail.com*

Groundnut is prone to weed infestations, especially during its early growth phase, which lasts up to 40 days after sowing (DAS). Extended weed presence in the field can severely interfere with key developmental processes such as pegging, reduce the size of pods, compete for underground resources, and complicate harvesting operations. The extent of yield loss caused by weed competition is determined by multiple factors, including weed species and density, the duration of competition, the type of groundnut cultivar, soil properties, irrigation practices, weed management strategies, cropping patterns, and environmental conditions. After pegging begins, the use of mechanical power weeders can be harmful to the crop, while herbicide application is often restricted due to the challenge of selective weed control in groundnut fields. To address these issues, an integrated weed management approach is typically adopted, combining the use of herbicides with manual, cultural, and mechanical weed control methods to maximize groundnut productivity. A field experiment was conducted at the Odisha University of Agriculture & Technology in Bhubaneswar over two consecutive years, 2020 and 2021. The experiment involved 16 treatment combinations, incorporating four weed management strategies and four fertility levels. The weed management strategies were: W1- Pre-emergence (PE) application of pendimethalin 0.75 kg/ha, W2- Pre-emergence (PE) application of pretilachlor 0.5 kg/ha, W3-Manual weeding (20 and 40 DAS), W4-Twin wheel hoe at 20 DAS followed by *(fb)* hand weeding at 40 DAS and four fertility levels includes 100% RDF (20:40:40) (N: P205: K2O kg/ha), 75% RDF + 5 tonnes FYM/ha, 50% RDF + 10 tonnes FYM/ha, without fertilizer + without FYM. Among the weed management practices, the use of a twin-wheel hoe at 20 days after sowing (DAS) followed by hand weeding at 40 DAS significantly decreased weed density, weed dry weight, and the weed index, while achieving the highest weed control efficiency and nutrient use efficiency. The highest weed index was observed with the pre-emergence application of pretilachlor at 0.5 kg/ha, followed by pendimethalin at 0.75 kg/ha. In terms of fertilizer management, applying 50% of the recommended dose of fertilizer (RDF) along with 10 tonnes of farmyard manure (FYM) per hectare resulted in the highest yield, highest nutrient uptake by crop, substantially reducing overall weed density, weed dry weight and found to be the most profitable with a higher net return and B:C. Lastly it can be concluded that groundnut under weed management with twin wheel hoe at 20 DAS followed by hand weeding at 40 DAS along with application of 50% RDF + 10 tonnes FYM/ha was the most effective strategy. This integrated method significantly mitigates weed competition, thereby promoting optimal groundnut growth and yield.

Weed management in summer groundnut

Niteen Danawale*, Nayan Jopale and Rushikesh Pawar

Department of Agronomy, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413722, India

**Email: niteendanawale@rediffmail.com*

Groundnut (*Arachis hypogea* L.) is an important oilseed crop in India which occupies first position in terms of area and second position in terms of production. It is highly susceptible to weed infestation because of its slow growth in the initial stages, short plant height and underground pod bearing habit. In India, yield loss in groundnut due to weeds ranged from 24-70%, however it depends on type of weed flora associated with groundnut. As groundnut is grown mainly in the rainy season when the conditions are more favourable for weed growth, that encourage repeated flushes of grasses and broadleaved weeds during the entire season for competition with the crop, more specifically during early stages of crop growth. The critical period for crop-weed competition was reported to be up to 45 days after sowing. Unlike other crops, weeds also interfere with pegging, pod development and harvesting of groundnut, besides competing for growth resources. Thus, a field investigation was conducted in summer season of 2023 at the AICRP on Groundnut, Mahatma Phule Krishi Vidyapeeth, Rahuri to study different weed management methods in summer groundnut. The experiment was laid out in randomized block design (RBD) with three replications. The experiment consists of ten treatments, *viz.* diclosulam 20 g/ha PE; diclosulam 25 g/ha PE; pendamethalin.1.0 kg/ha PE; diclosulam 20 g/ha PE *fb* hand weeding at 20 and 40 DAS; diclosulam 25 g/ha PE *fb* hand weeding at 20 and 40 DAS; diclosulam 20 g/ha PE *fb* quizalofop-p-ethyl 50 g/ha PoE at 20 and 40 DAS; diclosulam 25 g/ha PE *fb* quizalofop-p-ethyl 50 g/ha PoE at 20 and 40 DAS; pendimethalin 1.0 kg/ha PE *fb* quizalofop-p-ethyl 50 g/ha PoE at 20 and 40 DAS; weedy free check (at 20 and 40 DAS) and weedy check. As regards yield attributing characters, significantly higher dry pod yield (3.25 t/ha), haulm yield (4.06 t/ha), biological yield (7.32 t/ha) were recorded under treatment weed free than other treatments except application of diclosulam 25 g/ha PE *fb* hand weeding at 20 and 40 DAS which recorded dry pod yield (3.09 t/ha), haulm yield (3.81 t/ha), biological yield (6.90 t/ha) and diclosulam 20 g/ha PE *fb* hand weeding at 20 and 40 DAS which recorded dry pod yield (3.03 t/ha), haulm yield (3.73 t/ha), biological yield (6.76 t/ha). Significantly the highest gross monetary returns were obtained in weed free treatment (168897 Rs./ha). However, application of diclosulam 25 g/ha PE) *fb* hand weeding at 20 and 40 DAS recorded a significantly maximum net monetary returns (96867 Rs./ha) and B:C ratio (2.53) than other weed management treatments except treatment diclosulam 25 g/ha PE *fb* hand weeding at 20 and 40 DAS (93939 Rs./ha and 2.49, respectively). While, weedy check obtained minimum gross monetary returns, net monetary returns and B:C ratio among all the treatments.

Integrated weed management in *Kharif* groundnut under different crop geometry

P.P. Chaudhary* and G.S. Damor
Sadarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat 385506, India
**Email: ppc.sdau2014@sdau.edu.in*

Groundnut is extensively grown in India during the *kharif* season. Initial slow growth combined with prostate nature of its growth and hot humid climate prevailing during the *kharif* season permit early and severe crop weed competition resulting in loss of yield. Chemical control of weeds forms an excellent alternative to manual weeding. However, pre-emergence application of herbicides may allow the emergence of weeds after some time. Crop geometry, particularly in high density crops like groundnut plays important role in harvesting the environmental resources, which ultimately influence the crop productivity. Alterations in crop geometry by way of manipulation in row spacing may impart competing ability in crop plants with weeds. The present study was therefore conducted during *kharif* season of the year 2017 with fifteen treatment combinations comprising, three treatments of crop geometry *viz*., G1 : Line sowing with 45 cm, G2 : Paired row sowing with 22.5 – 45 – 22.5 cm and G3 : Paired row sowing with 30 – 60 – 30 cm and five treatments of integrated weed management, *viz*. W1: unweeded control, W2: interculture followed by hand weeding (HW) at 25 and 40 DAS, W3: Pendimethalin 1.0 kg/ha PE + interculture and 1 HW at 30 DAS, W4: Imazethapyr 100 g/ha at 20 DAS PoE and W5: Pendimethalin 1.0 kg/ha PE followed by imazethapyr 100 g/ha at 20 DAS PoE were evaluated in Split plot design with three replications. The results revealed that the weed count of grasses, broad leaved and sedges at 30, 60, 90 DAS and at harvest did not differ significantly due to crop geometry. Numerically higher weed count was observed under line sowing with 45 cm (G1) followed by paired row saplings 22.5-45-22.5 cm (G2) and paired row saplings 30-60-30 cm (G3). All the weed management treatments significantly reduced the population of weeds compared to unweeded control. While lowest weed count and dry weight of weeds at harvest was noted under pendimethalin 1.0 kg/ha PE + interculture and 1 HW at 30 DAS (W2). The interaction effect of crop geometry and integrated weed management treatments on numbers of pods per plant and pod yield of groundnut were significantly affected due to interaction effect between different crop geometry and integrated weed management treatments. Significantly the highest number of pods per plant (19.7) and pod yield (2700 kg/ha) were observed under treatment combination G3W2 (paired row spacing with 30-60-30 cm and interculture followed by hand weeding at 25 and 40 DAS), which remained at par with G3W3 (paired row spacing with 30-60-30 cm and pendimethalin 1.0 kg/ha PE + interculture and 1 HW at 30 DAS). This might due to paired row sowing and effective weed control through hand weeding at 25 and 40 DAS interval, which reduced crop weed competition, increased nutrient availability to crop that led to higher pod yield.

Poster 76

Synergistic effects of integrated nutrient and weed management on soybean growth and system productivity

Rathod Sridhar[1*], L.T. Longkumer[1], A.P. Singh[1], N. Charitha[2] and G. Zion[1]
Department of Agronomy, School of Agricultural Sciences, Nagaland University, Medziphema, Dimapur, Nagaland 797106, India
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India
**Email: sridharrathod27@gmail.com*

A study was conducted at the experimental farm of School of Agricultural Sciences, Nagaland University, Medziphema campus, dist. Chumkedima, Nagaland, India during the *Kharif* season (July to November) of 2023 to assess the effect of integrated nutrient and weed management on soybean growth, yield, quality, weed dynamics and biomass weed. The factorial randomized block design was used with three replications: Two Factors, four nutrient management treatments and four weed management treatments, total 16 treatments. The research involved 16 different treatments, including both integated nutrients and herbicides (pre-emergence and post-emergence with different dosages) as well as a weedy check. Findings of this study showed that critical importance of weed management in soybean cultivation, as unchecked weed infestation can lead to substantial yield losses. The study specifically examined how different herbicides and their dosages affected weed populations, as well as their effectiveness in controlling weed dynamics over time. This allowed for an understanding of the most effective weed management strategies for minimizing competition while ensuring that crop productivity was maximized. One of the key aspects of the study was the role of Imazethapyr and Pendimethalin, which were applied to control specific weed species like grasses, sedges, and broadleaf weeds. These herbicides are known for their selective action and residual control, meaning that they not only target current weed populations but also prevent future weed emergence. The study assessed the efficacy of these herbicides at different dosages to determine the optimal rates for controlling weed infestations without causing harm to the crops or the environment. In weed management W1- weedy check, W2- imazethapyr 75 g/ha (PE) + 1 HW at 25 DAS, W3- imazethapyr 100 g/ha (PoE) at 20 DAS, W4- pendimethalin 750 g/ha (PE) *fb* imazethapyr (75 g/ha (PoE) at 25 DAS. The results revealed that the application of W4- pendimethalin 750 g/ha (PE) *fb* Imazethapyr (75 g/ha (PoE) at 25 DAS significantly lower density and dry biomass of weeds, higher weed control efficiency. Plant height, plant dry matter, number of pods plant, seed yield and straw yield were recorded highest under W4- pendimethalin 750 g/ha (PE) *fb* imazethapyr (75 g/ha (PoE) at 25 DAS followed by W2- Imazethapyr 75 g/ha (PE) + 1 HW at 25 DAS. The bioassay showed a non-significant effect on the test crops.

Weed dynamics and production potential of soybean as influenced by different land configuration and weed control

Shyamli Kawanpure[1], Sunita Pawar[1] and Priyanka Motinge*[2]

[1]*Vasantrao Naik Marathwada Krushi Vidyapeeth, Parbhanai, Maharashtra 431401, India*

[2]*Punjab Agricultural University, Ludhiana, Punjab 141001, India*

**Email: motinge-2305012@pau.edu*

A field experiment was conducted during the *Kharif* season of 2022 at the Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krushi Vidyapeeth, Parbhani, to investigate the effects of different land configurations and weed management strategies on the weed dynamics and production potential of soybean. The study employed a split-plot design with three replications, where three land configurations—two-row broad bed furrow (BBF), four-row broad bed furrow, and flatbed—were tested as the main plot treatments. Additionally, four weed control treatments, namely pre-emergence (PE) application of diclosulum 84% WDG at 22-26 g/ha (W1), post-emergence (PoE) application of sodium acifluorfen 16.5% + clodinofop-propargyl 8% EC at 80+165 g/ha (W2), hand weeding + hoeing (W3), and a weedy check (W4), were assigned to subplots. The soybean variety '*MAU-158*' was sown in early July. Among the treatments of land configurations, the best land configurations for soybean were two-row broad bed furrow (L1) and four-row broad bed furrow (L2) configurations as compared to flatbed (L3). Both the BBF performed better throughout the crop growth phases and recorded higher soybean yields. From the treatments of weed management in Soybean, the treatment on W3 (1 hand weeding + 1 hoeing), which was on par with the W2 post-emergence sodium acifluorfen 16.5% + clodinofop-propargyl 8% EC @ 80+165 g/ha, was found most effective in control of monocot and dicot weeds and recorded significantly lower dry weed weight, as well as higher weed control efficiency and lower weed index. These treatments were comparable to weed-free and found significantly superior as compared to other treatments. All the growth parameters, yield attributes, and yield of soybeans were significantly higher under weed control treatment. The maximum seed yield, straw yield, and biological yield observed in treatment weed control (W3) were at par with (W2) post-emergence sodium acifluorfen 16.5% + clodinofop-propargyl 8% EC 80+165 g/ha. From the three land configurations and weed management practices, two-row BBF (L1) and treatment 1 hand weeding + 1 hoeing (W3) were significantly superior, and it was at par 2 row BBF with sodium acifluorfen 16.5%+ clodinofop-propargyl 8% EC 80+165 g/ha in terms of growth as well as seed yield. This might be because BBF stored more soil water and produced more yield than flat bed. The highest net return was recorded with the treatment combination of 4 row BBF (L2) with post-emergence application of sodium acifluorfen 16.5%+ clodinofop-propargyl 8% EC 80+165 g/ha. In conclusion, the study demonstrated that the two-row BBF configuration and integrated weed management involving either hand weeding + hoeing or post-emergence herbicide application were the most effective strategies to enhance soybean growth, yield and profitability.

Effect of plant extracts, straw mulch and herbicides on growth and yield of summer soybean

M.R. Kadivar*, B.S. Gohil and Abhishek Inaniya
Junagadh Agricultural University, Junagadh, Gujarat 362001, India
**Email: kadivarsakir33@gmail.com*

A field experiment entitled “Effect of plant extracts, straw mulch and herbicides on growth and yield of summer soybean” was conducted at Weed Control Research Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh (Gujarat) during the summer season of 2023 on medium black calcareous soil. The experiment comprising 12 treatments, *viz*. parthenium extract 20 L/ha at 15 and 30 DAS, Eucalyptus leaves extract 20 L/ha at 15 and 30 DAS, Sorghum extract 20 L/ha at 15 and 30 DAS, sunflower extract 20 L/ha at 15 and 30 DAS, mix weed flora extract 20 L/ha at 15 and 30 DAS, Wheat straw extract 20 L/ha at 15 and 30 DAS, wheat straw mulch 5 t/ha at 15 DAS, pendimethalin 900 g/ha as pre-emergence *fb* IC and HW at 30 DAS, pre-mix fluazifop-p-butyl 11.1% + fomesafen 11.1% SL 125+125 g/ha as post-emergence at 20 DAS, pre-mix pendimethalin 30% + imazethapyr 2% EC 750+50 g/ha as pre-emergence *fb* pre-mix fluazifop-p-butyl 11.1% + fomesafen 11.1% SL 125+125 g/ha at 30 DAS, Weed free check and unweeded check was laid out in a randomized block design with three replications. The results revealed that in weed free check significantly higher plant height (44.17 cm), no. of branches per plant (4.10), no. of pods per plant (42.80), seed yield (1778 kg/ha) and stover yield (2485 kg/ha). It remained statistically at par with the application of pendimethalin 900 g/ha as pre-emergence *fb* IC and HW at 30 DAS which showed plant height (43.50 cm), no. of branches per plant (3.93), no. of pods per plant (41.70), seed yield (1657 kg/ha) and stover yield (2278 kg/ha) and pre-mix pendimethalin 30% + imazethapyr 2% EC 750+50 g/ha as PE *fb* pre-mix fluazifop-p-butyl 11.1% + fomesafen 11.1% SL 125+125 g/ha at 30 DAS showed plant height (43.07 cm), no. of branches per plant (3.78), no. of pods per plant (40.60), seed yield (1648 kg/ha) and stover yield (2330 kg/ha).

Poster 79

Response of soybean crop, C_3 and C_4 weeds as influenced by elevated temperature

K.N. Geetha[1], B.S. Vidyashree[1], Shobha Sondhia[2], M Prabhakar[3], H.R. Laxman[4], S. Kamala Bai[1] and J.K. Sinchana[1]

[1]ICAR-NICRA Project, AICRP on Weed Management, University of Agricultural Sciences, Gandhi Krishi Vigyana Kendra, Bangalore, Karnataka 560065, India

[2]Directorate of Weed Research, ICAR, Jabalpur, Madhya Pradesh 482004, India

[3]ICAR-CRIDA, NICRA Project, Santhoshnagar, Hyderabad, Telangana 500059, India

[4]Indian Institute of Horticultural Research, Hesaraghatta, Bangalore, Karnataka 560089, India

Email: vidvibha@gmail.com

Climate change is the major driving force for the weed shift and reduction in agriculture productivity. To evaluate the changing climatic scenario on both C_3 weed (*Amaranthus retroflexus*) and C_4 weed species (*Echinochloa colonum*) in soybean crop grown under two temperature variables, *viz*. ambient and elevated temperature (+2°C) in polytunnel experiment at ICAR-Indian Institute of Horticultural Research (IIHR), Bangalore, Karnataka, India. The results showed that elevated temperature had a detrimental effect on the leaf area (-23.1%), photosynthetic rate (-34.3%), transpiration rate (-13.85%), stomatal conductance (-70.4%) and SPAD chlorophyll reading (-31.2%) at 45 DAS. Elevated temperature on soybean crop had pernicious influence on yield attributes to the magnitude of number of pods per plant (25.1%), number of seeds per pod (14.9%), test weight (3.2%), pod length (4.2%) and seed yield per plant (8.7%) at harvest as compared to ambient temperature. Among the crop-weed interactions and the interaction effect tested, showed no significant influence on number of seeds per pod, test weight, pod length and seed yield per plant except number of pods per plant. It also points out the fact that elevated temperature strongly influenced the biomass of both C3 and C4 weeds thus leading to attenuated competition on soybean crop.

Poster 80

Effects of herbicides on weeds of soybean crops

Ariunaa Ochir[*1], Bayarsukh Noov[2], and Otgonsuren Majaa[1]
[1]*Institute of Plant Protection Research, Mongolian University of Life Sciences, Enkhtaivan, Mongolia*
[2]*Plant Science and Agricultural Research Institute, Mongolian University of Life Sciences*
**Email: ariunaa.ochir14@gmail.com*

Soybean is a vital crop for improving soil health but is highly sensitive to weed competition during its early growth stages, which can result in yield losses of up to 37%. Effective weed management requires consideration of weed species, rotational crops, and cost. Herbicide-based strategies are generally economical and enhance soybean productivity. Specific weed infestations, such as *Chenopodium album* (2–10/m²), can reduce soybean yield by 4–18%; *Panicum miliaceum* by 3–15%; *Sonchus arvensis* by 5–22%; and *Cirsium setosum* by 6–21%. This research aimed to determine the distribution, density, and damage caused by weeds in soybean fields and to develop management strategies to improve productivity. A field experiment was conducted at the research farm of the Plant Protection Research Institute, Mongolian University of Life Sciences (49°482 N, 106°102 E, 665 m above sea level), using a randomized block design with nine treatments and three replications. The results showed that 27 weed species belonging to 15 families and 24 genera were distributed across 4.5 hectares of soybean fields. Among these, 60.4% were annual, 5.1% were winter/biennial, and 34.5% were perennial. The major grassy weeds included Common millet (*Panicum miliaceum* L.), Couch grass (*Agropyron repens* L.), Bristlegrass (*Seteria viridis* L.), and broad-leaved weeds Redroot Pigweed (*Amaranthus retroflexus* L.), Lambsquarters (*Chenopodium album* L.), AristateGoosfoot (*Chenopodium aristatum* L.), *etc*. Herbicide treatments were highly effective in controlling weeds: haloxyfop-p-methyl (10.8%) at 0.45–0.65 L/ha reduced weed density by 91.0–95.0% and biomass by 39.5–59.8% followed by quizalofop-p-ethyl (60 g/L) at 1–2 L/ha controlled 86.8–91.6% of grass weeds, reducing weed biomass by 38.7–66.1% and lactofen (24%) at 0.45–0.55 L/ha controlled broad-leaved weeds by 90.2–94.2% and reduced biomass by 36.7–41.4%. Herbicide application significantly increased soybean yield compared to untreated control plots. The highest yield was observed with haloxyfop-p-methyl (0.65 L/ha), which reduced weed density by 95.0%, biomass by 59.8%, and increased yield by 27.0% (8.8 c/ha). Lactofen (0.55 L/ha) reduced weed density by 94.6%, biomass by 50.7%, and increased yield by 7.5% (4.4 c/ha) and quizalofop-p-ethyl (1.1–1.34 t/ha) and haloxyfop-p-methyl (0.81–1.32 t/ha) resulted in the highest grain yields. Overall, haloxyfop-p-methyl (Gallant Super, 0.65 L/ha) demonstrated the highest weed control efficiency and significantly improved soybean yield.

Effect of mulching and herbicides on weed growth, productivity and profitability of lentil

B. Duary, D.K. Mohanta, M. Bauri* and A. Pradhan

Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal 731236, India

**Email: megh3madhurima@gmail.com*

A field experiment was conducted at Agricultural Farm of the Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal during *Rabi* 2021 to evaluate the effect of mulching and herbicides on weed growth and performance of lentil. Twelve treatment combinations consisting of 3 mulching i.e., straw mulching, soil mulching, no mulching and 4 herbicides i.e., pendimethalin at 1000 g/ha as a pre-emergence (PE), imazethapyr at 50 g/ha as post-emergence (PoE), PE pendimethalin *fb* PoE imazethapyr and no herbicide were assigned in a factorial randomized block design with three replications. The experimental field was infested mostly with *Digitaria sanguinalis*, *Cyanodon dactylon* and *Echinochloa colona* among the grasses, Spilanthes acmella and *Chenopodium album* among the broadleaved and *Cyperus rotundus* among the sedges throughout the cropping period. Findings also revealed that straw and soil mulching reduced the total weed density at 30 DAS by 26% and 14%, respectively compared to no mulching. Pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha reduced the weed density to the tune of 84% when compared to no herbicide and up to 40.2% and 76% when compared with sole application of pendimethalin and imazethapyr, respectively. The treatment pendimethalin at 1000 g /ha *fb* imazethapyr registered the highest total WCE both at 30 and 60 DAS. Throughout the experimental period, higher plant height of lentil was observed in the combination of straw mulching with pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha. Straw and soil mulching registered about 26.26% and 15.28% higher seed yield of lentil, respectively compared to no mulching. Pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha registered 42.85% and 48.08% higher seed yield over the sole application of PE pendimethalin and PoE imazethapyr, respectively. Pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha registered the highest cost of cultivation and net return. This treatment also recorded significantly the highest net return. Straw and soil mulching provided significantly higher net return over no mulching. Pre-emergence pendimethalin registered significantly higher net return under straw mulching as compared to that under soil mulching. Among the different treatment combinations, the highest net return (Rs.18141/ha) was obtained in soil mulching with pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha which was statistically at par with the integrated use of straw mulching with pendimethalin at 1000 g/ha *fb* imazethapyr at 50 g/ha (Rs. 17484/ha). Thus, integrated use of soil or straw mulching with PE pendimethalin at 1000 g/ha *fb* PoE imazethapyr at 50 g/ha appeared to be promising for effective weed management, higher productivity and profitability in lentil.

Poster 82

Growth, yield and economic of lentil as influenced by integrated weed management

J.R. Patel*[1], Ghanshyam[1], H.P. Agrawal[1], Chanchala Rani Patel[2] and Nagendra Kumar Varma[3]

[1]BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh 495006, India
[2]Krishi Vigyan Kendra, Sarkanda, Bilaspur, Chhattisgarh 495006, India
[3]Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India
**Email: jrpatel_fodder@rediffmail.com*

A field experiment was carried out at Barrister Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (Indira Gandhi Krishi Vishwavidyalaya) in Chhattisgarh during *Rabi* season of 2019-20 on clay loam soil under randomized block design (RBD) with three replications. The treatments were consisted nine weed management practices namely pendimethalin 30 EC 1 kg/ha as pre-emergence, quizalofop-ethyl 50 g/ha as post-emergence at 25 DAS, pendimethalin 30 EC 1 kg/ha as pre-emergence + quizalofop-ethyl 50 g/ha post-emergence at 25 DAS, hand hoeing at 20 DAS, pendimethalin 30 EC 1.0 kg/ha as pre-emergence + hand hoeing at 20DAS, pendimethalin 30 EC 1 kg/ha as pre-emergence + wheel hoe at 20DAS, two hand hoeings at 20 and 40 DAS, T_8- weed check/control and T_9- weed free. Lentil variety RKL-31 was sown on 10/11/2019 and harvested on 05/03/2020. The crop was fertilized basally of 20, 40, 20 Kg/ha of N, P_2O_5 and K_2O, respectively. Results revealed that maximum growth parameters (plant height, number of branches and dry matter accumulation), growth analysis (crop growth rate and relative growth rate), seed and biological yields were significantly maximum under treatment weed-free followed by treatment pendimethalin 30 EC 1.0 kg/ha as pre-emergence + hand hoeing at 20 DAS. Further, the lowest values of the above characters were the lowest under weed check/control treatment. The treatment pendimethalin 30 EC 1.0 kg/ha as pre-emergence + hand hoeing at 20 DAS proved its superiority over other practices in respect of reducing weed density and weed dry matter production as well as recorded maximum weed control efficiency under study. In economic point of view, the gross (Rs.71683/ha) and net (Rs. 32910/ha) returns were maximum under weed-free followed by treatment pendimethalin 30 EC 1.0 kg/ha as pre-emergence + hand hoeing at 20 DAS. However, the benefit-cost ratio was maximum (2.12) under pendimethalin 30 EC 1.0 kg/ha as pre-emergence + quizalofop-ethyl 50 g/ha post-emergence at 25 DAS under investigation.

Poster 83

Effect of integrated weed management on weed dynamics, crop growth, economics and yield of linseed

H.P. Agrawal[1], Chandrashekhar Patel[2], J.R. Patel[1], Chanchala Rani Patel[3] and Nagendra Kumar Verma*[4]

Indira Gandhi Krishi Vishwavidyalaya, Raipur Chhattisgarh 492012, India

**Email: nagendravermapc@gmail.com*

A field study was carried out during *Rabi* seasons of 2020-21 at the Instructional Farm Barriaster Thakur Chhedilal College of Agriculture and Research Station, Bilaspur (C.G.). to study the performance of nine treatments in managing weed community, in the experimental field, *Cynodon dactylon, Cyperus rotendus, Parthenium hystophorus, Echinochloa colona* and other distinctive weeds were dominant and recorded all the time during growth period of crop. A number of branches, dry matter accumulation, seed yield and harvest index were maximum under weed-free treatment, followed by pendimethalin 30 EC 1.0 kg/ha (pre-emergence) + one hand weeding (20 DAS), two hand weedings (20 and 40 DAS), pendimethalin 30 EC 1.0 kg/ha (pre-emergence) + one wheel hoeing. Weed-free treatment followed by, pendimethalin 30 EC 1.0 kg/ha (pre-emergence) + one-hand weeding (20 DAS), they were pertinent for reducing weed density, weed dry matter production, lowest weed growth rate and providing maximum weed control efficiency. The highest cost of cultivation, net monetary return and gross return were obtained highest in weed-free treatment followed by pendimethalin 30 EC 1.0 kg/ha (Pre-emergence) + one hand weeding (20 DAS) and the lowest was observed in weedy check. B: C ratio was recorded highest by pendimethalin 30 EC 1.0 kg/ha (pre-emergence) + one hand weeding (20 DAS).

Effect of nano fertilizer and weed management practices on productivity of lentil

Suman Dhayal* and M.K. Kaushik

Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India

**Email: sumandhayal680@gmail.com*

Lentil (*Lens culinaris* L.) is a high-value, annual, self-pollinated crop with a modest stature. It is a highly nutritious and inexpensive component that may be used in a variety of dishes. Nano scale fertilizers have the potential to act as a catalyst for plant growth and can enhance the exchange of plant gases and root efficiency. Nano-fertilizers are called smart delivery systems because of their large surface area, sorption capacity and controlled-release kinetics to specified areas. Nanotechnology in agricultural systems can boost crop growth while saving energy, resulting in better and more cost-effective food production. Moreover, severe crop losses have been observed due to weeds in lentil because of short statured growth habit and slow initial growth. The loss of grain yield in lentil due to weeds range from 50-70% and critical period for crop weed competition is around 15 to 45 DAS. Hand weeding and inter-culturing are effective, but not feasible due to poor soil physical condition and unavailability of labour. In this context, use of herbicides can play vital role in management of weeds. A field investigation entitled was conducted at Rajasthan College of Agriculture, MPUAT, Udaipur during the year 2022 and 2023 on vertisol soil. The soil of experimental field characterized as clay loam in texture, having neutral pH, moderate organic carbon status, low nitrogen content, high available potassium content and medium available phosphorus. In the experimental field, predominant weed flora was *Chenopodium album*, *chenopodium murale, melilotus indica* and *convolvulus indica, Fumaria parviflora, Malva parviflora* and *Phalaris minor*. Application of 75% RDF + two spray of each 2 mL l-1 nano DAP and nano Zn resulted in significant increase in number of nodules/plant (20.75), weight of nodules/plant (5.46 mg/plant), pods/plant (53.96), grain/pods (1.53), grain yield (1.66 t/ha) and haulm yield (2.77 t/ha). Maintenance of weed free condition (two hand weeding's at 40 and 60 DAS) resulted in significant reduction in population of grassy, broad-leaved and total weeds at 60 DAS. Among the weed management treatments, application of pendimethalin 1 kg/ha recorded significantly lower weed dry matter at 60 DAS, weed index and higher weed control efficiency as compared to weedy check. Similarly, significantly increase the number of nodules/plant (19.93), weight of nodules/plant (5.26 mg/plant), pods/plant (53.48), grain/pods (1.50), grain yield (1.65 t/ha) and haulm yield (2.83 t/ha) were also recorded with pendimethalin 1.0 kg/ha as compared to weedy check on pooled basis.

Response of *Rabi* castor to integrated weed management practices

B.K. Patel, V.M. Patel, J.V. Patel, D.A. Chauhan and R.B. Ardeshna

[1]*Pulses & Castor Research Station, Navsari Agricultural University, Navsari, Gujarat 396450, India*

[2]*Department of Agronomy, College of agriculture, Navsari Agricultural University, Waghai, Gujarat 396450, India*

[3]*College farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat 396450, India*

[4]*Pulses & Castor Research Station, Navsari Agricultural University, Navsari, Gujarat 396450, India*

[5]*ASPEE college of Horticulture, Navsari Agr icultural University, Navsari, Gujarat 396450, India*

Email: tanubrij@nau.in

Field experiment was conducted during *Rabi* season of the year 2014-15 on vertisols of Navsari, Gujarat, geographically located at 20° 57' N latitude and 72° 54' E longitude at an altitude of 10 meters above sea level. The soil of experimental site was low in available nitrogen, medium in available phosphorus and fairly rich in potash. Eight integrated weed management practices, *viz*. T1-pendimethalin 1.0 kg/ha (PE) with hand weeding (HW) at 40 days after sowing (DAS), T2-pendimethalin 1.0 kg/ ha (PE) with HW at 40 and 60 DAS, T3-weed free through hand weeding (HW) at 20, 40 and 60 DAS, T4-farmer's practice (2 HW at 30 and 60 DAS), T5-quizalofop-ethyl 0.05 kg/ha (PoE) at 20 DAS + HW at 60 DAS, T6-pendimethalin 1.0 kg/ha (PE) + quizalofop-ethyl 0.05 kg/ha (PoE) at 20 DAS, T7-pendimethalin 1.0 kg/ha (PE) + quizalofop-ethyl 0.05 kg/ha (PoE) at 20 DAS + HW at 60 DAS and T8-unweeded (control) were evaluated in a randomized block design (RBD) with 3 replications. Castor hybrid '*GCH 7*' was used for the study. Crop was sown at a spacing of 120 × 60 cm. Results indicated that significantly more number of branches, spikes/plant, capsules/plant and spike length were recorded with pre-emergence application of pendimenthalin 1.0 kg/ha *fb* either two hand weedings at 40 and 60 DAS or one hand weedings at 40 DAS which remained statistically at par with weed free condition. The integrated weed management practices showed significant effect on seed yield of castor. Pre-emergence application of pendimethalin (1.0 kg/ha) followed by two hand weeding at 40 and 60 days after sowing recorded significantly higher seed yield (22.48 t/ha) of castor but, it was remained at par with pre-emergence application of pendimethalin (1.0 kg/ ha) with one hand weeding at 40 DAS and three hand weeding at 20, 40 and 60 DAS (weed free treatment). Further, these treatments (T1, T2 and T3) also recorded higher economics returns than other treatments. No residual/carry over phytotoxicity of any herbicides was observed on succeeding greengram crop under bioassay study. Further, result of residue analysis of pendimethalin in soil and seed of castor at laboratory indicated the no residue of pendimethalin in seed of castor and 0.029 ppm in soil which was below than European commission approved maximum residue level (EU-MRL) *i.e.* 0.05 ppm.

Estimation of water use by diverse category of weeds and seed yield of summer sesame under varying irrigation and weed regimes

Divya Jaiswal*[1], B.K. Saren[1], B. Duary[1] and D.K. Jaiswal[2]

[1]*Department of Agronomy, Institute of Agriculture, Visva-Bharati, Sriniketan, West Bengal 731236, India*

[2]*College of Horticulture & Research Station, Surguja, Chhattisgarh 497001, India*

**Email: divyajaiswal1195@gmail.com*

A field experiment was conducted during pre- *Kharif* season of 2024 at Agricultural Farm, Institute of Agriculture, Visva Bharati, Sriniketan, Birbhum, West Bengal to study the impact of irrigation and weed regimes on water use by diverse category of weeds and performance of sesame (*Sesamum indicum* L.). Two irrigation regimes (three irrigations at branching + flowering + capsule development and four irrigations at branching + flowering + capsule development + seed development) were imposed in main plot and eight weed regimes [crop only (weed free), crop + grasses, crop + broad-leaved weeds (BLW), crop + sedges, crop + grasses + BLW, crop + grasses + sedges, crop + BLW + sedges and crop + weeds of all categories] in sub-plots in a split-plot design replicated thrice. *Digitaria sanguinalis* (L.) Scop., *Echinochloa colona* (L.), Link, *Echinochloa glabrescens Munro* ex Hook. f., *Panicum repens* (L.), *Paspalum distichum* L., *Eleusine indica* (L.) Gaertn., and *Leptochloa chinensis* (L.) Nees among grasses; *Cyperus iria* (L.) and *Fimbristylis miliacea* (L.) Vahl among sedges and *Heliotropium indicum* (L.), *Croton bonplandianum Baill*., *Eclipta alba* (L.), *Spilanthes calva* DC., *Ludwigia perennis* L., *Alternanthera philoxeroides* (Mart.) Griseb., *Alternanthera sessilis* (L.) R. Br. ex DC., and *Melochia corchorifolia* (L.) Garcke among BLW were major weeds in the experimental field. Among different weed regimes, grass and sedge had the highest and lowest impact on water use by weed, respectively. Water use by weeds was higher by grasses when present alone as compared to the situation where diversified categories of weeds were present. Grasses when present alone had higher impact than its presence along with broadleaved, sedge or both. The highest water use by weed was recorded in a combination of crops + grasses, followed by the combination of crops + grasses + sedges, crops + grasses + BLW and crop + weeds of all categories. The seed yield of sesame was approximately 20.9% higher with four irrigations compared to three irrigations. However, among weed regimes the highest seed yield of sesame was recorded under weed free situations. The presence of grassy weed only with crop had greater yield loss (95%) compared to crop + BLW only (86%), and crop + sedges only (upto 28%). Grasses caused more loss of seed yield of sesame when present singly or in combination with BLW, sedge or both. Thus, it appeared that among different categories of weeds grasses caused more competition for water in summer sesame compared to other categories of weeds when present either alone or in combinations.

Poster 88

Evaluation of pre- and post-emergence herbicide for chemical weed management in sesame under assured rainfall zone of North Maharashtra

B.D. Malunjkar*, N.M. Magar, G.B. Chaudhari, S.S. Patil and S.S. Chitodkar
Oilseeds Research Station, Mahatma Phule Krishi Vidyapeeth, Jalgaon, Maharashtra 425001, India
**Email: malunjkar_bharat@rediffmail.com*

Sesame is an ancient oilseed crop, with the long history of cultivation. Sesame is quality food, nutrition, edible oil, biomedicine and health care, all in one. The superior nutritional, medicinal, cosmetic and cooking qualities of oil made it the queen of oilseeds. Globally, India is a major producer, consumer and exporter of sesame. India ranks first in the world with respect to area under sesame cultivation with an area of 16.22 lakh hectares, production of 6.57 MT and productivity of 405 kg/ha during 2019-2020. In Maharashtra, sesame was cultivated in 10700 hectares with a production of 2700 tonnes and productivity of 248.5 kg/ha during 2022-23. Among the different constraints in sesame production, weed infestation is one of the major factors limiting the sesame yield. Being a slow growing crop during seedling phase, weeds affect the growth of sesame and reduced the yield. The crop is very sensitive to weed competition during the first 20-25 days. The critical crop weed competition period in sesame is up to 40 DAS. Hand weeding and hoeing at 15-20 and 30-35 DAS were required to keep the field free from weeds as well as it helps moisture retention in soil and subsequently it helps in nutrients availability to the crop. Yield losses of 50 to 70% observed due to crop kept weedy throughout crop growth period. It is therefore a field experiment on herbicidal weed management was conducted at Oilseeds Research Station, Jalgaon during *Kharif* 2021 to study the weed dynamics and seed yield of sesame. The field experiment was laid out in randomized block design with eight weed management treatments in three replications. Experimental data shows that application of pre- or post- emergence herbicides significantly affected the weed density, weed dry matter production and weed control efficiency in sesame during *Kharif* season. The lowest weed density (5.45 and 6.16 no/m^2), dry matter production (114.0 and 226.0 g/m^2), and maximum weed control efficiency (64 and 63%) was observed with pre-emergence application of Pyroxasulfone 80 g/ha and it was significantly superior over the rest of the treatments at 30 and 60 DAS. The maximum weed density (9.04 and 10.09/ m^2), dry matter production (254.67 and 704.67 g/m^2) was observed with weedy check at 30 and 60 DAS. The reduction in yield due to weeds in sesame was to the extent of 67% in weedy check, whereas, only 10% in pre-emergence application of Pyroxasulfone 80 g/ha. Application of oxyfluorfen 60 g/ha as pre-emergence showed phytotoxicity on sesame resulted in loss of plant stand and ultimately on sesame seed yield. The sesame crop during *Kharif* season kept weedy could produce only 182 kg/ha of seed yield. However, weed free check achieved significantly higher seed yield (564 kg/ha). While, among the herbicidal weed management, pre-emergence application of Pyroxasulfone 80 g/ha produced higher seed yield (508 kg/ha) which at par with rest of the weed management treatments except oxyfluorfen 60 g/ha as pre-emergence. On the basis of above studies, it is therefore concluded that application of Pyroxasulfone 80 g/ha as pre-emergence was superior in minimizing weed density, weed dry matter, higher weed control efficiency and higher seed yield of sesame during *Kharif* season under assured rainfall zone of North Maharashtra.

Real-time weed detection and classification in cotton using YOLO11: A machine vision approach for precision weed management

Aditya Kanade*, Milind Potdar, B.N. Aravinda Kumar and Gurupada Balol
University of Agricultural Sciences, Dharwad, Karnataka 580005, India
**Email: adityakanade276@hotmail.com*

Poor weed management in cotton can lead to a significant yield reduction and depending on weed management the yield reductions can range from 10 to 90%. The world herbicide consumption has crossed 1.3 million tons. A site-specific approach, which takes into account the spatio-temporal variability in weed species establishment and growth, can facilitate effective and economical weed management. To achieve this, an idea about infestation, density and types of weeds present in field is necessary. Accurate weed identification and detection is crucial for the success of machine vision-based precision weed removal while causing minimal damage to crops. Unfortunately, conventional manual methods of identifying and managing weed infestations are time-consuming and require significant labour, limiting their effectiveness for farmers. Therefore, this study aims to develop an effective and robust real time system for automated weed identification and classification in cotton crop. An experiment was conducted during the *kharif*-2022 season at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, Karnataka, India. Cotton crop was sown with the 90 cm × 60 cm spacing. High-resolution images were captured in different natural light and climatic conditions using a DSLR camera mounted on a tripod stand, positioned vertically downward at a height of 80 cm. The images obtained were labeled annotated for three classes namely BLW (broad leaf weed), NLW (narrow leaf weed) and Cotton using annotation tools available at www.makesense.ai. The dataset consisted 2000 annotated images with a total of 37766 instances of the above three classes which was randomly split into training and validation sets in the ratio 9:1, respectively. A state-of-the-art deep learning detector YOLO11 was selected for the study. This detector leverages a combination of convolutional neural networks (CNNs) and anchor boxes to identify and classify objects within images. The model was trained for 100 epochs on a computer system using P100 GPU in Kaggle Notebook and validated on 200 images. This study represents a unique contribution to the research community on weed detection and control by creating a 3-class weed dataset with more than 37000 bounding box annotations collected under natural field conditions. The study also highlighted the value of affordable, computationally less complex, and less storage demanding RGB imageries in assisting farmers with weed assessment and precision weed management. The evaluation of the algorithm demonstrated promising results, with detection accuracy expressed as mean average precision (mAP@0.5) of 77.7% for YOLO11s. However, the inference time was less in YOLO11n (1.9 ms). The machine learning-based classification model developed and employed in the study will be helpful in devising suitable agronomic interventions. The findings offer a significant advancement in precision agriculture by demonstrating an accessible, high-accuracy and resource-efficient system for real-time weed detection in cotton fields. This approach has the potential to transform weed management practices, reducing labor requirements, minimizing herbicide dependence and promoting environmentally sustainable crop production on a large scale.

Poster 90

DWR Weedseed GURU android application for weed seed identification

Sandeep Dhagat*, D. Sreekanth, D.V. Pawar, P.K. Singh and J.S. Mishra
ICAR-Directorate of Weed Research, Jabalpur, Jabalpur, Madhya Pradesh 482004, India
**Email: dhagatsandeep@gmail.com*

Weed seed identification presents a significant challenge due to the diversity of seed characteristics. Weed seeds can vary greatly in size and shape, with some having distinctive features like spines, ridges, or hairs that complicate their recognition. Additionally, certain weed seeds closely resemble those of other plant species, making differentiation difficult. Compounding this issue is the fact that detailed descriptions or images of many weed species may not always be available, further hindering accurate identification. This is especially problematic for farmers and agronomists who rely on quick and precise identification for effective weed management. To address these challenges, the 'DWR Weedseed GURU' Android application was developed specifically for weed seed identification. This user-friendly app allows users to easily identify weed seeds by selecting images on their smartphones. It features a comprehensive database containing high-quality photographs and taxonomic information for 82 *Kharif* and 38 *Rabi* season weeds commonly encountered in agricultural fields. The app provides detailed descriptions that enhance the accuracy of identification. By leveraging this digital tool, farmers, agronomists, and researchers can quickly and reliably identify weed species, enabling them to implement timely and effective management strategies. The application is an invaluable resource, particularly in environments where rapid identification is critical for mitigating the negative impacts of weed infestations on crop productivity. As weed pressure continues to challenge modern agriculture, this innovative technology offers a practical solution for managing weeds in a more efficient and informed manner.

Poster 91

Weed control by drone and sensor technology in sustainable agriculture

Shital Suman*[1], Swati Sagar[2], Rajesh Reddy[3] and Reeta Singh[4]

[1,2,3]Bihar Agricultural Management & Extension Training Institute, Patna, Bihar 800014, India

[4]Krishi Vigyan Kendra, Patna, Bihar 800014, India

**Email: sumanshital595@gmail.com*

Weeds are amongst the most impacting biotic factors in agriculture, causing yield loss globally. Precision agriculture relies on technologies that combine sensors, information systems, and informed management to optimize crop productivity and to reduce the environmental impact. Integrated Weed Management coupled with the use of Unmanned Aerial Vehicles (drones), allows for Site-Specific Weed Management, which is a highly efficient methodology as well as beneficial to the environment. The identification of weed patches in a cultivated field can be achieved by combining image acquisition by drones and further processing by machine learning techniques. Specific algorithms can be trained to manage weeds removal by Autonomous Weeding Robot systems via herbicide spray or mechanical procedures. However, scientific and technical understanding of the specific goals and available technology is necessary to rapidly advance in field and GPS technologies, that provide geographical information for field mapping, can help in precisely monitoring large areas in a few minutes. Thanks to more accurate planning of weed management that can increase mechanical methods effectiveness or reduce herbicide spread.

Artificial intelligence tools for precision weed management

Abhishek Malav*, Richa Chaudhary and Nikhil Kumar Singh
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: abhishekmalav@bhu.ac.in*

The total food grain production is threatened by the many biotic and abiotic factors. Among these factors, weeds are dynamic constraints for successful crop production over the years. Weed management over the years carried out by manual, mechanical, cultural and chemical ways. Hence, climate change poses an all-time greater crop weed competitions now days. Therefore, weed control is an essential component of effective crop production, but it may be a tough and time-consuming task. AI-driven weed management appears to be a potential answer for farmers looking to increase yields while reducing herbicide use. Artificial intelligence has been applied to weed management, such as identification, precision weed control, predictive modeling, and weed mapping. Machine learning algorithms can be trained to identify crops and weeds. Agribot refers to the robot applied in agriculture. Most people believe that a change to the landscape of farming in the near future will be brought by the progress in robotics science and engineering. Today, global spending and research into the topic are rapidly approaching exponential growth. Using these techniques in identifying weeds with the use of site-specific weed control has become attractive. The most important first step in the development of SSWM is how to detect and recognize. Weed detection methods can be divided into two categories: machine learning and deep learning. Some of the used machine learning algorithms to identify weeds includes convolutional neural networks, deep convolutional neural network, support vector machine, artificial neural networks, random forest classifier, k-nearest neighbors, ShuffleNet-v2, and very deep convolutional networks. The most modern and powerful technique of control of weeds in agriculture by laser weeding is chemical-free and tilling-free. By laser weeding technology, it detects and removes weeds at substantially earlier stages of their life, even before they grow to the stage when they are visible to the naked eye, destroying them before they can damage the crops. It can see weeds with millimeter precision, including how to detect and remove weeds between crops. Artificial Intelligence (AI) has made it easier to bring about a paradigm shift in agriculture, particularly in the domain of weed management. It offers more than innovation, using precise and eco-friendly solutions for the identification and control of weeds and thereby resolves major agricultural challenges. The article is focused on how AI is used in weed management with different aspects such as application in the detection of weeds and the increasing influence of deep learning methods on the agriculture field. Some advantages of AI-based weed control systems include their accuracy, precision, cost-effectiveness, environmental conservation, efficiency in labor, high crop yield, time saving, scalability, robustness against climate change, and technical innovation. Lastly, but not least, comes digital literacy as an enabling factor for the stakeholders to effectively move AI technology towards sustainable transformation in agriculture weed management practices.

New emerging digital technologies in weed management

Shivendra Singh* and Naushad Khan
Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208002, India
**Email: shivendranduat@gmail.com*

Globally the increase in food demand requires maximizing crop productivity, but weeds are significant abiotic stressor, contribute to substantial agricultural losses estimated approximately 13.2% of annual food production. Conventional weed control such as using blanket herbicide spraying, give rise to issues of herbicide overuse, environmental deterioration, and proliferation of herbicide-resistant weed species. Digital technologies such as robotics, sensors, Unmanned Aerial Vehicles (UAVs), and Deep learning (DL) models, have revolutionized weed management practices by using accurate and efficient weed control methods. Smart spraying systems use a synergistic combination of sensors, robotics, and machine learning to deliver site-specific weed management. The goal of these systems is to reduce chemical waste by focusing on areas affected by weeds, thereby minimizing the use of herbicides. Some of the key advancements involve the implementation of machine vision-based sprayers that utilize deep learning models, such as YOLO v4, to recognize specific weed species in real-time and apply herbicides only to the targeted areas. The integration of FLIR RGB cameras for image capture and edge computing platforms like Nvidia Jetson AGX Orin enables swift and accurate weed detection, ensuring precise management of spraying equipment such as TeeJet solenoid valves. Recently, UAVs have emerged as an impactful tool in modern agriculture, particularly in weed management. With their ability to cover large farm area quickly. When UAVs are combined with DL models, it can efficiently collect multispectral imagery data and better weed detection and monitoring. DL methodologies, especially Convolutional Neural Networks (CNNs), have proven advantageous in image recognition tasks, thereby rendering them suitable for the identification of weeds, pests, and crop maturity. The YOLO (You Only Look Once) series of models, particularly YOLOv3 and YOLOv4, have become well-known in the field of real-time weed detection among DL methodologies. These models enable quick identification of multiple weed species under various field conditions. Other models like SegNet and U-Net have been employed for semantic segmentation tasks, particularly in the examination of multispectral aerial imagery captured by drones. However, there are still challenges related to optimizing models for edge devices with limited resources and broadening the availability of open-source weed image datasets. Deep Learning (DL) is at the cutting edge of site-specific weed management (SSWM), but several key hurdles must be addressed. Firstly, most studies use transfer learning from pre-trained models rather than custom-designed neural networks, limiting the specificity of models for weed detection. Furthermore, although several models attain high accuracy on particular datasets, no model exhibit consistent performance across varying field conditions. Additionally, research is currently deficient in areas such as the optimization of DL models tailored for edge devices, minimizing energy consumption, and improving training efficacy. Digital technologies, particularly UAV's and DL-based smart sprayers, have the potential to transform weed control by facilitating site-specific, data-driven interventions. Although the technology shows promise, additional research is required to tackle issues related to model optimization, data accessibility, and scalability. Overcoming these challenges could lead to a substantial reduction in herbicide use, improved environmental sustainability, and increased crop productivity through the use of digital technologies. Collaboration in this developing area presents thrilling prospects for researchers, farmers, and technology developers to collectively strive for more sustainable agricultural practices.

Poster 94

Assessment of farmers' knowledge and practices on herbicide application and weed management in the irrigated North Western Plain Zone of Rajasthan

Gajanand*[1], Sunil Kumar[2], Sunil Kumar[3] and Devilal Birla[4]

[1]*Deptartment of Agronomy, RCA, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India*

[2]*Extension Education, Krishi Vigyan Kendra, Pokaran, Jaiasalmer, Rajasthan 345021, India*

[3]*Department of Agronomy, TCA, Dholi, Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India*

[4]*Department of Agronomy, BA College of Agriculture, Anand Agricultural University, Anand, Gujarat 388110, India*

**Email: gnthori600@gmail.com*

A survey was conducted to assess the knowledge and practices of herbicide application and weed management among farmers in the irrigated north-western plain zone of Rajasthan. The study involved 160 farmers selected from Hanumangarh and Shri Ganganagar districts (20 farmers from each village, two villages from each tehsil, and two tehsils from each district). The survey aimed to understand the farmers' awareness, adoption, and challenges related to herbicide use. Data were collected through structured questionnaires and personal interviews, covering multiple aspects of herbicide use. These included the types of herbicides employed, the methods of application, the frequency and timing of usage, and the farmers' understanding of the consequences of improper herbicide use. The study also focused on evaluating the farmers' knowledge of herbicide safety practices and integrated weed management (IWM) approaches. The findings revealed that a majority of the farmers had some awareness of herbicides, but few could identify specific herbicides suitable for different crops and weed types. Most respondents used herbicides regularly as part of their weed management strategy, while a smaller portion relied on manual or mechanical methods. However, only a fraction of the farmers adhered to recommended guidelines for herbicide application, such as correct dosage, timing, and safety precautions. Key challenges identified in the study included inadequate knowledge of herbicide resistance, limited access to updated information on new herbicides, and insufficient understanding of integrated weed management practices. Moreover, some farmers reported crop damage due to incorrect herbicide usage, underscoring the need for enhanced educational and extension services. Notably, although all of the farmers were aware of the health risks posed by herbicides to humans, none used safety kits such as gloves, masks, or protective clothing during application. This gap between knowledge and practice raises serious concerns about farmer health and safety, as prolonged exposure to herbicides without protection can lead to acute and chronic health issues. The survey highlights the critical need for targeted training programs and extension activities to improve farmers' knowledge and practices regarding herbicide application. There is a clear need for educational campaigns that not only inform farmers about the risks associated with improper herbicide use but also encourage the adoption of safety kits during application. Furthermore, promoting integrated weed management (IWM) strategies, which combine chemical, biological, and mechanical methods, can help reduce reliance on herbicides and mitigate the development of herbicide-resistant weeds. In conclusion, the findings provide valuable insights for policymakers, agricultural extension workers, and other stakeholders in the agricultural sector. Addressing the gaps in knowledge, access to information, and safety practices is essential to ensuring sustainable weed management and protecting farmer health in the region. Implementing comprehensive training programs and facilitating access to modern weed control technologies will be key to improving the long-term sustainability of agriculture in the irrigated north-western plain zone of Rajasthan.

Poster 95

Efficacy evaluation of herbicides using drones for effective weed control, crop yield, profitability and resource savings in direct-seeded rice

R. Arockia Infant Paul*[1,2], P. Murali Arthanari[1], Panneerselvam Peramaiyan[2], Virender Kumar[3] and Muthukumar Bagavathiannan[4]

[1]*Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India*

[2]*International Rice Research Institute South Asia Regional Centre, Varanasi, Uttar Pradesh 221005, India*

[3]*International Rice Research Institute, Philippines;* [4]*Texas A&M University, USA*

**Email: raipaul307@gmail.com*

Rice is one of the most pivotal staple food grain crops in India, with a production of 129.5 million metric tons from a cultivated area of 46.3 million hectares, yielding an average of 2.79 t/ha. Present-day agriculture is facing a paucity of resources, which leads to a transformation of conventional transplanting into direct-seeded rice (DSR). Weeds are the most critical crop pest, hindering crop growth and improper weed management poses severe yield reductions in DSR. The major shares of energy and cost in DSR is spent on weed management. Controlling weeds in DSR during the critical period assumes great importance for realizing higher yield. The unavailability of labor has necessitated the use of herbicides as the most effective and economically viable option for weed control in DSR. The conventional method of knapsack sprayers often leads to non-uniform applications, increased application costs, human drudgery, and a higher risk of pesticide exposure for spraying personnel, compared to drone application. Therefore, a field experiment was conducted during *Kharif* 2022 and *Rabi* 2022-2023 to evaluate suitable weed management options to control complex weed flora in direct-seeded rice with better energy and economic returns. Twelve weed management treatments included pre-emergence pretilachlor (450 g/ha) *fb* post-emergence bispyribac sodium (35 g/ha), pre-emergence pretilachlor (450 g/ha) *fb* post-emergence fenoxaprop-ethyl (67.5 g/ha) + carfentrazone-ethyl (20 g/ha), early post-emergence bispyribac sodium (35 g/ha), early post-emergence fenoxaprop-ethyl (67.5 g/ha)+carfentrazone-ethyl (20 g/ha), early post-emergence bispyribac sodium (35 g/ha) *fb* post-emergence fenoxaprop-ethyl (67.5 g/ha)+carfentrazone-ethyl (20 g/ha) were applied in drone and knapsack sprayer along with controls (unweeded and weed-free check). Results revealed that the lowest weed density, weed dry weight, highest weed control efficiency and grain yield were recorded in the sequential application of pretilachlor *fb* bispyribac sodium using knapsack sprayer, which was on par with drone application. The herbicide application cost and total weed management cost were significantly less in drone spraying, resulting in reduced production costs, increased net return and a higher benefit-cost ratio. The drone application of pretilachlor *fb* bispyribac sodium reduced labor requirements (by 50%), application costs (by 18%) and total weed management costs (by 13%) in comparison with knapsack application, which resulted in increased net returns (59067 and 52235 ^{1} /ha) and benefit-cost ratio (2.27 and 2.09). Furthermore, the energy requirement for herbicide application through drone was less compared to knapsack application. The highest output energy, energy use efficiency (10.86 and 9.55) and energy productivity (0.81 and 0.71 kg/MJ) were recorded in the sequential application of pretilachlor *fb* bispyribac sodium through drone in both seasons, which saves 32% input energy than manual application. Thus, the results emphasize that drone spraying system provides a great opportunity to conserve the resources (labor, energy, and capital) for effective weed management than knapsack application. Therefore, sequential application of pretilachlor (450 g/ha) *fb* bispyribac sodium (35 g/ha) through drone may be used instead of conventional knapsack spraying for effective weed management with more remunerative yield, energy and economic returns in direct-seeded rice.

Crop weather simulation modeling in weed management

Neeraj Kumar*, B.M. Mote, T.U. Patel, H.H. Patel and D.D. Patel
Department of Agronomy, College of Agriculture, Navsari Agricultural University Bharuch, Gujarat 392012, India
**Email: neeraj34012@gmail.com*

A simulation is an imitation of the dynamics of a real-world process or system over time. Although simulation could potentially still be done "by hand," nowadays it almost always implicitly requires the use of a computer to create an artificial history of a system to draw inferences about its characteristics and workings. Suppose we decided to open a donut shop and are unsure about how many employees to hire to sell donuts to costumers. The operations of our little shop are the real-world system whose behavior we want to understand. Given that the shop is not operating yet, only a simulation model can provide us with insights. Crop simulation models are powerful tools that simulate crop growth using biophysical equations. These models can be used to help design and identify strategies to enhance the productivity of water use in crop production at a much lower time and monetary cost than field experiments. As well as the ability to compare more combinations of climate, management and irrigation scenarios, these models can be linked to optimization algorithms to more effectively discover potential scheduling strategies. Weeds have been the main cause of crop yield loss since the early stages of agriculture. Herbicide-based control methods have played a major role in maximizing agricultural productivity although their continuous application have negatively affected the environment and caused concern regarding the risk of human exposure. a DSS-oriented model must include crop-weed demography as well as the intervening ecophysiological elements that will finally define crop yields and weeds' population dynamics. The present model enables simulation of the competitive interactions between an annual weed and a grain crop. One of the solutions to overcome these limitations is extending cropping system models already used within operational or pre-operational DSS by providing them with algorithms for the simulation of key dynamics of crop-weed interaction. Some of these models have indeed been used for years in a variety of contexts and they have been validated under operational conditions for a variety of purposes. Moreover, their functioning and outputs are often simple enough to be understood by farmers directly or after their implementation in dedicated software platforms. A wide variety of crop simulation models exist, each designed with specific use cases in mind and thus with their own strengths and weaknesses.

Poster 97

Leverage of digital technologies to evaluate the spread of *Parthenium* in Puducherry

P. Saravanane*, A. Karthickraja, R. Poonguzhalan and R. Mohan
Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal, Puducherry 609603, India
Email: psaravanane@pajancoa.ac.in

Parthenium hysterophorus, an invasive herb from the Asteraceae family, is a significant threat to agriculture, biodiversity and human health. Aggressive colonization and prolific seed production have made it one of the world's most problematic weeds, significantly impacting ecosystems and livelihoods in affected regions. Weed mapping is an important part of *P. hysterophorus* management. Digital technologies will improve the accuracy and efficiency of surveying and mapping, and reducing the need for manual labour. The study was conducted during 2024-25 in Karaikal region, by integrating digital mapping which systematically documenting the infestation density that comprises of five communes and 27 villages. Using a quadrat (0.25 × 0.25 m²) survey method, weed samples were collected at 3 km intervals across the region, noting the presence and density of parthenium and associated weed species. GPS coordinates were uploaded to QGIS software for geospatial analysis, allowing for visualizing the spread of parthenium infestations and phytosociological indices such as density, frequency, Important Value Index (IVI) and Summed Dominance Ratio (SDR) were calculated. The survey identified 22 weed species from 12 families. They are *Parthenium hysterophorus*, *Cyanthillium cinereum*, *Tridax procumbens*, *Bergia capensis*, *Cardiospermum halicacabum*, *Leucas ciliata*, *Clinopodium vulgare*, *Alysicarpus ovalifolius*, *Sesbania bispinosa*, *Borreria hispida*, *Ziziphus mauritiana*, *Corchorus tridens*, *Dactyloctenium aegyptium*, *Eragrostis tenella*, *Cyperus iria*, *Alternanthera sessilis*, *Cleome viscosa*, *Calotropis gigantea*, *Rumex crispus*, *Achyranthes aspera*, *Gomphrena celosiodes* and *Cynodon dactylon*. The geospatial analysis identified the prevalence of parthenium was higher in Thirunallar commune, where urbanization and high vehicle traffic contributed to its spread. Lower densities of parthenium was observed in T. R. Pattinam and Kottucherry commues, respectively. Higher IVI and SDR of parthenium indicated significant competitive ability in Thirunallar commune. Associated weeds, including *Cynodon dactylon*, *Cyanthillium cinereum* and *Alternanthera sessilis* were also observed, with varying densities and localized dominance across different communes. The phytosociological survey underscores the ecological threat posed by parthenium. This study demonstrated the value of digital tools like GPS and QGIS in monitoring and managing invasive weed. The findings of the study will help to devise effective management strategies to mitigate the adverse impact of parthenium.

Digital mapping of *Parthenium hysterophorus* using geo-spatial techniques for crop lands of Amravati district of Maharashtra

Surabhi Hota[1*], Gopal Tiwari[2], V.K. Choudhary[1], N.C. Paul[3], Yogita Gharde[1] and V.V. Goud[4]

[1] ICAR- Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India

[2] ICAR- National Bureau of Soil Survey and Land Use Planning, Nagpur Maharashtra 440033, India

[3] ICAR- National Institute of Abiotic Stress Management, Baramati, Maharashtra, 413115, India

[4] Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, 444104, India

[*]Email: surabhi.hota@icar.gov.in

A study was conducted in 9 blocks of Amravati district of Maharashtra, to map the spatial distribution of *Parthenium hysterophorus* population, using primary data of weed count and predictive modelling approach. The remote sensing (RS) derived terrain parameters such as multiresolution index of valley bottom flatness (MRVBF), multiresolution index of the ridge top flatness (MRRTF), slope length, aspect, digital elevation model (DEM), channel network and RS derived vegetation parameters normalized differential vegetation index (NDVI) and soil adjusted vegetation index (SAVI) were used as input covariates to derive 300 sampling points using conditional Latin hypercube sampling in R studio. The sampling points were then traversed and real time weed count was recorded from derived geo-coordinates, at undisturbed sites such as bunds of agricultural fields in a 0.5 × 0.5 m quadrat. The primary data was then put into four predictive models, such as Poisson regression, negative binomial regression, zero inflated binomial regression and zero inflated Poisson regression. The terrain and vegetation parameters mentioned above, were used as covariates, to map the spatial distribution of *Parthenium hysterophorus*. A 10-fold cross validation method was used for validation of the derived results. The prediction accuracy of the models was compared on the basis of Akaike information criterion (AIC) and Bayesian information criterion (BIC). The lower the values of these parameters, the higher is the accuracy of the model. Based on both AIC (1254.7) and BIC (1338.9), the zero inflated Poisson regression model was found to be the most accurate predictor of variability. The result showed that the predictive modelling approach was successful in digital mapping of spatial distribution of *Parthenium hysterophorus* population in the study area.

Advancements in precision agriculture: Utilizing unmanned aerial vehicles and multispectral sensors for enhanced weed management

Shiv Bhushan Verma* and Divya Singh
Adour Super Science Pvt. Ltd., Varanasi, Uttar Pradesh 221005, India
Department of agriculture, Prof. Rajendra Singh University, Prayagraj, Uttar Pradesh 221005, India
**Email: Shiv.b.verma7@gmail.com*

Weeds, being one of the primary abiotic factors impacting crop yield, contribute to approximately 13.2% of annual food loss. The integration of Unmanned Aerial Vehicles (UAVs) and multispectral sensors in precision agriculture represents a significant advancement in the field of weed management. This study explores the potential of these technologies to enhance the detection, monitoring, and control of weeds, thereby improving crop yields and reducing the environmental impact of herbicide use. UAVs, commonly known as drones and GPS offer a versatile platform for aerial surveillance and data collection. When equipped with multispectral sensors, these UAVs can capture high-resolution images across various wavelengths, including visible and near-infrared spectra. This capability allows for the detailed analysis of vegetation health and the identification of weed infestations with greater accuracy than traditional methods. The research focuses on the application of UAVs and multispectral sensors in several key areas of weed management. Firstly, the study examines the effectiveness of these technologies in early weed detection. By analyzing multispectral imagery, it is possible to distinguish between crops and weeds based on their spectral signatures. This early detection enables timely intervention, preventing weeds from establishing and competing with crops. Secondly, the study investigates the role of UAVs and multispectral sensors in monitoring weed populations over time. Continuous monitoring provides valuable insights into the dynamics of weed growth and spread, allowing for the development of more effective management strategies. The ability to track weed populations also aids in assessing the efficacy of applied treatments and adjusting management practices accordingly. Furthermore, the research explores the potential of UAVs and multispectral sensors in precision herbicide application. By creating detailed weed maps, farmers can implement site-specific herbicide treatments, targeting only the affected areas and minimizing the use of chemicals. This approach not only reduces the environmental impact of herbicides but also lowers costs and promotes sustainable agricultural practices. The study also addresses the challenges associated with the adoption of UAV and multispectral sensor technologies. These include the initial investment costs, the need for technical expertise, and regulatory considerations. However, the long-term benefits, such as increased crop productivity and reduced environmental footprint, outweigh these challenges. In conclusion, the integration of UAVs and multispectral sensors in precision agriculture offers a promising solution for enhanced weed management. The ability to detect, monitor, and control weeds with high precision can lead to significant improvements in crop yields and sustainability. This research highlights the potential of these technologies to revolutionize weed management practices and contribute to the advancement of precision agriculture.

Poster 100

Efficacy of pre-emergence, early post-emergence and post-emergence herbicides for weed management and yield attributes in wheat

Priya Garhewal[1], Anupma Kumari[2*] and Devendra Singh[3]
Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar 848125, India
**Email: anupamakumari.bhu@gmail.com*

An experimental trial was conducted during *Rabi* season of 2021-22 in wheat at Research Farm Pusa, RPCAU, Pusa, Samastipur, Bihar to evaluate the efficacy of pre-emergence and early post-emergence herbicides for weed management and yield attributes in wheat. The experiment contained thirteen treatments, of which eleven treatments were based on sole and tank mixed application of herbicides at three different stages, *viz.* pre-emergence, early post-emergence and post-emergence and rest two were weed free and weedy check. All the treatments were outlaid in randomized block design with three replications. Pyroxasulfone is a novel pre-emergence herbicide discovered amongst a series of herbicidal 3-sulfonylisoxazoline derivatives. Pre-emergence application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha recorded superior growth parameters at 30 DAS, and early post-emergence application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha at 60 and 90 DAS and at harvest over the other herbicidal as well as weedy check treatments. However, pre-emergence application of metribuzin at 300 g/ha and pre-emergence pendimethalin + metribuzin 1250 + 280 g/ha both caused plants to exhibit phytotoxic symptoms 5 and 10 days after treatment and scored 1 on a scale of 1 to 10 for phytotoxicity. Pre-emergence application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha resulted significantly lower density of weeds, weed dry weight, and maximum WCE at 30 DAS. However, in later stages, early post-emergence application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha resulted in maximum WCE with lowest values of weed density. Yield and yield attributing parameters *viz*. spike length and number of seeds per spike were recorded significantly maximum in early post-emergence application of pyroxasulfone + metsulfuron 127.5 + 4 g/ha as well as in post-emergence application of sulfosulfuron + metsulfuron 25 + 4 g/ha and weed free. Post-emergence application of sulfosulfuron + metsulfuron 25 + 4 g/ha was registered the most economical over the other treatment, as it had been observed maximum gross return, net return and BC ratio. However, significant minimum gross return, net return and B:C ratio were recorded in the weedy check. Different herbicides are used to control mixed flora of weeds in wheat crop according to their time of application or the type of target weed. Therefore, selection of effective herbicides to control the weed is essential for the better yield of crops.

Effect of *Phalaris minor* Retz emergence timing and density on its economic threshold level in wheat

Pawan Kumar Verma*, Makhan Singh Bhullar, Manpreet Singh and Tarundeep Kaur
Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab 141004, India
**Email: pkverma8545@gmail.com*

Phalaris minor has been a major threat to productivity and sustainability of rice-wheat system in NW India. The yield losses in wheat due to *P. minor* competition could be up to 80% and under severe conditions, it can be a sole cause of complete crop failure which was fairly common during late 1970’s due to the absence of effective herbicide and, in mid-nineties, after it evolved resistance against isoproturon. The knowledge of threshold level of weed infestation can be utilized to reduce herbicide use. With this perspective, the study was planned to estimate yield losses in wheat caused by *P. minor* competition as a function of its density and time of emergence, and to determine its economic threshold level in wheat. A field experiment was carried out on a sandy loam soil during winter season of 2019-20 and 2020-21 at Punjab Agricultural University, Ludhiana, India. The treatments consisted of five timing of emergence of *P. minor* (0, 14, 28, 42 and 56 days after wheat emergence, d) in main plots and five *P. minor* densities (0, 5, 15, 45 and 135 plants/m^2) in sub plots in a split plot design with three replications. *Phalaris minor* emerged along with wheat (0 d) recorded highest values for all growth and reproductive attributes. Each delay in emergence of *P. minor* from 0 through 28 d resulted in significant reduction in plant dry biomass, spikes/plant and seeds/spike. *P. minor* plants emerged at 42 and 56 d did not survive till crop harvest. *P. minor* emerged at 14 d accumulated 43% lower plant dry biomass than 0 d; delay in emergence from 14 to 28 d further reduced its dry biomass by 23%. *P. minor* plant density showed variable effect on its growth and reproductive attributes. In case of plant dry biomass, there was significant increase with every increase in density from 5- 135 plants/m2. At each *P. minor* density, dry biomass was significantly reduced with each delay in emergence from 0-28 d. In case of seed number/spike, at each emergence time, it did not show any consistent trend with respect to plant density. However, at each *P. minor* density, there was significant reduction in seed number/spike with every delay in *P. minor* emergence from 0-28 d. When *P. minor* emerged at 0 d, it produced higher seed number/spike at densities from 5 to 45 than 135 plants/m2. Each delay in emergence of *P. minor* from 0 through 42 d resulted in significant increase in wheat grain yield. When *P. minor* emerged at 0 and 14 d, wheat grain yield was significantly reduced even at 5 plants m-2 compared to weed free. The economic threshold levels of *P. minor*, for achieving 95% of potential wheat yield level, turns out to be 0, 6, 24, 103, and 331 plants/m2, respectively, when *P. minor* emerged at 0, 14, 28, 42 and 56 days after wheat emergence. Hence, any management practice for *P. minor* must delay its emergence and minimize its density till 42 days after wheat emergence for minimizing losses in wheat grain yield.

Weed management in wheat sown with super seeder

M.P. Singh[1*], S.K. Tomar[2], P.K. Singh[1], L.B. Gaur[1] and R.R. Singh[3]

[1]*Krishi Vigyan Kendra, Sonbhadra, Tagore Nagar, Robertsganj, Uttar Pradesh 231216, India*

[2]*Krishi Vigyan Kendra, Belipar, PO Belipar, Gorakhpur, Uttar Pradesh 273413, India*

[3]*Narendra Dev University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh 224229, India*

**Email: mpsinghbjn@gmail.com*

The On Farm Trial (OFT) was conducted at farmers field of 5 village in Sonbhadra district during the winter season of 2021-2022 and 2022-23 to assess the efficacy of tank mixture Clodinofop with 2,4-D, metsulfuron and carfentrazole ethyle as well as sulfosulfuron with metsulfuron, 2,4D, and carfentrazole ethyle in super seeder sown wheat [*Triticum aestivum* (L.)]. Wheat variety DBW 187 was sown using 100kg seed/ha by super seeder in partial residue of rice. The prominent weeds were *Phalaris minor, Solanum nigram, Canabis sativa, Chenopodium album, Anagalis arvensis and Fumaria parviflora.* The result opts for the highest grain yield (4.20 t/ha) and straw yield (4.79 t/ha) in clodinifop + carfentrazole ethyle (60 + 20 g ai/ha) followed by sulfosulfuron + carfentrazole ethyle and sulfosulfuron + metsuluron which was significantly superior over rest of the treatments. Tank mixed application of clodinifop with carfentrazole ethyle at par with sulfosulfuron + carfentrazole ethyle significantly reduced the weed density and weed dry weight compared to rest of the herbicide tested. Tank mixed application of clodinifop + carfentrazole ethyle remaining at par with sulfosulfuron mix with either Carfentrazole, metsulfuron or 2,4-D was most effective in enhancing yield attributes, grain & straw yield. Highest net return and benefit cost ratio recorded with clodinifop + carfentrazole ethyle.

Effect of tillage and herbicides on weeds and productivity of wheat in Northern part of Madhya Pradesh

Pavan Kumar Para*[1], Shailendra Singh Kushwah[2] and R.K. Tiwari[3]

[1]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[2]*R.V.S.K.V.V. Gwalior, College of Agriculture, Gwalior, Madhya Pradesh 474002, India*

[3]*J.N.K.V. V, Jabalpur, College of Agriculture, Rewa, Madhya Pradesh 482004, India*

Email: pkpara94@gmail.com

A field experiment was conducted on "Effect of tillage and herbicides on weeds and productivity of wheat (*Triticum aestivum* L.) in Northern Part of Madhya Pradesh" at Research farm of Agronomy, Collage of Agriculture Gwalior, during the *Rabi* seasons of 2019-20 and 2020-21. Tillage systems, *viz.* conventional, reduced and zero tillage with weed control measures as an integrated weed management approach were investigated. Zero tillage reduced weed density and dry biomass and resulted in significantly higher grain yields (4.81 t/ha) over two other tillage practices. The highest grain yield (5.2 t/ha) was obtained under two hand weeding with zero tillage, which was observed statistically at par to clodinafop + metsulfuron (60+4 g/ha) application under zero tillage system. Zero tillage practices with the use of two hand weeding (30 and 60 DAS) gave the highest gross monetary return (Rs 144262/ha) however highest net monetary return (Rs. 105474/ha) and B: C ratio (3.11) was obtained under the treatment application of clodinafop + metsulfuron (60 + 4 g/ha) under zero tillage. The B:C ratio in all herbicidal treatments with remaining two tillage systems was observed low due to the high cost involved. Sowing of wheat in zero tillage could be recommended with the use of ready-mix product of clodinafop + metsulfuron (60 + 4 g/ha) for management of weeds profitably.

Effect of different sowing environments and IW/CPE based irrigation scheduling on weeds under wheat crop

Mrinali Gajbhiye*[1], Manish Bhan[1], K.K. Agrawal[1] and Narendra Kumar[2]

[1]*Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[2]*Department of Agronomy, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh 474002, India*

**Email: mrinaligajbhiye29@gmail.com*

Wheat (*Triticum aestivum* L.) is one of the major cereal crops consumed in India. In context to climate change scenario and growing population there is need to enhance production. Weed infestation is a foremost reason of low wheat yield under irrigated situation. They contend with plants for light, moisture, space and nutrients. Beside this, sowing time plays important role in reducing crop-weed competition during the initial growth period. In Madhya Pradesh, wheat is sown from mid-November to the end of December. Now-a-days, its sowing gets delayed due to late harvest of *Kharif* pulses. This affects wheat as it is sensitive to temperature. Moreover, irrigation scheduling could help to overcome the effect of temperature up to some extent and weed density as well. Therefore, a field experiment was carried out during the *Rabi* season of 2020-21 at Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh with an objective to study the response of different sowing environments and IW/CPE based irrigation scheduling on weeds under wheat crop. The experiment was laid out in split-plot design with three replications, comprising three sowing environments (E1 – December 03, E2 – December 18 and E3 – January 02) in main plots and four irrigation schedules based on Irrigation Water/Cumulative Pan Evaporation (IW/CPE) ratio (I1- 1.0, I2 - 0.9, I3 - 0.8 and I4 - 0.7) in sub-plots. The soil of the experimental plot was clay loam with neutral pH and medium EC, N, P and K. The results of the present study revealed that the relative density of *Medicago denticulata* (23.0%), *Chenopodium album* (29.0%), *Cyperus rotundus* (29.5%), *Anagallis arvensis* (10.0%) and *Alternanthera sessilis* (8.5%) was maximum under 3rd December sowing than 18th December and 2nd January. The relative density of all the weeds were observed to be reduced as the sowing delayed. Among the sowing environments, the total weed density and weed dry weight was reduced with the 18th December and 02nd January sowing over 03rd December by 21.8% and 26.7%, respectively and 4.4% and 18.3%, respectively at 30 days after herbicide application (DAHA). Among irrigation schedule, total weed density and total weed dry weight was reduced with 0.9, 0.8 and 0.7 IW/CPE ratio over 1.0 by 12.3%, 25.3% and 36.3%, respectively and 12.01%, 17.5% and 31.8%, respectively. Also, crop sown under 03rd December registered maximum grain yield (4.6 t/ha) than 18th December and 02nd January sown wheat. Among the irrigation schedule, IW/CPE ratio 1.0 registered maximum grain yield (4.5 t/ha) which was significantly at par with 0.9. The crop sown under 3rd December (2.77) and 1.0 IW/CPE ratio (2.65) was found to be more remunerative as it fetched maximum benefit-cost ratio than other treatments. The study concludes that delaying the sowing environment with irrigation scheduling could help to reduce the weed density and dry weight up to certain extent.

Assessment of conservation tillage practices vis-à-vis herbicide treatments on wheat growth: a spectral and chlorophyll content analysis

Monika Raghuwanshi*[1], Namrata Jain[1], V.K. Choudhary[2] and A.K. Jha[1]

[1]*Department of Agronomy, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[2]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

**Email: monika5252raghu@gmail.com*

Conservation technology in wheat production is pivotal for sustainable agriculture, particularly in addressing soil health and productivity challenges. This research, conducted at the Instructional Research Farm, Krishi Nagar, Adhartal, Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *Rabi* season of the year 2022 and 2023, aimed to evaluate the effects of different tillage practices and herbicide treatments on wheat growth parameters using spectral reflectance and chlorophyll content index (CCI). The study utilized a split plot design with four main plot treatments: zero tillage practices, zero tillage with chemical stale seed bed, conventional tillage with stale seed bed, and conventional tillage. Subsequently, four sub plot treatments were applied: clodinofop (15%) + metsulfuron (1%) 60 + 4 g/ha (PoE), mesosulfuron-methyl (3%) + iodosulfuron-methyl sodium (0.6%) 12+2.4 g/ha (PoE), weedy check, and hand weeding at 20 and 40 days after sowing (DAS). Spectral reflectance was measured using a spectroradiometer, while chlorophyll content index (CCI) was assessed with a SPAD meter. Results indicated that among the main plot treatments, conventional tillage with stale seed bed exhibited the highest normalized difference vegetation index (NDVI) and CCI, whereas zero tillage recorded the lowest values. Among the sub plot treatments, the weedy check treatment showed the lowest NDVI and CCI values, while hand weeding resulted in the highest NDVI and CCI. This research underscores the importance of conservation tillage practices and effective herbicide management strategies in optimizing wheat growth and productivity, thereby contributing to sustainable agricultural practices in the region.

Efficacy of post-emergent herbicides used in wheat against *Polypogon monspeliensis* (L.) Desf.

Manpreet Singh* and M.S. Bhullar
Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab 141004, India
Email: khivams@pau.edu

Polypogon monspeliensis (L.) Desf. (Beard Grass, Rabbits foot Grass, Loombar g/ha) is an annual C3 grass and reproduces through seeds. It thrives well in damped to wet areas, often close to water streams and can tolerate alkalinity and salinity up to some extent. In Northern India, dominance of *P. monspeliensis* was reported in the moist fields under rice-wheat rotation. In Punjab, it was observed during weed survey in *Rabi* season, that in addition to *Phalaris minor*, *Polypogon monspeliensis* and *Poa annua* infestation is frequent in fields with higher soil moisture. These weeds were predominant near water channels/moist fields and there were reports of poor control of these weeds with herbicides at farmers' fields. Keeping theses points in mind, pot experiment was conducted at Research Farm, Punjab Agricultural University, Ludhiana to evaluate the efficacy of different herbicides against five biotypes of P. monspeliensis collected from district Moga (vill. Singhan Wala), Ludhiana (vill. Dholan), Sri Muktsar Sahib (vill. Bhagsar), Fazilka (vill. Sahiwala), Fatehgarh Sahib (vill. Khamanon Khurd) of Punjab. Pot experiment was conducted in winter 2022-23, with five post-emergence herbicides namely isoproturon 937.5 g/ha, sulfosulfuron 25 g/ha, pinoxaden 50 g/ha, mesosulfuron plus iodosulfuron 14.4 g/ha and clodinafop-propargyl plus metribuzin 275 g/ha. Control pots of each biotype was also maintained for comparison with treated pots. Earthen pots of diameter 25 cm and height 25 cm were filled with soil and vermicompost in ratio of (2:1). Soil for filling pots were taken from 0-5 cm depth of uncultivated soil. In each pot, 40 seeds of P. monspeliensis were sown in December 2022. Emergence was ensured by keeping the soil moist. Thinning was done to maintain plant population of 20 plants of each biotype per pot before herbicide application. Herbicides were applied in moist pots using knapsack sprayer fitted with flat fan nozzle using 350 litres of water per ha at 3-5 leaves stage of weed. Mortality and biomass were recorded at 30 days after application of herbicides. Clodinafop-propargyl plus metribuzin 275 g/ha and pinoxaden 50 g/ha was found most effective against *P. monspeliensis* with mortality and biomass reduction of 95-99%. In four biotypes, clodinafop-propargyl plus metribuzin and pinoxaden resulted in 100% morality with while pinoxaden recorded 80% morality in case of Sahiwala biotype. Similarly, isoproturon at 937.5 g/ha provided complete control of four biotypes except Dholan where it recorded 57% mortality and 40% reduction in biomass than control. Average over all biotypes, sulfosulfuron 25 g/ha and mesosulfuron plus iodosulfuron 14.4 g/ha recorded <50% mortality and was lowest in Dholan biotype. Therefore, among commonly used post-emergent herbicides in wheat, clodinafop-propargyl plus metribuzin was found most effective followed by pinoxaden and isoproturon for control of *P. monspeliensis*.

Evaluation of efficacy of premix bixlozone 50%WG + metribuzin 10% WG for weed management in wheat

S.P. Singh, Pranjal Sharma*, Kanchan Taragi, Vishal Vikram Singh, Dharmendra Kumar and Manoj Kumar Bhatt

Govind Ballabh Pant University of Agriculture and Technology Pantnagar, Udham Singh Nagar, Uttarakhand 263145, India

**Email: sharmapranjal164@gmail.com*

A field experiment was conducted in *Rabi* 2022 at Norman E. Borlaug, Crop Research Center, G. B. Pant University of Agriculture & Technology, Pantnagar, Uttarakhand to study the efficacy of premix (bixlozone 50% + metribuzin 10% WG) to control *Phalaris minor* and broad leaf weeds in wheat and its effect on succeeding crop. The experiment consisted of 14 treatments, *viz*. premix (bixlozone 50% + metribuzin 10% WG) + safener (500+100) g/ha., premix (bixlozone 50% + metribuzin 10% WG) + safener (625+125) g/ha., premix (bixlozone 50% + metribuzin 10% WG) + safener (750+150) g/ha., premix (bixlozone 50% + metribuzin 10% WG) + safener (875+175) g/ha, premix (bixlozone 50% + metribuzin 10% WG) 500+100 g/ha., premix (bixlozone 50% + metribuzin 10% WG) (625+125) g/ha, premix (bixlozone 50% + metribuzin 10% WG) (750+150) g/ha, premix (bixlozone 50% + metribuzin 10% WG) at (875+175) g/ha, F9600 40% SC + safener 750 g/ha, metribuzin 70% WP + safener 150 g/ha, metribuzin 70% WP 210 g/ha, clodinafop propargyl 12% + metribuzin 42% WG (60+210) g/ha + surfactant at 1250 mL/ha, weed free plot by manual weeding and untreated plot. The experiment was laid out in randomized block design with three replications. The wheat variety '*UP 2568*'was sown on 22/12/2022 and harvested on 25/5/2023. Results revealed that lowest total weed density was recorded in premix (bixlozone 50% + metribuzin 10% WG + safener at (875+175) g/ha, and the highest total weed density was recorded in the untreated plot. No phytotoxicity symptoms were recorded under any dose of premix (bixlozone 50% + metribuzin 10% WG) + safener. Highest net returns and B:C ratio was recorded under premix (bixlozone 50% + metribuzin 10% WG) (750+150) g/ha + safener. Observations recorded on tillers count, plant height and grain yield of rice revealed that premix (bixlozone 50% + metribuzin 10% WG) + safener at 750 + 150 g/ha and 1500 + 300 g/ha applied in preceding wheat crop did not cause any adverse effect on growth development and yield of succeeding rice crop.

Weeds, yield, and economics of wheat are affected by herbicides in Eastern Uttar Pradesh

Ramesh Kumar Dhaka, S.K. Verma, Abhishek Patidar*, Sudhir Kumar Rajpoot, Chandra Bhushan, Neelkamal Mishra, Aishwarya, Amit Yadav, Pawan Kumar Bansal and Vineet Shukla

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: patidarabhishek05@gmail.com*

The productivity of wheat (*Triticum aestivum* L.) in eastern Uttar Pradesh is very low due to the continuous adoption of a cereal-cereal (rice-wheat) cropping system and poor weed control measures. Weed lowers wheat yield by up to 78% if not controlled at the critical crop growth stages. Chemical weed control is a popular practice in this region due to the unavailability of labour and high labour costs. This research was carried out in the winter (*Rabi*) season of 2023-24 at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, to evaluate the effect of herbicides on weeds, yield and economics of wheat in eastern Uttar Pradesh. The experiment was set up in a randomized complete block design with three replications and seven weed control treatments. Six weed species commonly infesting wheat fields were *Phalaris minor*, *Cynodon dactylon*, *Rumex dentatus*, *Chenopodium album*, *Melilotus indica*, *Cyperus rotundus*, and *Anagallis arvensis* including a few minor weeds. The weed density and dry weight were taken at 30 DAS from three randomly selected places using a 50 x 50 cm^2 quadrate. Treatments include weed management practices such as weedy check, weed-free (weeds were removed with the help of hand hoe during entire crop period), metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 2250 mL/ha, metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 3000 mL/ha, metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 3750 mL/ha, metribuzin 70% WP at a rate of 0.25-0.30 kg/ha, and bentazon 480 g/L SL at a rate of 2000 g/ha. The treatment which includes metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 3750 mL/ha recorded the lower weed density and their dry weight, together with higher yield attributes, yield, gross returns, net returns, and cost-benefit ratio of wheat over other herbicidal treatments and it was statistically comparable with metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 3000 mL/ha, metribuzin 70% WP at a rate of 0.25-0.30 kg/ha, and bentazon 480 g/L SL at a rate of 2000 g/ha, respectively. Thus, the ready-mix application of metribuzin (6%) + fenoxaprop-p-ethyl (2.9%) + bentazon (12.9%) at a rate of 3750 mL/ha can be a better option for effective weed management and obtaining better wheat yield in Eastern UP.

Weed infestation in wheat in relation to different rice straw management practices in Punjab

Vivek Kumar* and Karamjit Sharma
Krishi Vigyan Kendra, Punjab Agricultural University, Sri Muktsar Sahib, Punjab 152026, India
**Email: vivek33@pau.edu*

Rice-wheat cropping system is predominant in Punjab and is crucial in meeting the increasing food demand. The widespread adoption of this cropping system and increased agricultural mechanization such as combine harvester have created challenges in managing rice residues, as a significant amount of crop residue is left in the field after rice harvesting. Due to the short window period between rice harvest and wheat sowing, farmers often resort to burning rice residue, which emits harmful gases and contributes to soil degradation. Therefore, in-situ rice residue management is essential. To address this challenge, various wheat sowing methods have been developed, such as the happy seeder, super seeder, smart seeder, zero till drill *etc*., which enable simultaneous sowing of the crop while effectively managing rice straw. Weeds are a major limiting factor in wheat production, leading to substantial yield losses. In the northwest region of the country, *Phalaris minor* is the most common grassy weed, while *Rumex dentatus* is the most prevalent broad-leaved weed. Different rice straw management practices can have varying effects on weed infestation. Weed dynamics are significantly influenced by whether the residue is retained on the surface or incorporated into the soil. Retaining crop residue on the soil surface can inhibit weed seed germination by blocking light, creating a physical barrier to seedling emergence, and modifying soil conditions. Therefore, mulching the soil with crop residues can effectively reduce weed problems by preventing weed seed germination and suppressing the growth of emerging weeds. Keeping these facts in view, an experiment was planned during *Rabi* 2022-23 to study the effect of different rice straw management practices on weed infestation in wheat crop. The experiment was laid out in randomized complete block design with three replications and comprised of nine sowing method treatments, *viz*. Zero till drill, Convetional method, Sowing after incorporation of straw with MB plough, Happy seeder, Mulcher *fb* Happy seeder, Super seeder, Mulcher *fb* Super seeder, Smart seeder, Mulcher *fb* Smart seeder. Wheat variety PBW 766 was sown as per recommended agronomic practices. Pre-emergence herbicide was not applied while premix of Metribuzin plus Clodinafop was applied as post-emergence herbicide. Weed density (no./m2) and weed biomass (g/m2) of major weeds, *viz*. *P. minor* and *R. dentatus* was recorded at 30 (before herbicide application) and 60 DAS. Significantly lower weed density and biomass at both the stages was recorded under Mulching *fb* Happy seeder treatment and these were statistically at par with the treatments (Happy seeder), Smart seeder and Mulcher *fb* Smart seeder. Among all the wheat sowing methods, the highest value of weed density and biomass was recorded with Convectional method followed by treatment Sowing after incorporation of straw with MB plough, Super seeder and Mulcher *fb* Super seeder. It was concluded from the study that *P. minor* and *R. dentatus* infestation was lower in fields with rice residue retention. Therefore, rice residue management can be used as an important integrated weed management component in wheat cultivation.

Beyond the rows with strip-intercropping as a game-changer for weed control in wheat

Mrinal Sen*[1,2], Raj Singh[1], Jainendra Kumar Singh[2], Anchal Dass[1], Subhash Babu[1], Teekam Singh[1] and Ankur Singh[2]

[1]*Division of Agronomy, ICAR- Indian Agricultural Research Institute, Pusa, New Delhi 110012, India*

[2]*Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*

**Email: mrinalsen99@gmail.com*

Wheat (*Triticum aestivum* L.) is second most important cereal crop of India, contributing significantly to the country's food and nutritional security. Wheat based intercropping has been identified very beneficial over sole crops in terms of productivity and profitability. Strip-intercropping is one of the important agronomic strategies of high-intensity cropping systems that help in boosting output per unit area by preserving ecological balance and increasing resource use efficiency. Weed management plays a crucial role in agriculture, as it directly impacts crop yields and, thus, food security. Factors such as climate change, intensive agricultural practices, and herbicide resistance have made weed control more complex, necessitating the adoption of diverse weed management strategies through exploration of plant weed interaction. Effective strategies, such as crop diversification through intercropping, have been shown to suppress weed growth. Therefore, a field experiment was laid out in a strip plot design with seven strip-intercropping treatments in vertical plots and two planting methods in horizontal plots during *Rabi* season of 2021-22 at ICAR-Indian Agricultural Research Institute, New Delhi. The study was carried out to evaluate the effect of different strip-intercropping options and planting methods on weed density, weed dry matter and overall weed growth. Among the strip-intercropping combinations, wheat + mustard (75: 25) strip-intercropping system has the lowest density of grasses and broad-leaved weeds at 40 DAS, which was at par with wheat + chickpea (75: 25) strip-intercropping system. Though in case of sedges, no significant difference was found among the treatments. The total weed density and total weed dry matter at 40 DAS were found to lowest in wheat + mustard (75: 25) strip-intercropping system, which was also statistically similar with wheat + chickpea (75: 25) strip-intercropping system. Highest weed smothering efficiency was found in wheat + mustard (75: 25) strip-intercropping system, followed by wheat + chickpea (75: 25) strip-intercropping system. So, it can be inferred from the present study that both wheat + mustard (75: 25) and wheat + chickpea (75: 25) strip-intercropping system can be great options for effective weed management through exploitation of plant-weed interactions.

Poster 111

To check the efficacy of clodinafop-proporgyl 15% SC along with carfentrazone-ethyl 40% SC against different weed flora in wheat of Mahrajganj, Uttar Pradesh

Shiv Poojan Yadav*, D.P. Singh and Vijay Chandra

Acharya Narendra Dev University of Agricultural and Technology, Kumarganj, Ayodhya, Mahranjganj, Uttar Pradesh 224229, India

**Email: shivpoojanyadav65@gmail.com*

Wheat (*Triticum aestivum* L.) is an important cereal crop. It is a dietary mainstay for approximately one-third of the total world population. Being staple food wheat plays an important role in the economy of India as well as Uttar Pradesh, hence occupies a central position in agricultural policy making. Weeds pose a significant challenge to wheat production, impacting both yield and quality. It is also well documented that in wheat yield losses range from 20% to 40% due to weeds. The management of weeds during critical period (critical period of crop weed competition in wheat is 20 to 40 days after sowing) is very crucial. Krishi Vigyan Kendra, Mahrajganj conducted a participatory rural appraisal survey to identify the major problems of the district and found that wheat yield declines due to infestation of weeds. To tackle the weeds damages Krishi Vigyan Kendra conducted an on-farm trials (OFT) on farmers field during *Rabi* 2022-23 and 2023-24 at different location for the assessment and refinement of weed management technology in wheat (*Triticum aestivum*). The study aimed to assess the efficacy of post-emergence application of clodinafop-propargyl 15% SC 60 g/ha in combination with carfentrazone-ethyl 20% SC 20 g/ha on the dominant weed species, including broadleaf weeds and grassy weeds, under local agro-climatic conditions. The major weed flora observed in the field includes broad-leaved weeds like *Amaranthus viridis* L., *Lathyrus aphaca* L., *Convolvulus arvensis* L., *Rumex dentatus* L., *Chenopodium album* L. and grassy weeds comprises of *Phalaris minor* Retz., *Avena fetua* L. and *Anagallis arvensis* L. Weeds like *Melilotus alba* Desr., *Melilotus indica* (L.) All., *Vicia sativa* L., *Asphodelus tenuifolius* Cav. and *Cirsium arvense* (L.) Scop. are also observed in the field as minor weeds. Results showed that wheat grain yield averaged from all the farmers field shows 26.8% higher in comparison to farmers practices. Weed control efficiency was recorded maximum whereas, weed index was found lowest in herbicide applied treatment in comparison to farmers practices. The combination treatment resulted in a significant reduction in weed density and biomass, leading to an increase in wheat grain yield. This combination effectively controlled both broad-leaf and grassy weeds, providing season-long weed suppression, enhanced wheat yields, and demonstrated the herbicide’s value in improving crop productivity and profitability for farmers. Based on the above findings it can be suggest that the integration of clodinafop-propargyl with carfentrazone-ethyl is a promising weed management strategy for wheat cultivation in Maharajganj, Uttar Pradesh.

Evaluation of new generation herbicide (Lumax) on weed control index, growth and grain yield of hybrid maize

S. Anbarasan[1]*, S. Ramesh[1] and P. Saravanane[2]

[1]*Department of Agronomy, Faculty of Agriculture, Annamalai University Annamalai Nagar, Tamil Nadu 608002, India*

[2]*Department of Agronomy, Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal, Puducherry 609603, India*

**Email: anbumugam10@gmail.com*

Maize (*Zea mays L.*) is an important and versatile cereal grown over diverse environment and geographical ranges for human food, feed and fodder for livestock. The low yield of maize under Indian conditions may be attributed by number of factors, among them weeds rank as prime enemy. Presence of weeds reduces the photosynthetic efficiency, dry matter production and distribution to economical parts and there by reduces sink capacity of crop resulting in poor grain yield. The use of herbicides is the best way which gives a quick and cost-effective solution of the numerous weed problems in maize field and hence has gained an important position over conventional methods. The usage of pre-emergence herbicides has been advocated as the best option because of their ability to control weeds at initial growth stages of crop and also provide a weed competition free environment to ensure better crop establishment in maize. However, the continuous use of single herbicide or herbicides having the same mode of action may lead to resistance problem in weeds. Hence it is necessary to test combination of the existing and new herbicide Lumax, (combination of atrazine, metalachlor and mesotrione), cyanazine, pendimethalin and acetochlor to control mixed weed flora in maize. Field experiment was conducted at the Annamalai University, Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai Nagar to evaluate the lumax and other new herbicides on growth and grain yield of hybrid maize. The experiment was laid out in randomized block design with three replications and nine treatments. The result of the study clearly showed that pre-emergence application of Lumax 440 ZC W/V @ 3.5 lit ha^{-1} on 3 DAS significantly registered lesser weed biomass, maximum weed control Index (WCI), higher growth attributes *viz.*, plant height, LAI, DMP and yield attributes *viz.*, cob length, cob diameter and number of grains cob^{-1}, grain and stover yields of maize. However, it was on par with twice hand weeding at 20 and 40 DAS. Weedy check recorded the higher weed biomass resulting in lesser values of growth and yield attributes and grain yield. From the results of the field study, it can be concluded that application of ready mix pre emergence herbicide Lumax 440 ZC W/V (S-Metolachlor 27.1% + Mesotrione 2.71% + Atrazine 10.2%W/W) @ 3.5 lit ha^{-1} on 3 DAS to hybrid maize was found to be an agronomically sound, economically viable practice and efficient weed management method for augmenting higher grain yield of hybrid maize.

Poster 113

Herbicide based weed management for weed control in maize

B.T. Sinare*, S.V. Yadav, R.P. Andhale and B.T. Shete
Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra 413722, India
**Email: sinarebt69@gmail.com*

The field experiment for weed control in maize with different herbicides was carried out at All India Coordinated Research Project on Maize, Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra (India). The experiment was laid out in Randomized Block Design with three replications. The experiment comprised of eight treatments of weed management *viz*. Tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS, Topramezone 35 g/ha + atrazine 250 g/ha at 20 DAS, Atrazine 1000 g/ha (PE), Pendimethalin 1000 g/ha (PE), Atrazine 750 g/ha + pendimethalin 750 g/ha (PE), Weed free and Weedy check. The maize variety 'Uday (DMR-248)' was dibbled at 75 cm x 20 cm spacing. The gross plot size was 4.50 m x 5.00 m and net plot size was 3.00 m x 4.20 m. The recommended dose of fertilizer was 120:60:40 Kg/ha NPK. The weed flora of the experimental field consisted of monocot weeds like *Cynodon dactylon*, *Dinebra retroflexa*, *Echinochola colona*, *Brachiaria eruciformis* and dicot weeds like *Euphorbia hirta*, *Convolvulus arvensis*, *Commelina benghalensis*, *Amaranthus polygamus*, *Parthenium hysterophorus*, and *Cyperus rotundus* as a sedge. Among the herbicidal treatments, the lowest number of weed population, dry wt. of weeds and weed index were found in application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS and it was at par with topramezone 35 g + atrazine 250 g/ha at 20 DAS. While, weed control efficiency was higher in the in application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS and it was at par with topramezone 35 g + atrazine 250 g/ha at 20 DAS. The growth parameters *viz*., plant height, number of functional leaves, leaf area, leaf area index, dry matter production plant-1 and stem girth and yield contributing characters *viz*. number of cobs plant-1, length of cob, diameter of cob and weight of cob were recorded significantly higher in weed free treatment, however, it was at par with application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS and also application of topramezone 35 g/ha + atrazine 250 g/ha at 20 DAS. The significantly higher grain yield (8.48 t/ha), straw yield (9.72 t/ha) and biological yield (18.20 t/ha) were obtained in weed free treatment while, it was at par with the herbicidal treatment application of tembotrione 120 g/ha + atrazine 250 g/ha and topramezone 35 g/ha at 20 DAS + atrazine 250 g/ha at 20 DAS. Among herbicidal treatment, significantly highest gross monetary returns (Rs.184349/ha) were obtained with application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS and it was at par with application of topramezone 35 g/ha + atrazine 250 g/ha at 20 DAS. The net monetary returns (Rs 127561/ha) were significantly higher in application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS, but it was at par with weed free treatment and application of the topramezone 35 g/ha + atrazine 250 g/ha at 20 DAS. Similarly, the maximum benefit:cost ratio was obtained in the application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS. Hence, under labour constraints condition application of tembotrione 120 g/ha + atrazine 250 g/ha at 20 DAS is suggestive for weed control in maize for higher remuneration.

Poster 114

Biology of *Cyperus esculentus* L. and its management using novel herbicides

Tarun Sharma*, T.K. Das, D. Vijay, Rishi Raj, Prabhu Govindasamy and C.T. Manjunath Prasad

ICAR-Indian Agricultural Research Institute, New Delhi 110 012, India

**Email: tarun.sharma06620@gmail.com*

A long-term conservation agriculture (CA) experiment under maize-wheat system is being undertaken at ICAR-Indian Agricultural Research Institute, New Delhi since 2010. In this system, continuous zero tillage (ZT) with residue has triggered weed flora dynamics and shift from annual to perennial weeds over the years. The most dominating perennial weed observed is *Cyperus esculentus* L., whose biology and management was studied to arrest its growth and proliferation in long-term CA. A study was conducted on the dormancy and germination patterns of the tubers to understand their survivability under field conditions. Further, different herbicides were tested for their effectiveness in controlling this highly menacing weed. The vegetative tubers were sampled from the soil at five different months *viz*., November, February, April, May and June as this period marks the end of the vegetative period and the emergence of a new flush in the field. A varied level of dormancy was observed in the tubers extracted at different months. Temperature has a profound effect on the germination of the tubers. Among the three different temperatures (42, 25 and 20!) studied, maximum germination was noticed at 42!, followed by 25! and 20! in the tubers extracted at five different months. The November collected tubers have maximum dormancy, indicating dormancy induction after the rainy season. The dormancy was released after the tubers got exposed to high temperatures, as observed in the June collection. The after-ripening at 42! has increased the germination rate, confirming the temperature's positive effect on dormancy release. However, the standard dormancy-breaking chemicals, GA_3 and KNO_3, have no impact on tuber germination. After the loss of dormancy, light helped in enhancing the germination rate. Among the several herbicides studied for controlling *Cyprus esculentus L.*, the halosulfuron-methyl 60 g/ha was the most effective. However, under field conditions, the tank mix application of halosulfuron-methyl 30 g/ha + topramezone 25 g/ha showed a more efficient broad-spectrum weed control at 30 days after maize sowing. This could be a novel recommendation for broad-spectrum weed control in maize.

Integrated weed management approach: Combining new-generation herbicides (HPPD-Inhibitor) with Sesbania brown manuring in conservation agriculture for maize-based cropping systems

Sougata Roy*, Kapila Shekhawat and S.S. Rathore
International Potato Centre (CGIAR-CIP), Patna, Bihar
**Email: sougataroy038@gmail.com*

The rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L.) cropping system (RWCS) plays a vital role in global food security, providing essential staples to populations worldwide. Over 85% of RWCS in South Asia is concentrated in the Indo-Gangetic Plains (IGP), with India leading by cultivating 9.2 million hectares, significantly contributing to national food security. However, the productivity and sustainability of RWCS face threats as crop yields plateau and factor productivity declines. Continuous use of a single herbicide for controlling *Echinochloa spp*. in rice has led to the emergence of resistant weeds, including *Leptochloa chinensis*, *Cynodon dactylon*, *Cyperus rotundus*, and *Phalaris minor* in wheat. To address these concerns, an alternative cropping system like maize (*Zea mays*)-wheat (*Triticum aestivum*)-mung bean (*Vigna radiata*) under conservation agriculture (CA) has been proposed. Maize productivity in India (2689 kg/ha) is significantly lower than the global average (5500 kg/ha), largely due to weed interference, particularly in the IGP where post-emergence herbicides are scarce. Tillage modifications affect weed seed dynamics, often concentrating seeds in the topsoil of no-till systems (Mulugeta and Stoltenberg, 1997). Weed competition can reduce maize yields by up to 90%, with reductions ranging from 40% to 80%. Integrated weed management through Resources Conservation Technologies (RCT), such as brown manuring, with new generation herbicide having different mode of action and low application dose (like: tembotrione, HPPD inhibitor) offers an eco-friendly alternative. An experiment was conducted at the ICAR-Indian Agricultural Research Institute in New Delhi during the rainy (*Kharif*) seasons of 2021 and 2022. The study aimed to evaluate the weed control efficiency of low dose new generation herbicide: tembotrione (34.4% SC), with *Sesbania* brown manuring as two components of integrated weed management (IWM) on zero-till (ZT) and conventional till (CT) maize (*Zea mays* L.). The treatments were comprised of conventional tillage maize (M1:CT-M), conventional tillage maize with green manure from preceding green gram (M2: CT-M+GM), zero tillage maize with residue retention at 3 t/ha (M3: ZT-M+R), zero tillage maize with *Sesbania* co-culture as brown manuring (cover crop) (M4: ZT-M+BM) in the main plot and five weed control treatments, *viz* S1: un-weeded check, S2: pre +1 HW, S3: Pre + Post (tembotrione) at 120g/ha, S4: pre + post (Premix of mesotrione + atrazine) at 120 g/ha, S5: weed free check (WFC) in the sub-plots were evaluated in split-plot design. It was observed that ZT-M+BM caused a considerable reduction in the population of broad-leaf weed, narrow leaf weed with sedges and total weeds (28.4% reduction at 60 days after sowing) compared to M1 due to smothering effect of *Sesbania*. The results also revealed that the sequential application of atrazine and pendimethalin at 750g/ha (pre) each followed by (*fb*.) tembotrione (34.4% SC) at 120 g/ha (post) among the herbicide options reduced the weeds population (78.5%) and dry weight (81.3%) significantly than the un-weeded control (UWC). Maize yield attributes were higher in ZT with *Sesbania* co-culture (ZT-M+BM) than conventional-tilled treatments (CT-M). The application of atrazine + pendimethalin at 750 g/ha (pre) *fb* tembotrione at 120 g/ha (post) combined with ZT-M+BM resulting in higher maize yield (6.88 t/ha) which was comparable with that in weed-free check (WFC). The post-emergence application of tembotrione (34.4% SC) at 120 g/ha recorded highest weed control efficiency (86.2%), weed control index (88.1%) and lowest value of weed index (7.04) when applied in the ZT-maize with *sesbania* as a cover crop. Therefore, combining zero tillage (ZT) with brown manure (*Sesbania*), along with atrazine and pendimethalin (at 750g/ha each) as pre-emergence herbicides, and tembotrione (at 120 g/ha) as a post-emergence herbicide is recommended for effective weed control and high maize productivity in the North-Western Indo-Gangetic plains (IGP).

Effect of brown manuring and crop establishment methods on weed dynamics in maize

Sanju Choudhary*, Sudhir Kumar Rajpoot, Ambikesh Tripathi and Saurabh Raj Pandey

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India.

**Email: 98sanjuchoudhary@bhu.ac.in*

Conservation agriculture (CA) can promote sustainable crop intensification. However, weeds are the major constraints under CA, in the initial years. Intensive tillage has increased production costs, lowered productivity, and significantly depleted soil nutrients. Although brown manuring within crop establishment options based maize production system is seldom explored, it is increasingly advocated to tackle problems with soil health, food security, and climate change. This study investigates the effects of brown manuring and different crop establishment methods on weed dynamics in maize cultivation. Brown manuring, involving the incorporation of sesbania, plays a crucial role in enhancing soil fertility and suppressing weed growth through physical competition and allelopathic interactions. A field experiment was conducted to study the effect of conventional tillage (CT) and Conservation tillage with brown manuring on weed dynamics during 2023-24 in maize (*Zea mays* L.) at Agriculture Research farm, Banaras Hindu University, Varanasi. In this study, four establishment methods treatment conventionally tilled ridge and furrow system, conventionally tilled ridge and furrow system with brown manuring, conventionally tilled temporary ridge and furrow system with brown manuring, No till Permanent ridge and furrow system with brown manuring were kept in the main plot and three biostimulants were tested in five subplots. Results showed that population of sedges was significantly reduced at no till permanent ridge and furrow system with brown manuring comparing to treatments. However, population of grasses and broad leaf weeds were found non-significant in all the treatments. Conventionally tilled temporary ridge and furrow system with brown manuring resulted in significantly higher weed biomass compared to other treatments. Tillage modifications affect weed seed dynamics, often concentrating seeds in the topsoil of no-till systems. Integrated weed management through resources conservation technologies such as brown manuring, offers an eco-friendly alternative. Brown manuring, a no-till version of green manuring, uses a selective herbicide (2,4-D) to knock down the legume plants before blossoming, thus contributing organic matter to the soil. BM technique as growing Sesbania alongside the crop for the first 25- 30 days after sowing and then knocking it down with 2,4-D providing up to 35 kg N/ha. The resulting dark brown or yellow Sesbania plants are left in the field to decompose naturally, reducing weed interference through allelopathy or smothering effects.

Effect of new molecule mesotrione 40% SC on weeds and seed yield of fodder maize

A.K Jha*, Gaini Sairam and Pushpendra Yadav
Jawaharlal Nehru Krishi Vishwavidayala, Jabalpur, Madhya Pradesh 482004, India
**Email: amitagcrewa@rediffmail.com*

Maize is commonly cultivated as rainfed crop. Maximum yield loss occurs in the early stages of crop growth from 3-6 weeks before development of enough canopy to smother the weeds (Barla et al 2016). Atrazine is a widely used pre-emergence herbicide in maize crop because of lower cost, controls broad spectrum weeds, flexibility in application time (pre- or post-emergence) and compatibility with other herbicides. However continuous use of the herbicide causes shift in weed flora and development of resistance to herbicides mesotrione inhibits the enzyme called p-hydroxyphenyl pyruvate dioxygenase (HPPD) which show most effective in controlling annual broad-leaved weeds than grassy weeds. A field experiment entitled "Study effect of mesotrione 40% SC on weeds and seed yield of (*Zea mays* L.)" was conducted at Research Farm, AICRP on Forage Crops, Department of Agronomy, JNKVV, Jabalpur (Madhya Pradesh) during *kharif* season of the year 2019-2020. The main objective of the experiment was to find out the effect of application of mesotrione on growth, development and yield of maize. The soil of the experimental field was neutral in reaction (pH 7.21), and medium in organic carbon (0.58%) as well as with medium available nitrogen (285.56 kg/ha), medium available phosphorus (16.59 kg/ha) and medium available potassium (262.66 kg/ha) contents with normal electrical conductivity (0.33 write unit of EC). The total rainfall received during crop season was 1642.30 mm, which was equally distributed in 56 rainy days from June second week to last week of October. Therefore, crop did not suffer due to adverse effect of rains on the crop. As a whole the weather conditions prevailed during the crop season were almost conducive for proper growth, development and yield of maize crop. Eight treatments consisted with pre emergence application of atrazine 1000 g/ha, pendimethalin 750 g/ha and post-emergence application of mesotrione 250 g/ha, mesotrione 300 g/ha, mesotrione 350 g/ha and tembotrione 286 g/ha and hand weeding twice at 20 and 40 DAS and weedy check were tested in a randomized block design with three replications. Sowing of maize cv. African Tall was done on 1st July, 2019 by using the seed rate 20 kg/ha as per treatments in the rows 60 cm apart. A uniform dose of 80 kg/ha N + 40 kg P2O5 + 20 kg K2O ha-1 was applied in all plots. Several weeds severely infested maize in weedy check plot of experimental area. The predominant weeds were *Echinochloa colona* (31.48%), *Commelina communis* (11.48%) , *Digitaria sanguinalis* (11.37%), *Cyperus rotundus* (10.31%) and *Eleusine indica* (7.79%) under monocot weeds and *Phyllanthus niruri* (9.78%) and *Eclipta alba* (9.36%) among dicot weeds and many others minor weeds having small intensity (8.42%) were also present in maize ecosystem at 30 and 60 DAS stages, respectively. In weedy check treatments the total weed population was significantly higher than all the herbicidal treatments mesotrione 250 g/ha, mesotrione 300 g/ha, mesotrione 350 g/ha, tembotrione 286 g/ha, atrazine 1000 g/ha and pendimethalin 750 g/ha. The weed menace was minimum under hand weeding done at 20 and 40 DAS but it was marginal at 60 DAS due to emergence of weeds during later part of crops growth. Among the all herbicides treatments, activity of atrazine 1000 g/ha and pendimethalin 750 g/ha was not well marked against most of weeds but remaining herbicides application of mesotrione 250 g/ha, mesotrione 300 g/ha, mesotrione 350 g/haand tembotrione 286 g/ha controlled most of the associated weeds. The grain (2803 kg/ha) and stover (22528 kg/ha) yield were maximum with hand weeding twice at 20 and 40 DAS, which were comparable between to those obtained with the post-emergence application of mesotrione 350 g/ha (244 kg/ha and 21804 kg/ha of gain and Stover yields respectively).

Weed dynamics and yield of maize-mustard-green gram cropping system under tillage and weed management practices

Todar Mal Poonia*, Ankur Chaudhary, Kautilya Chaudhary and Ajay Kumar
Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana 125004, India
**Email: todarmal.poonia6@gmail.com*

Rice-wheat (RW) cropping system is a major cropping system in north-west Indo-Gangetic Plains, although providing food security in the country, has also led to soil degradation and over exploitation of underground water resources. The diversification of RW with maize-based systems and alternate soil and crop management practices could help enhance the system productivity, sustain soil health, environmental quality, save irrigation water and labour costs. Weed's infestation is one of the most important yield-limiting factors in maize and other crops. Keeping this in view, the present study was carried out to study weed dynamics and yield of maize-mustard-green gram cropping system under tillage and weed management practices during 2022-23 and 2023-24 at Research Farm, Department of Agronomy, CCS Haryana Agricultural University, Hisar under irrigated conditions. The experiment was carried out in split plot design with three replications consisted of four tillage and residue management options for maize-mustard-green gram under main plots, while four sub plots as HR (herbicide rotation), IWM (integrated weed management), weedy check and weed free. The results showed that main plot treatments (tillage and residue management) significantly influence the density of *Cyperus rotundus* while the density of *Echinochloa colona* and *Dactyloctenium aegyptium* did not differ significantly in maize during *Kharif* 2022. Application of atrazine (1000 g/ha) *fb* post-emergence (PoE) topramezone 25.2 g/ha significantly reduced the weed density compared to weedy check. Yield attributes were at par in conventional and zero tillage with and without residue. The same treatment resulted in 72% higher kernel yield as compared to weedy check treatment. Mustard and green gram yields were at par with CT and ZT with and without residue. However, pendimethalin *fb* hand weeding resulted in higher seed yield (2.2 t/ha) which was at par with pendimethalin *fb* pinoxaden (2.1 t/ha) but significantly higher than weedy check (1.7 t/ha) treatment in mustard. Similarly, seed yield of summer green gram, application of pendimethalin *fb* hand weeding resulted in 59.5% higher seed yield as compared to weedy check. In *Kharif* maize (2023), the density of *C. rotundus*, *E. colona* and *D. aegyptium* was significantly lower in conventional tillage as compared to zero tillage. Yield was at par in conventional and zero tillage with and without residue. Atrazine (1000 g/ha, PE) *fb* topramezone (25.2 g/ha, PoE) *fb* hand weeding resulted in 53.9% and pyroxasulfone (127.5 g/ha, PE) *fb* tembotrione (120 g/ha, PoE) 52.3% higher yield as compared to weedy check.

Poster 119

Effect of herbicides on growth and yield of maize

Himanshu Kuldeep*[1] and Arvind Verma

[1]Department of Agronomy, RCA, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India

**Email: kuldeephimanshu99@gmail.com*

Weeds significantly impact maize crop productivity, as they compete with maize plants for essential resources like nutrients, water, light, and space. This competition can severely hinder maize growth and development, leading to substantial losses in crop yield. Global reports estimate a 37% reduction in maize production due to weed infestations. Given this, effective weed management has become a priority for farmers, with various methods available to control weed populations. Among these, chemical weed control using herbicides has become the most prevalent approach in recent times. The increasing reliance on herbicides is driven by economic factors, as chemical methods are often seen as cost-effective and labor-saving. Herbicides provide efficient weed control over large areas and reduce the need for manual labor, which is both time-consuming and expensive. Surveys indicate a growing interest in chemical weed control globally, as farmers seek to maximize production with minimal input costs. Herbicides, when applied correctly, can offer quick and effective results, contributing to higher maize yields by eliminating weeds that would otherwise compete with the crop. However, despite the initial benefits, the overuse of herbicides poses long-term environmental risks. Continuous and excessive herbicide application can lead to several adverse effects, including soil degradation, reduced soil fertility, and the development of herbicide-resistant weed species. This over-reliance on chemical methods is market-driven, yet unsustainable in the long run. The reduction in soil productivity and the environmental damage caused by herbicides has led to a growing call for more sustainable and integrated weed management practices. Reports suggest that no single method of weed control is entirely effective for maize crops. Therefore, integrated weed management (IWM) is being increasingly recommended. IWM combines various methods, including chemical, biological, and mechanical approaches, to achieve better weed control. The use of biological methods, such as introducing natural weed predators or pathogens, has garnered significant academic and research interest in recent years. Biological control methods offer a more sustainable alternative to chemical herbicides by reducing the environmental impact and maintaining soil health over time. Weed control practices have shown substantial improvements in maize yield. Studies indicate that effective weed management can result in a 77% to 96.7% increase in grain yield compared to untreated, weedy conditions. While manual weeding is popular among farmers, it is labor-intensive, costly, and time-consuming. On the other hand, herbicides, when applied pre- and early post-emergence, provide efficient weed control throughout the growing season. Research and development in herbicide technology have opened new opportunities for chemical weed management in maize. In conclusion, while herbicides play a critical role in maize weed management and yield improvement, their long-term effects on soil health and the environment necessitate a shift toward more integrated and sustainable practices. Efficient weed control, along with proper nutrient management, is crucial for enhancing maize productivity and ensuring long-term agricultural sustainability.

Effect of herbicides on weeds, seed yield and soil-microbiome of *Rabi* fodder maize in Eastern plain zone

Abhishek Singh*, Pratik Sanodiya and Aishwarya
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: abhisheksinghagro@bhu.ac.in*

Maize (*Zea mays* L.), a globally significant crop, serves multifaceted roles in food, feed, nutritional, bioenergy security and environmental sustainability. Its nutritional richness, high digestibility and palatability with suitability for silage production makes it a vital component of animal feed, enhancing livestock productivity. Fodder maize, known for its low seed yield due to its nature as a 'shy seeder' crop, faces additional challenges from weed competition, which further reduces yield. To address this issue, herbicides due to their high efficiency, economic viability and ease of application have emerged out to be the most preferred tool in present-day agriculture. Herbicides boost farm income, but at the cost of ecological functioning. In today's world, microbial population in soil is the index of agricultural prosperity. Soil harbours an array of microbes responsible for naturally renewing soil fertility, as well as executing other important functions. It is now apparent that use of these herbicides not only has unforeseen impact on the environment but also severely impacts our soil microflora. A field experiment was conducted at Agricultural Research Farm, Banaras Hindu University, Varanasi, Uttar Pradesh in *Rabi* 2023, to evaluate the effect of pre- and post-emergence herbicides on soil microbial population, enzymatic activity, weeds and seed yield. The experiment utilized a randomized block design, comprising twelve treatments with three replications. Weed density, dry weight and weed control efficiency (WCE) were recorded at 50 DAS, using a 100 cm x 100 cm quadrate to measure two randomly selected spots within the net plot area. The major weeds encountered were *Cyperus rotundus* in sedges, *Cynodon dactylon* and *Polypogon monspeliensis* among grasses, *Chenopodium album*, *Physalis minima*, *Solanum nigrum* and *Rumex dentatus* among dicot weeds. Soil samples were collected after harvest and analysed for soil microbial population, *viz*. bacteria, fungi, actinomycetes and soil enzymatic activity, *viz*. dehydrogenase, urease, alkaline phosphatase and soil microbial biomass carbon. At 50 DAS, (pyroxasulfone 127g/ha + Hand weeding at 25-30 DAS) recorded statistically lesser weed density and dry weight as compared to all other treatments except weed free. Similar trend of higher weed control efficiency (WCE) of 93.97%, weed index (WI) of 5.16 and yield 3.94 t/ha was observed in Soil analysis showed that the highest microbial population, *viz*. bacteria (74 cfu×105/g soil), fungi (66 cfu×104/g soil), actinomycetes (90.6 cfu×104 /g soil) were observed in (Weedy check) followed by (Weed free), Amongst herbicidal treatment (Pyroxasulfone 127g/ha + Hand-weeding at 25-30 DAS) was at par with weed free plot. Similar trend was visible for soil enzymatic activity, *viz*. dehydrogenase activity (ìg TPF/g soil/24 h), Urease activity (ìg UH/g soil/h), alkaline phosphatase activity (ìg p-NP/g soil/h) while microbial biomass carbon (ìg/g) was found highest in (Weedy check) *fb* which was at par with (Weed free). Thus, treatment (pyroxasulfone 127g/ha + Hand-weeding at 25-30 DAS) can be a better option for effective weed management and obtaining higher seed yield in *Rabi* fodder maize in Eastern plain zone.

Poster 121

Integrated weed management: The best approach for controlling weeds and achieving highest yield of maize

Rishika Hada* and Niharika Shekhawat
RNT College of Agriculture, Kapasan, Chittorgarh, Maharana Pratap University of Agriculture and Technology, Rajasthan 312202, India
Email: 2rishikahada5@gmail.com

A field study was conducted on weed management in maize during *Kharif*- 2024 under guidance of the scientists of *Krishi Vigyan Kendra*, Rajasmand at farmers' fields in Dhoinda village of Rajasmand district (Raj). During Rural Agriculture Work Experience (RAWE), a village Dhoinda of Rajasmand district was allotted for study. A survey was made in the village for this study. Maize growers of the village Dhoinda were divided in three groups, *viz*. 1. Farmers were using herbicide for weed control in maize, 2. Farmers were using herbicide *fb* one hand weeding or mechanical weeding at 30 days after sowing for weed control in maize, and 3. Farmers were not applying any weed control measures in maize crop. Soil of the village under study was sandy loam having organic carbon 0.5%, pH 8.1 and medium in NPK content. Sowing of maize seed was done by farmers from 15th June, 2024 to 25th June, 2025. Seed rate, fertilizers, plant protection measures, irrigation etc. were applied by farmers as per package of practices of the district. Study on weed density and weed dry matter was made at stage of 50 days after sowing of maize crop under the guidance of KVK scientist by using 1m x 1m size quadrate. Minimum density of sedges, narrow and broadleaved weeds was recorded in fields of 2nd group of farmers where herbicide *fb* one hand weeding or mechanical weeding at 30 days after sowing was applied by farmers. Maximum population of sedges, narrow and broadleaved weeds was recorded in fields of 3rd group of farmers where any weed control measures were not applied by farmers. Similar trend as weed density was also recored for weed dry matter. Maximum weed biomass/m^2 was recorded in fields of 3rd group of farmers where any weed control practices were not applied by the farmers, whereas, minimum weed dry matter/m2 was recorded in fields of 2nd group of farmers where herbicide *fb* one hand weeding or mechanical weeding at 30 days after sowing was applied by farmers. Highest yield of maize was also obtained in fields of 2nd group of farmers where herbicide *fb* one hand weeding or mechanical weeding at 30 days after sowing was applied by farmers, whereas, lowest yield of maize was obtained in fields of 3rd group of farmers where any weed control practices were not applied by the farmers. On the basis of findings of the study, it can be concluded that, the integrated weed management practices *i.e*. herbicide application *fb* manual weeding or mechanical weeding may be the best approach for controlling weeds in maize crop and achieving the highest yield of maize.

Weed management in fodder maize

H.K. Patel*, P.H. Rathod and N.S. Litoriya
Anand Agricultural University, Anand, Gujarat 388110, India
**Email: hirenubi@gmail.com*

Maize (*Zea mays* L.) is one of the most important cereal crops plays a pivotal role in agriculture economy both as food for man and feed for animals. The loss of yield due to weed in maize varies from 28 to 93%, depending on the type and intensity of weed flora and duration of crop weed competition (Sharma and Thakur, 1998). To minimize losses due to weeds, several methods are available such as mechanical, cultural, biological and chemical. A Field experiment on "Weed Management in Fodder Maize was carried out at Main Forage Research Station, Anand Agricultural University, Anand during *Kharif* season 2019 and 2020 with objective of the study the associated weed flora and identify suitable dose of new post-emergence herbicides for optimum growth, green forage yield and returns in fodder maize. There was total ten treatments along with hand weeding and weedy check treatment, experiment was laid out in randomized block desing with three replications under sandy loam soil. Application of topramezone + Atrazine 35 g + 250 g or tembotrione + atrazine 120 g + 250 g at 20 DAS to forage maize recoded higher weed control efficiency, along with higher plant population, comparative good growth and yield attributing characteristic like periodical plant height, number of leaves per plant as well as green fodder yield, after harvest fresh dry matter content, crude protein, dry matter yield, crude protein yield as well as leaf stem ratio.

Effect of pre- and post-emergence herbicide on weeds, productivity and economics of *Kharif* Maize in eastern plain zone of Uttar Pradesh

Pawan Kumar*, Pratik Sanodiya, Riju Pratap Singh and Neelkamal Mishra

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: pawancpsbansal@gmail.com*

Weeds are an important factor in the management of all land and water resources, but its effect is greatest on agriculture. The losses caused by weeds exceed the losses caused by any other category of agricultural pests. Of the total annual loss in agriculture produce, weeds account for 45% and leading to reduced crop yield of 31.5% (36.5% in *Kharif* seasons), besides deteriorating quality of produce and causing health and environmental hazards. The total economic losses will be much higher, if indirect effects of weeds on health, losses of biodiversity, nutrient depletion, grain quality, *etc*. are taken into consideration. Global climate change, shifting weather patterns, and the excessive use of single-mode action herbicides have led to severe weed infestation problems in maize crops. Effective weed management in maize is vital for sustained production and productivity, which is crucial for India's leadership in maize cultivation. Weeds continue to pose a greater threat to maize production in the eastern part of Uttar Pradesh. Despite several methods of weed management, chemical weed control in maize is still the most sought-after measure. The changing global climate scenario has resulted in weed flora shifts, poor efficacy of herbicides, changes in cropping systems, *etc*. This warrants the need for novel herbicides which can control weed population efficiently in *Kharif* maize. To evaluate the effect of pre and post-emergence novel herbicides in *Kharif* maize in eastern U.P. a field experiment was conducted at, Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif* 2023, comprising twelve treatments with three replications in randomized block design. The observations on weed density, dry weight, and growth parameters were taken at 25, 50 and at harvest and, 25, 45, and 65 DAS respectively from two randomly selected spots from net plot area by using a quadrate of 100 cm x 100 cm. Results revealed that, among the herbicidal treatments, pyroxasulfone127g/ha as pre-emergence + handweeding at 25-30 DAS resulted in lesser number of weed count and weed dry matter than the rest of the herbicides. Among the herbicidal treatments, higher weed control efficiency at 25, 50 DAS and at harvest 91%,96% and 90% respectively, lower weed index (4%), maximum growth and yield attributes were recorded in pyroxasulfone127g/ha pre-emergence + handweeding at 25-30 DAS. Pyroxasulfone 127g/ha pre-emergence + handweeding at 25-30 DAS (5.6 t/ha) proved as effective as weed-free treatment (5.8 t/ha) and recorded significantly higher grain and straw yields (7.8 t/ha) and lower cost of production (37292 Rs./ha) with net monitory returns of 120741.81 Rs./ha and B-C ratio of 3.24. This research comprehensively evaluates different herbicide classes, offering valuable insights for optimizing weed management strategies in *Kharif* hybrid maize cultivation.

Poster 124

Effect of novel herbicides on weeds and productivity of *Rabi* fodder maize in Varanasi

Abhishek Singh, Pratik Sanodiya and Aishwarya*
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesha 221005, India
**Email: aish260198@gmail.com*

Fodder maize (*Zea mays*), commonly referred to as a 'shy seeder crop' because of its reduced seed yield, is a significant fodder crop. Weeds, on the other hand, greatly hinder its cultivation since they compete with it for water and nutrients. Effective weed management is critical for increasing maize production, and a combination of novel herbicides is frequently used to promote optimal growth. The variability that may arise from mechanical or manual weeding is minimized by chemical control methods, which provide consistent and dependable results. Although manual methods may overlook weeds or fail to eradicate deep-rooted species, herbicides offer targeted action against a wide range of weed types. Integrating herbicides into the weed control approach enables farmers to optimize fodder maize production, thus assuring a more stable and profitable crop. The chemicals examined in the study include atrazine, which obstructs photosystem II, thereby restricting energy synthesis and eradicating weeds. Pyroxasulfone inhibits fatty acid production, thereby stunting seedling development. Halosulfuron methyl inhibits acetolactate synthase, preventing the synthesis of essential amino acids and resulting in plant mortality. Tembotrione, topramezone, and mesotrione inhibit HPPD, disrupting carotenoid synthesis, leading to chlorophyll degradation, leaf chlorosis, and ultimately plant death. The objective was to identify effective weed management strategies utilizing novel herbicide combinations to reduce weed competition and improve crop yield. This research was carried out in the winter (*Rabi*) season of 2023-24 at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh, to evaluate the effect of novel herbicides on weeds and productivity of *Rabi* fodder maize (*Zea mays* L.) in Varanasi. The experiment adopted a randomized complete block design comprising three replications and twelve treatments. Seven weed species frequently observed in *Rabi* fodder maize fields are *Polypogon monspeliensis, Cynodon dactylon, Rumex dentatus, Chenopodium album, Physalis minima, Cyperus rotundus,* and *Solanum nigrum*, in addition to various miscellaneous weeds. Pyroxasulfone 127 g/ha + hand weeding at 30 DAS resulted in lower weed density, dry weight, and weed index, alongside higher weed control efficiency, weed control index, and yield, which were statistically at par with atrazine 500 g/ha + hand weeding at 30 DAS. At the same time, atrazine 500 g/ha *fb* halosulfuron methyl 67 g/ha at 30 DAS showed higher weed density, dry weight, and weed index, along with lower weed control efficiency, weed control index, and yield, which were statistically comparable to pyroxasulfone 127 g/ha *fb* halosulfuron methyl 67 g/ha at 30 DAS. Thus, pyroxasulfone 127 g/ha + hand weeding at 30 DAS offers a better choice for effective weed management in *Rabi* fodder maize in Varanasi.

Poster 125

Effect of different doses of pre-and post-emergence herbicides on weeds, productivity, soil microbiome and economics of *Kharif* hybrid maize in Varanasi

Neelkamal Mishra*, Pratik Sanodiya and Abhishek Patidar
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesha 221005, India
**Email: neelkamalmishra010@gmail.com*

Maize is a versatile cereal crop, widely grown for food, feed, and industrial products. It thrives in diverse climates and supports global agriculture. Weeds pose a significant threat to both cropped and non-cropped ecosystems. Despite various weed management methods, chemical control remains the most preferred. Pre- and post-emergence herbicides provide an efficient and cost-effective solution, especially during critical crop competition, making it more practical than costly manual or mechanical weeding. They also affect soil microbes, essential for nutrient cycling and soil health. Varying herbicide doses can alter microbial diversity and activity. While moderate doses are less harmful, higher doses can reduce microbial populations, impacting soil fertility and crop productivity. A field experiment was conducted at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif* 2022 to study the relative efficacy of herbicides on weed control, crop growth, yield, and soil enzymes activity (dehydrogenase, alkaline phosphatase and microbial biomass carbon) in *Kharif* hybrid maize. The experiment comprised nine treatments: atrazine 1.0 kg/ha *fb* one hand weeding 20 days after sowing (DAS); atrazine 1.0 kg/ha *fb* topramezone; atrazine 1.0 kg/ha *fb* halosulfuron; atrazine 1.0 kg/ha *fb* tembotrione; atrazine 0.5 kg/ha *fb* topramezone; atrazine 0.5 kg/ha *fb* halosulfuron; atrazine 0.5 kg/ha *fb* tembotrione; manual weeding 20 and 40 DAS and weedy check with three replications in randomized complete block design. The observations on weed density and dry weight, and growth parameters were taken at 15, 30, 45 and 60 DAS and at harvest and, 30, 45, 60 DAS and at harvest, respectively from two randomly selected spots from net plot area by using a quadrate of 100 x 100 cm^2, and soil enzyme activity at the time of harvest. Results revealed that among the herbicidal treatments, atrazine 1.0 kg/ha *fb* topramezone 25 g/ha PoE at 25 DAS produced less weed count and weed dry matter, maximum growth and yield attributes, and optimum soil enzyme activity, dehydrogenase (13.72 µg of TPF released/g soil/24 hour), alkaline phosphatase (106.29 µg PNP released/g soil/h) and microbial biomass carbon (180.41 MBC µg/g) compared to the other treatments. It also recorded a lower weed index (16.79%) and yield (4.82 t/ha), proving to be nearly as effective as the weed-free treatment (5.79 t/ha), with a net monetary return of Rs.71,346/ha and a B-C ratio of 2.89. Thus, atrazine 1.0 kg/ha *fb* topramezone 25 g/ha PoE 25 DAS offers a better choice for effective weed management, yield and soil microbes in hybrid maize in Varanasi. Future studies should explore sustainable herbicide practices that protect soil enzymes, ensuring microbial diversity and maintaining crop productivity.

Poster 126

Plant growth promoters and herbicides on the performance of *Kharif* hybrid maize

Shravan Kumar Maurya*[1], V.K. Verma[2], Dinesh Sah[3], Shikhar Verma[4] and Devrani Gupta[5]

[1,2,4]*Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208002, India*

[3,5]*Department of Agronomy, Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India*

**Email: shravan419maurya@gmail.com*

A field experiment was conducted during two consecutive *kharif* seasons 2022 and 2023 at Students' Instructional Farm, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, (U.P.) - 208002 India. The experiment was laid out in split plot design with three replications. Three plant growth promoters [*viz*. gibberellic acid (P1), cytokinin + enzymes (P2) and amino acid + humic acid + sea weed extract (P3)] were allocated in main plots; whereas six herbicidal treatments [*viz*. weedy check (W1), tembotrione 42% SC 120 g/ha (W2), halosulfuron-methyl 75% WG 72 g/ha (W3), topramezone 33.6 SC 25.2g/ha (W4), atrazine 50%WP 1.0 kg/ha (W5) and mesotrione 2.27%W + atrazine 22.7% SC 750 mL/ha (W6)] were setup in sub plots. On the pooled basis of two years experimental results showed that, application of amino acid + humic acid + sea weed extract (P3) recorded significantly highest value of plant height (208.22 cm), crop growth rate (47.54 and 9.96 g/m^2/day at 60 - 90 DAS and 90 DAS - harvest stage, respectively), relative growth rate (0.1029, 0.1052 and 0.0825 g/g/day at 30 - 60 DAS, 60 - 90 DAS and 90 DAS - harvest stage, respectively), length of cob (18.56 cm), number of grains/cob (574.01), grain yield (6835.95 kg/ha) and harvest index (34.26). However, among herbicidal treatments, Tembotrione 42% SC 120 g/ha (W2) was recorded significantly maximum weed control efficiency (85.86% at 75 DAS) plant height (216.59 cm), leaf area (5226 cm^2) crop growth rate (43.45, 48.77 and 10.26 g/m^2/day at 30-60 DAS, 60-90 DAS and 90 DAS-harvest stage, respectively), relative growth rate (0.1037. 0.1053 and 0.0829 g/g/day at 30 - 60 DAS, 60-90 DAS and 90 DAS-harvest stage, respectively) and net assimilation rate (5.65 g/m^2/day at 30 - 60 DAS), length of cob (18.56 cm), number of grains/cob (574.01), grain yield (6835.95 kg/ha) and harvest index (34.26).

Efficacy of fertigation levels and weed management practices on weed flora and yield of maize

Pooja. P. Mane*[1], J.P. Deshmukh[1], A.A. Patil[1], V.V. Goud[1] and G.V. Mitkar[2]

All India Co-ordinated Research Project on Weed management, Department of Agronomy,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India
**Email: poojaprakashrao05@gmail.com*

This study comprehensively explores the productivity and economics of maize under different fertigation levels and weed management practices at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during the *kharif* season of 2021. Employing a split-plot design, we meticulously evaluated twenty treatments encompassing various fertigation levels (75%, 100%, and 125% of the recommended nitrogen and potassium), were compared with 100% RDF as soil application, however p was applied as basal dose along with five distinct weed management strategies: ; (W2) atrazine (0.75 kg/ha) pre-emergence followed by topramezone (0.0252 kg/ha) post-emergence 20 days after sowing; (W3) atrazine (0.75 kg/ha) pre-emergence followed by halosulfuron-methyl (0.052 kg/ha) post-emergence 20 days after sowing; (W4) farmer practice (two hoeing's at 15-20 day intervals followed by two hand weeding's); and (W5) a weedy check. In case of fertigation levels, the highest weed control efficiency and weed index were recorded under drip fertigation with 125% RDNK in 5 splits followed by 100% RDNK in 5 splits. In case of weed management practices, highest weed control efficiency and lowest weed index were observed in (W4) farmer practice (two hoeings at 15-20-day intervals followed by two hand weedings and in chemical weed management atrazine (0.75 kg/ha) pre-emergence followed by topramezone (0.0252 kg/ha) post-emergence 20 days after sowing. Results clearly showed fertigation 125% RDNK significantly recorded higher grain yield (q/ha) straw yield (q/ha) and biological yield (q/ha) followed by 100% RDNK. However, 100% RDF through soil application and fertigation of 75% RDNK found to be on par with each other. Among the weed management practices, significantly higher yield parameters recorded in (W4) farmer practice (two hoeings at 15-20-day intervals followed by two hand weedings). However, among the chemical weed management practices (W2) atrazine (0.75 kg/ha) pre-emergence followed by topramezone (0.0252 kg/ha) post-emergence 20 days after sowing showed its significance over (W3) atrazine (0.75 kg/ha) pre-emergence followed by halosulfuron-methyl (0.052 kg/ha) post-emergence 20 days after sowing and treatment (W5) weedy check recorded lowest but closely followed by (W1) atrazine (0.75 kg/ha) pre-emergence followed by tembotrione (0.120 kg/ha) post-emergence 20 days after sowing .The study recorded the highest gross monetary return (¹ 213,290/ha) associated with the farmer practice (W4), with optimal net monetary returns (Rs. 144,789/ha) achieved through 125% RDNK via fertigation. In conclusion, the application of 125% of the recommended nutrients through fertigation, paired with strategic weed management by using herbicide atrazine 0.75 kg/ha pre-emergence followed by topramezone (0.0252 kg/ha) post-emergence 20 days after sowing, maximizes maize yield and economic returns, making it the ideal choice for maize growers.

Impact of long-term fertilization on herbicide dynamics in maize-finger millet systems: a study of bensulfuron-methyl and tembotrione

P. Janaki*, Mahesh Rewar and Yerra Pavani

Department of Soil Science & Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India

**Email: janakibalamurugan@rediffmail.com*

In modern agriculture, herbicides are vital tools for weed control. In Tamil Nadu, managing weeds in maize-finger millet systems using tembotrione and bensulfuron-methyl as early post-emergence herbicides is common. However, herbicide dynamics in soil and their efficacy can be affected by different fertilization practices. This study, conducted at Tamil Nadu Agricultural University, Coimbatore, aimed to assess the impact of long-term fertilization practices on the behavior of these herbicides in soils cultivated with maize and finger millet for 50 years. Soil samples were collected from plots with various long-term fertilization treatments: (50% NPK), (100% NPK), (150% NPK), (100% NPK + hand weeding), (100% NPK + Zn), (100% NP), (100% N), (100% NPK + FYM), (100% NPK (S)), and (control). These samples were used in leaching column and sorption experiments to evaluate the movement and retention of bensulfuron-methyl and tembotrione, applied at two different rates. Herbicide residues were analyzed using high-performance liquid chromatography (HPLC), and the data were used to understand how different fertilization practices influenced herbicide dynamics. Results showed that long-term fertilization practices and herbicide application rates significantly affected their leaching and sorption behaviours. Bensulfuron-methyl residues were detected at all soil depths, increasing with depth and dose, indicating that it is prone to leaching, particularly in alkaline soils. Residue concentrations in the 0–15 cm, 15–30 cm, and 30–45 cm depths ranged from 0.019–0.038 mg/kg, 0.069–0.095 mg/kg, and 0.133–0.156 mg/kg at the X dose, and 0.032–0.041 mg/kg, 0.081–0.119 mg/kg, and 0.182–0.215 mg/kg at the 2X dose. Among the fertilization treatments, 100% NPK + FYM retained the most bensulfuron-methyl. Tembotrione showed a different behavior, with more than 50% of its residue retained in the surface layer (0–15 cm). Residue distribution was 57%, 37%, and 6% at the 60 g/ha dose, and 58%, 29%, and 14% at the 120 g/ha dose, indicating that tembotrione is a low-to-moderate leacher. According to the USEPA (2007), its low adsorption in soil (Koc = 14) explains its moderate leaching potential. Sorption studies revealed that both herbicides exhibited higher sorption under the 100% NPK + FYM treatment, followed by the 150% NPK and 100% NPK + Zn treatments. Sorption coefficients (Kd) ranged from 2.13 to 7.98 for bensulfuron-methyl and 3.22 to 13.88 for tembotrione, with higher Kd values for tembotrione, suggesting it leaches less than bensulfuron-methyl. The study concluded that applying 100% NPK with FYM at 10 t/ha reduces herbicide leaching and increases sorption, helping prevent contamination of water bodies and persistence in soil. Therefore, these herbicides should be applied at recommended levels, and the use of FYM can mitigate their environmental impact.

Weed smothering efficiency of cover crops and their effect on growth and yield of *Rabi* maize

Swapna S. Hittalamani and S. Rajkumara*
Department of Agronomy, University of Agricultural Sciences Dharwad, Karnataka 580005, India
**Email: rajkumars@uasd.in*

Maize (*Zea mays* L.) is one of the major cereal crops of India with an area of 10.04 mha with the production of 33.62 mt at an average productivity of 3.35 t/ha in the country (DACNET 2022). It is gaining popularity in all the seasons and growing conditions. Assured high yielding ability, ease in handling and better price are some factors for its popularity. Though maize is a widely spaced and highly competitive crop to combat weed menace; continuous cultivation and prevalence of weeds has resulted in greater use of herbicides. Mechanical intercultivation is the chief method of weed management along with the use of herbicides in recent years. Combining herbicides with cover crops not only reduces the weeds also has a potential to reduce the use of herbicide. Cowpea and sunhemp crops as smother crops were tried with mulching either at 30 DAS or 45 DAS along with pendimethalin at 0.75 and 1 kg in *Rabi* maize under protective irrigation. Weed smothering efficiency of both cowpea and sunhemp was higher when mulched at 45 DAS than at 30 DAS. The efficiency did not differ at 20 DAS. Sunhemp mulching at 45 DAS resulted in higher weed smothering of 73.1% at 60 DAS. This was closely followed by cowpea mulching at 45 DAS. This may be due to higher fresh biomass production. Significantly higher fresh biomass was observed in maize + sunhemp (1:2) and mulching of sunhemp at 45 DAS (20 t ha-1). This was on par with maize + cowpea (1:2) and mulching of cowpea at 45 DAS (14.9 t/ha). Lower fresh biomass was recorded in cowpea and sunhemp mulching at 30 DAS. Significantly higher fresh biomass was recorded in maize + sunhemp (1:2) and mulching of sunhemp at 45 DAS with pendimethalin 1 kg (22.7 t/ha). While, lower fresh biomass was observed in sunhemp mulching at 30 DAS with pendimethalin 0.75 and 0.5 kg/ha (5.2 and 5.2 t/ha) and it was on par with cowpea mulching at 30 DAS with pendimethalin 1 kg (6.0 t/ha). This further resulted in higher dry matter in sunhemp mulching at 45 DAS. Cover crops were highly competitive with maize though they were effective in reducing the weed density, dry matter of weeds and herbicide rates. Significantly higher grain yield (5.03 t/ha) was recorded in maize + cowpea (1:2) and mulching of cowpea at 30 DAS and was on par with maize + cowpea (1:2) and mulching of cowpea at 45 DAS (4.93 t/ha). Pre-emergence application of pendimethalin 1 kg recorded higher grain yield (5.1 t/ha). This was on par with pendimethalin 0.75 kg (4.96 t/ha). Cowpea and sunhemp cover crops with mulching at 30 DAS with reduced pendilethalin 0.75 kg application has the potential to yield higher yields.

Poster 130

Effect of IWM practices on growth and yield of *Rabi* maize

V.G. Bavalgave*, J.D. Thanki and V.P. Usadadiya
Department of Agronomy, Navsari Agricultural University, Navsari, Gujarat 396450, India
**Email: vgbavalgave@gmail.com*

A field experiment was conducted during rabi-2017, 2018 and 2019 at Instructional farm, Department of N. M College of Agriculture, N. A. U., Navsari, Gujarat. The soil of the experimental site clayey in texture and PH was high (7.8). The soil was low in available nitrogen (199 kg/ha), medium in available phosphorus (52 kg/ha) and high in available potassium (481 kg/ha). The study consisted ten weed management practices *viz*. weedy free (T1), weedy check (T2), two HW and two IC at 20 and 40 DAS (T3), atrazine 1.0 kg/ha PE + Hand weeding at 40 DAS (T4), atrazine 1.0 kg/ha PE + interculture at 40 DAS (T5), Atrazine 1.0 kg/ha PE + 2,4-D amine 0.5 kg/ha PoE at 40 DAS (T6), wtrazine 1.0 kg/ha PE + halosulfuron methyl 65g/ha PoE at 40 DAS (T7), Atrazine 1 kg/ha PE + Halosulfuron methyl 130 g/ha PoE at 40 DAS (T8), Atrazine 1 kg/ha PE + (halosulfuron methyl 65 g/ha + 2,4-D amine 0.5 kg/ha PoE as tank mixture at 40 DAS) (T9), Atrazine 1 kg/ha PE + (halosulfuron-methyl 130 g/ha + 2,4-D amine 0.5 kg/ha PoE as tank mixture) at 40 DAS (T10). These treatments were replicated three times in a randomized block design. The highest weed control efficiency (95.88%) was recorded with T3 (Two HW and two IC at 20 and 40 DAS) followed by T5 (Atrazine 1 kg/ha PE + interculture at 40 DAS) *i.e*. 91.55%. The lower weed index (1.27%) was recorded with T3 (Two HW and two IC at 20 and 40 DAS) followed by T5 (Atrazine 1 kg/ha PE + interculture at 40 DAS) *i.e*. 4.71%. Among the different weed management treatments, T1 *i.e*. weed free recorded significantly higher plant height (247.3 cm), but it remained at par with T3. In case of number of leaves per plant and stem girth were also recorded significantly higher under T1 *i.e*. weed free (15.54 and 5.89 cm), but which was remain at par with T3 and T5. Significantly higher grain yield and straw yield (Table 1) was recorded with treatment T1 *i.e* weed free but which was at par with treatments T3 and T5 during 2017-18, 2018-19 and in pooled results and T3, T5, T6, T9 and T10 during 2016-17. The treatment T4, T6, T9 and T10 failed to exert their significant effect in pooled results. On pooled basis, the treatments T1 (5030 kg/ha), T3 (4966 kg/ha), T5 (4793 kg/ha) and T1 (7521 kg/ha), T3 (7484 kg/ha), T5 (7262 kg/ha) were at par with each other for grain yield and straw yield respectively. Based on the results of three years experimentation for effective management of weeds in *Rabi* maize, treatment Two hand weeding (HW) and interculture (IC) at 20 and 40 DAS) produced higher yields (4966 kg/ha) along with higher weed control efficiency (95.88%) followed by application of atrazine 1.0 kg/ha as pre-emergence and interculture at 40 DAS reduced weed competition and obtained better growth and produced higher yields (4793 kg/ha) along with higher weed control efficiency (91.55%)

Integrated weed management in *Kharif* maize under South Gujarat condition

J.V. Patel, H.A. Katariya, M.M. Patel[1], B.K. Patel[2] and P.S. Patel[1]

N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat 396450, India

[1]Main Cotton Research Station, Navsari Agricultural University, Surat, Gujarat 395007, India

[2]Pulses and Castor Research Station, Navsari Agricultural University, Navsari, Gujarat 396450, India

**Email: jvpatel@nau.in*

The field experiment was carried out during *Kharif* season of 2021 at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari (Gujarat) to study the effect of integrated weed management in *Kharif* maize under south Gujarat condition. The experiment was laid out in randomized block design replicated three times with eleven treatments, *viz*. Weedy check, Weed free, Hand weeding at 15 and 30 DAS, atrazine 1.0 kg/ha as pre-emergence, pendimethalin 1.0 kg/ha as pre-emergence, atrazine 1.0 kg/ha as pre-emergence + one hand weeding at 25 DAS, atrazine 1.0 kg/ha as pre-emergence + tembotrione 100 g/ha at 25 DAS, atrazine 1.0 kg/ha as pre-emergence + halosulfuron-methyl 100 g/ha at 25 DAS, pendimethalin 1.0 kg/ha as pre-emergence + one hand weeding at 25 DAS, pendimethalin 1.0 kg/ha as pre-emergence + tembotrione 100 g/ha at 25 DAS and pendimethalin 1.0 kg/ha as pre-emergence + halosulphuron-methyl 100 g/ha at 25 DAS. The results revealed that treatments *viz*. weed free, hand weeding at 15 and 30 DAS and application of atrazine 1.0 kg/ha as pre-emergence + one hand weeding at 25-30 DAS were found effective in enhancing growth, yield attributes and yield of *Kharif* maize and reducing dry weight of weeds.

Phytosociology and diversity of weeds in maize-wheat cropping systems under mid hill conditions of Himachal Pradesh

Nandita Gupta, Bharat Bhushan Rana*, MC Rana, GD Sharma, Sandeep Manuja, Tarun Sharma, Garima Chauhan and Akashdeep Singh

Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh 176062, India

**Email: bharatbhushan5500@gmail.com*

Phytosociology and diversity study of weeds play a vital role in understanding the ecological dynamics of a cropping system. This study explores weed species composition, distribution and dominance patterns, offering insights into crop-weed interactions and management strategies. By assessing biodiversity indices, it aids in sustainable weed control and enhances agricultural productivity in such systems. Therefore, the study was carried out under the All India Coordinated Research Project on Weed Management (AICRP-WM) at Palampur from *Kharif* 2022 to *Rabi* 2022-23, evaluated ten weed control treatments for effective weed management in a maize-wheat based system. Treatments included T_1 - hand weeding (HW), T_2 - stale seed bed (SSB) + HW, T_3- raised SSB (RSSB) + HW, T_4 - mulch + HW, T_5 - SSB + mulch + HW, T_6 - RSSB + mulch + HW, T_7 - Intercropping + HW, T_8 - crop rotation + HW, T_9 - intensive cropping + mulch + HW, T_{10} - hoeing in a randomized block design with three replications. Soil was silty clay loam in texture and moderately acidic in reaction with high organic carbon. The soil was low in available nitrogen and medium in phosphorus and potassium. The total amount of rainfall received was 1900 mm in *Kharif* and 609.7 mm in *Rabi.* The weed count was recorded at 30 days interval after sowing till harvest. For weed count, a quadrat with in an area of 0.50 m^2 was placed randomly between border rows at two places in each plot. The experiment revealed 22 weed species in *Kharif* and 17 weed species in *Rabi,* with *Ageratum* spp. (19%), as dominant weeds *fb Cyprus* spp., and *Commelina benghalensis* in maize, and *Stellaria media* (28%*) fb Tulipa asiatica* and *Spergula arvensis* in wheat. Important value index (IVI) is a standard tool used to assess the overall significance of a species under a particular crop weed environment and can be obtained by summing up relative density, relative frequency and relative abundance. *Ageratum spp*. had highest relative density, relative frequency and relative abundance and was the most important weed during the *Kharif* season with IVI value ranging from 34.9 to 50.1 under different treatments. This was followed by *Cyperus* spp., and *Commelina benghalensis*. During *Rabi*, *Stellaria media* was most important weed with IVI value ranging from 22.6 to 98.8 under different treatments. This was followed by *Tulipa asiatica* and *Spergula arvensis*. Shannon weiner index accounting for order or abundance of a species within a sample plot was highest under HW, SSB + HW and RSSB + mulch + HW in *Kharif* and RSSB + mulch + HW, Intercropping + HW, Crop rotation + HW, Intensive cropping + mulch + HW in *Rabi* season. Simpson's index of diversity and Simpson's reciprocal index indicated higher weed diversity under SSB + HW *fb* hoeing and HW in *Kharif* and RSSB + HW, SSB + mulch and mulch + HW in *Rabi* season.

Evaluation of critical period of weed control in sweetcorn during *Kharif* through different periods of weed infestation in North-Eastern ghats zone of Odisha

Triptesh Mondal* and Monalisa Sarkar

Centurion University of Technology and Management, Paralakhemundi, Odisha

**Email: mtriptesh@gmail.com*

A field experiment was conducted in Post Graduate Research farm of M. S. Swaminathan School of Agriculture, Centurion University of Technology and Management during *Kharif* season of 2024 to evaluate the critical period of weed control (CPWC) in sweetcorn in north eastern ghats zone of Odisha. The soil was sandy loam in texture and slightly acidic type (pH: 6.21). The experiment was laid out in randomized complete block design (RCBD). Ten treatments comprised of different periods of weed infestation were taken including weed free and weed infested checks. The sowing was done on 13th July, 2024 in all the plots with the single cross hybrid '*Sugar 75*' and harvesting of the green cobs were done twice at 75 and 79 days after sowing (DAS), respectively. Pre-emergence spraying of atrazine 1 kg/ha was done at 1 DAS in all the four weed free treatments, *viz.* weed free until 21 DAS, 42 DAS, 63 DAS and throughout the crop growing period and integrated weed management (IWM) treatment where atrazine 1 kg/ha was applied at 1 DAS *fb* one hand weeding was done at 40 DAS. Total rainfall occurred during the crop growing period was 747.50 mm of which 82.94% occurred in 63 DAS. Maximum green cob yield was obtained from weed free check (16.30 t/ha) followed by weed free until 63 DAS (14.60 t/ha). The green cob yield loss was 10.43% under weed free until 63 DAS treatment as compared to weed free treatment. Surprisingly, the yield loss of green cobs was 53.99% in the IWM treatment as compared to weed free check. It was lower than weed infested until 63 DAS (65.60%) and weed infested until 42 DAS (59.50%) but higher than weed infested until 21 DAS (51.53%). The spraying of topramezone + atrazine 25.2 + 250 g/ha at 20 DAS showed 47.90% loss in green cob yield as compared to weed free treatment. This was in between the treatments, weed free until 21 DAS (42.90%) and weed infested until 21 DAS (51.50%). At 60 DAS, the density of grassy weeds [7.19 (51.33) no./m^2], broad-leaved weeds [9.08 (82) no./m^2] and sedges [4.14 (16) no./m^2] were recorded highest under weedy check which were statistically *at par* with weed infested until 63 DAS treatment. The density of grassy weeds, broadleaved weeds and sedge weeds were 7.29 (52.67), 9.15 (83.33) and 4.06 (16.70) no./m^2, respectively under weed infested until 63 DAS treatment. Similar trend was also noticed in case of dry weight of grassy and broadleaved weeds and sedges at 60 DAS. The beginning and end of the CPWC was considered based on 10% acceptable yield loss. Therefore, efficient weed management practices should be adopted by the farmers to keep the fields weed free from 13-69 DAS (collar of 2nd leaf visible to very late roasting ear stage) in the north-eastern ghats zone of Odisha to increase the productivity and profitability of sweetcorn.

Integrated weed management in *Rabi* popcorn with new generation herbicides

Ajay P. Patel* and Hiren N. Chaudhary
College of Agriculture, Navsari Agricultural University, Waghai, Gujarat 394730, India
**Email: appatel@nau.in*

Effect of "Integrated Weed Management in *Rabi* pop corn (*Zea mays* L. var. everta) under South Gujarat condition"were evaluated in College Farm, Navsari Agricultural University, Navsari (Gujarat) during *Rabi* season 2017-18. The experimental field was "Deep Black" soils as old alluvium of basaltic material by its origin under the great group of Ustochrepts, a sub group of Vertic, Ustochrepts, suborder Ochrepts and order Inceptisols with Jalalpore series. The experimental soil was clayey in texture, slightly alkaline (pH 8.23) with normal electric conductivity (0.30 ds m-1), low in available nitrogen (164 kg/ha), medium in available phosphorus (42 kg/ha) and high in available potash (315 kg ha-1). Ten treatments including in weed management practices *viz*., T1: Atrazine 0.75 kg/ha as a pre-emergence, T2: Atrazine 0.5 kg/ha as pre-emergence *fb* HW and IC at 40 DAS, T3: Pendimethalin 0.9 kg/ha as pre-emergence *fb* HW and IC at 40 DAS, T4: Atrazine 0.5 kg/ha + Pendimethalin 0.45 kg/ha tank-mix as pre-emergence *fb* HW and IC at 40 DAS, T5: Atrazine 0.5 kg/ha *fb* tembotrione 0.12 kg/ha as post-emergence at 20 DAS, T6: Atrazine 0.5 kg/ ha *fb* Topramezone 0.025 kg/ha as post-emergence at 20 DAS T7: Atrazine 0.5 kg/ha as a pre-emergence *fb* 2,4-D (Na salt) 0.5 kg/ha as post-emergence at 40 DAS, T8: HW and IC at 20 and 40 DAS T9: Weed-free and T10: Unweeded control were evaluated with an amber variety of popcorn as a test crop in randomized block design along with three replications. Popcorn cv. 'Amber' (110-120 days duration) seeds of 15 kg/ha were sown with hand in rows at 60 cm × 20 cm planting geometry. The crop was subjected to 120:60:00 kg N, P 2 O 5 and K2O ha-1, P 2 O 5 was supplied at basal and N was applied with three splits (50% basal, 25% at four-leaf stage, and 25% at the tasselling stage). On species wise weed count (per m2), dry weight of weed at harvest (kg/ha), Weed Control Efficiency (%), Weed Index (%), grain and stover yield (kgha-1) in *Rabi* pop corn during 2017-18. The experimental soil was clayey in texture, low in available nitrogen (164 kg ha-1), medium in available phosphorus (42 kg/ha) and high in available potash (315 kg/ha). Results revealed that the significantly minimum number of monocot (*Cynodon dactylon* L., *Sorghum helepense* L., *Dactyloctenium aegyptium*, *Echinochloa colona* L. and *Brachiaria ramose* L.), dicot (*Euphorbia hirta* L., *Chenopodium album* L., *Digera arvensis* Forsk, *Physalis minima* L., *Phyllanthus niruri* L., *Amaranthus viridis* L., *Alternanthera sessilis* L. and *Portulaca oleracea* L.), sedge weed (*Cyperus rotundus* L.), dry weight (148.52 kg/ha) of weeds at harvest, weed index (1.57%) and highest weed control efficiency (36.30%) were observed under the weed control through treatment T6 *fb* treatment T5 While, significantly the maximum monocot, dicot, sedge weeds, dry weight (233.17 kg/ha) of weeds at harvest, weed index (58.17%) and lowest weed control efficiency (0) were recorded under the treatment T10 (control), at 30 DAS, 60 DAS and harvest. Significantly greater grain yield and stover yield (3748 and 7898 kg/ha, respectively) were registered with treatment T9 but it is statistically at par with treatments of T6, T5 and T4.

Poster 135

Non-chemical weed management in baby corn – fenugreek cropping system

Arvind Verma
Rajasthan college of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
Email: arnd_verma@rediffmail.com

The expansion of organic cultivation in India, particularly in Rajasthan, presents significant challenges, with weeds being a primary concern for organic crop production. Farmers often fear ineffective weed control, which hinders the transition from conventional to organic farming. A two-year field study (2021-22 and 2022-23) was conducted at Udaipur, Rajasthan, to assess non-chemical weed management strategies in organically grown baby corn (*Zea mays* L.) and fenugreek (Trigonella foenum-graecum). The experiment evaluated twelve organic weed management treatments namely stale seedbed preparation *fb* inter culture at 20 DAS *fb* mechanical weeding at 40 DAS, stale seedbed preparation *fb* straw mulch (5 t/ ha) at 20 DAS *fb* inter culture at 20 DAS *fb* hand weeding at 40 DAS, stale seedbed preparation *fb* plastic mulch at sowing, soil solarization *fb* inter culture at 20 DAS *fb* mechanical weeding at 40 DAS, soil solarization *fb* straw mulch (5 t/ha) at 20 DAS *fb* inter culture at 20 DAS *fb* hand weeding at 40 DAS, soil solarization + plastic mulch at sowing, stale seedbed preparation *fb* sesbania as smothering crop in between rows and used same as mulch after 30 days and 1 HW at 40 DAS, soil solarization *fb* sesbania as smothering crop in between rows and used same as mulch after 30 days *fb* 1 HW at 40 DAS, IC at 20 DAS *fb* straw mulch (5 t/ha), inter culture at 20 DAS *fb* mechanical weeding at 40 DAS, straw mulch (5 t/ha) at 20 DAS+HW 20 days and weedy check. The experiment was infested *Chenopodium album*, *Chenopodium murale*, *Fumeria parviflora, Melilotus indica, Convolvulus arvensis, Cynodon dactylon*, *Phalaris minor*, *Malva parviflora* and *Cyprus rotundus* in *Rabi* while *Cyperus rotundus*, *Echinochloa colonum*, Cynodon dactlyon, *Commelina benghalensis*, *Digera arvensis*, *Amaranthus viridis* and *Phyllanthus niruri* in *kharif*. Among these, soil solarization combined with plastic mulch at sowing significantly reduced weed density and dry matter, although it was statistically comparable to the treatment of stale seedbed preparation (SSB) followed by plastic mulch. SSB with plastic mulch demonstrated the higher weed control efficiency (99.96% in baby corn, 99.95% in fenugreek) and significantly increased yields (1.715 t/ha for baby corn and 2.306 t/ha for fenugreek), along with the highest net return (Rs 119,588/ha for baby corn and Rs 76,136/ha for fenugreek). The results indicate that SSB combined with plastic mulch is a highly effective strategy for weed management in organic cropping systems, providing optimal yields and substantial economic benefits in the baby corn-fenugreek cropping system.

Integrated weed management in cotton-based intercropping systems

B. Padmaja* and T. Ramprakash
AICRP on Weed Management, Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana 500030, India
Email: bhimireddymaduri@gmail.com

In India, cotton is grown in an area of about 12.5 million hectares. It is a wide spaced crop and grows slowly during the initial period and consequently vulnerable for the weed competition. Weeds can cause significant yield losses in cotton crop, ranging from 40–90% depending on the intensity and nature of the weeds. Growing the weed smothering intercrops not only curtails the weed problem in cotton but also gives additional and intermittent yield for the farmer. Selective pre- and post-emergence herbicides are available for sole cotton crop but under intercropping situation, selective herbicides are not available. Hence screening of the herbicides suitable for intercropping situation and also their integration with other weed management practices has become imperative. A field experiment was conducted at AICRP centre on Weed Management, PJTAU, Hyderabad during 2021-22 and 2022-23, to investigate the efficacy of herbicides and their integration with HW/MW and the effect on the productivity of cotton and intercrops. The soil of the experimental site was a sandy loam with a pH of 7.15, EC of 0.5 dS/m, low in available N (195 kg/ha) and medium in available P2O5 (49 kg/ha) and high in available K2O (342 kg/ha). The experiment was laid out in a split plot design with cropping system in the main plot [M1: Sole cotton at a spacing of 90x60 cm, M2: Cotton + sesame (non-legume) in 1:2 ratio, M3: Cotton + soybean (legume) in 1:2 ratio, M4: Cotton + dhaincha (Sesbania aculeata) (green manure crop) in 1:2 ratio and mulching at 40 DAS] and weed management in sub-plots (W1- IWM, W2 - Herbicidal control and W3 - Hand weeding/ Mechanical control). The results indicated that growing soybean as intercrop in cotton at 1:2 ratio was found to suppress the weed growth with high smothering efficiency and reduced weed density and weed dry weight compared to sole crop and other intercrops i.e., sesamum and dhaincha (live mulching upto 40 DAS) and gave 7.0 percent additional cotton equivalent yield (17.69 q/ha) over sole cotton (16.53 q/ha). Under intercropping situation, application of pendimethalin (38.7 CS) 640 g/ha as PE *fb* MW/HW at 30 and 45 DAS (IWM) was found to be effective for weed control and resulted in higher cotton equvivalent yield (17.62 q/ha) over chemical weed control i.e., pendimethalin (38.7 CS) 640 g/ha as PE *fb* quizalofop--ethyl 45 g/ha as POE at 25 DAS (13.97 q/ha). From this study it can be concluded that intercropping in cotton with legume crop like soybean suppresses the weeds and realise additional yield.

Poster 137

Weed suppression in cotton through high density planting system

K.B. Sankat*, M.M. Patel and M.C. Patel
Main Cotton Research Station, Navsari Agricultural University, Navsari, Gujarat 396450, India
**Email: kanusankat@gmail.com*

An experiment was conducted at Main Cotton Research Station, Navsari Agricultural University, Surat to study the “Feasibility of HDPS and its fertilizer requirement in Cotton (L.) under South Gujarat” during 2014 and 2015. Eight combinations of two plant densities (D1:2,22,222 and D2:1,66,666 plants/ha) and four fertilizer levels (F1:120-00-00 kg NPK+15kg ZnSO4/ha, F2:120-30-00kg NPK+15 kg ZnSO4/ha, F3:120-00-60 kg NPK+15 kg ZnSO4/ha and F4:120-30-60 kg NPK+15 kg ZnSO4/ha) in addition to an absolute control (120 x 45 cm spacing with 160-0-0 kg NPK/ha) were embedded in FRBD with three replications. Significantly higher weed plants/m2 recorded was 60.1 in treatment D2 as against 50.7 in treatment D1. The average number of weed plants/m2 recorded in HDPS (55.4) was significantly lower than control (62.2). For Control vs TM, significantly lower number of weed plants/m2 were recorded in D1 as compared to control. Weed dry weight recorded in D2 was 37.1 and that in D1 was 31.8 g/m^2. Weed dry weight recorded in treatment averaged to 34.4 was significantly lower as against 40.8 g/m2 in control. For Control vs TM, treatment D1 and D2 recorded significantly lower weed dry weight as compared to control (40.8 g/m^2). At 60 DAS, wider spaced crop (D2) recorded significantly higher number of weed plants/m2 as compared to 33.6 weed plants/m2 recorded in narrow spaced crop (D1). The average number of weed plants/m^2 recorded in HDPS (36.3) was significantly lower than control (47.2). For Control vs TM, both the tested plant densities (D1 & D2) recorded significantly lower number of weed plants/m2 than control. In pooled over results, the weed dry weight recorded in treatment D2 was 19.4 g/ m2 as against 16.7 g/m^2 recorded in treatment D1. Weed dry weight (18.1 g/m^2) recorded in closure spacing was significantly lower than that recorded in control (26.1 g/m^2). In case of control vs TM, both the tested plant densities (D1 and D2) recorded significantly lower weed dry weight than control. In light of the results obtained from the investigation, it can be concluded that cotton crop planted with HDPS proved effective tool for suppressing weed infestation in South Gujarat condition.

Influence of weed management practices on growth and yield of irrigated cotton

P.S. Patel*, M.M. Patel, K.B. Sankat, H.R. Ramani and M.C. Patel

Main Cotton Research Station, Navsari Agricultural University, Athwa Farm, Surat, Gujarat 395007, India

**Email: prakashsoilsci@gmail.com*

The field experiment was carried out during the rainy (*kharif*) season of 2022 at Main Cotton Research Station, Navsari Agricultural University, Surat, Gujarat, to study the effect of integrated weed management in cotton under irrigated condition. The experiment was laid out in randomized block design replicated fourth time with six treatments, *viz*. weedy check (T1), weed free check through hand weeding (T2), pendimethalin 30% EC 1.0 kg/ha as pre-emergence + hand weeding at 30 and 60 DAS (T3), pendimethalin 30% EC 1.0 kg/ha as pre-emergence followed by pyrithiobac-sodium 10% EC 62.5 g/ha + quizalofop-ethyl 5% EC 50 g/ha (tank mixture) at 30 DAS (T4), T4 + 1 interculture and hand weeding at 60 DAS (T5) and pendimethalin 30% EC 1 kg/ha as pre-emergence + 0.5 kg/ha of paraquat dichloride 24% SL + 1 interculture and hand weeding at 60 DAS (T6). The results revealed that treatments, *viz*. three hand weeding at 30, 60 and 90 DAS, pre-emergent application of pendimethalin 1.0 kg/ha as pre-emergence + hand weeding at 30 and 60 DAS and pendimethalin 1.0 kg/ha as pre-emergence followed by pyrithiobac sodium 62.5 g/ha + quizalofop-ethyl 50 g/ha (tank mixture) at 30 DAS + interculture and hand weeding at 60 DAS were found effective in enhancing growth, yield attributes and yield of cotton and reducing dry weight of weeds.

Soil biological responses to tillage and weed management in a conservation agriculture-based cotton-maize-green manure system

T. Ram Prakash*, B. Padmaja and Nthebere Knight
Professor Jayashankar Telangana Agricultural University, Hyderabad, Telangana 500030, India
**Email: trp.soil@gmail.com*

A field experiment was conducted at College Farm, Hyderabad, during 2021-22 and 2022-23 to study the impact of tillage and weed management practices on soil biological properties yield in a cotton-maize-green manure system. The experiment was laid out in a split-plot design with three tillage practices—conventional tillage (CT), zero tillage (ZT), and zero tillage with residue retention (ZT+R)—and four weed management practices—chemical weed control, herbicide rotation, integrated weed management (IWM), and unweeded control. Soil dehydrogenase activity (DHA) was measured at 5, 15, and 30 days after pre-emergence herbicide application (DAA) and at the flowering and harvest stages of the crops. DHA increased gradually from sowing to flowering, followed by a decline at harvest. Tillage treatments did not significantly affect DHA at any crop stage. However, DHA was significantly influenced by weed management practices. At 5 and 15 DAA, DHA was reduced in all treatments where atrazine was applied as a pre-emergence herbicide. Post-emergence herbicide application further reduced DHA in chemical weed management treatments, which were significantly lower than IWM and unweeded control treatments. At the flowering stage, DHA levels in IWM and control treatments were statistically similar and superior to chemical weed management treatments. At harvest, significantly lower DHA was recorded across all treatments, and the effect of weed management was non-significant. The interaction between tillage and weed management on DHA was also non-significant. Urease activity (UA) was assessed at 5 and 15 DAS, 30 DAA, and at the flowering and harvest stages. UA increased gradually from sowing to flowering, followed by a decline at harvest. Tillage significantly influenced UA up to the post-emergence herbicide stage, with higher UA recorded in ZT treatments compared to CT. However, weed management practices did not significantly influence UA at 5 and 15 DAS. Similarly, post-emergence herbicide application did not result in significant differences in UA between chemical weed management and IWM treatments, though UA was significantly lower in the unweeded control. This trend persisted at flowering. By harvest, UA levels were significantly lower across all treatments, and the effect of weed management was non-significant. The interaction effect between tillage and weed management on UA was also non-significant. Soil microbial counts, including bacteria, fungi, and actinomycetes, were estimated at 5, 30, and 60 DAS. Tillage significantly influenced microbial populations, with higher counts in ZT treatments compared to CT at 5 and 30 DAS. Weed management significantly affected bacterial and actinomycetes populations at 5 and 30 DAS. The highest bacterial and actinomycetes counts were recorded in the unweeded control at 5 DAS, while the lowest counts were observed in chemical weed management at 30 DAS. However, fungal populations were not significantly affected by tillage or weed management at any stage. The impact of herbicides on microbial populations was not evident at the flowering stage. ZT with residue retention significantly increased microbial populations and enzyme activities compared to conventional tillage. Integrated weed management and unweeded control treatments showed higher soil dehydrogenase and urease activities, while chemical weed management reduced microbial counts, particularly for bacteria and actinomycetes.

Integrated weed management in cotton under irrigated condition of south Gujarat

M.M. Patel*, K.B. Sankat, S.L. Pawar, P.S. Patel and M.C. Patel
Main Cotton Research Station, Navsari Agricultural University, Athwa Farm, Surat, Gujarat 395007, India
**Email: mmpatel@nau.in*

The field experiment was carried out during the rainy (*Kharif*) season of 2021 at Main Cotton Research Station, Navsari Agricultural University, Surat, Gujarat, to study the effect of integrated weed management in cotton under irrigated condition. The experiment was laid out in randomized block design replicated fourth time with six treatments *viz*., weedy check, weed free check through hand weeding, pendimethalin 30% EC 1.0 kg/ha as pre-emergence + hand weeding at 30 and 60 DAS, pendimethalin 30% EC 1.0 kg/ha as pre-emergence followed by pyrithiobac sodium 10% EC 62.5 g/ha + quizalofop-ethyl 5% EC 50 g/ha (tank mixture) at 30 DAS + one interculture and hand weeding at 60 DAS and pendimethalin 30% EC 1.0 kg/ha as pre-emergence + 0.5 kg/ha of paraquat dichloride 24% SL + one interculture and hand weeding at 60 DAS. The results revealed that treatments *viz*., three hand weeding at 30, 60 and 90 DAS and application of pendimethalin 1.0 kg/ha as pre-emergence + two hand weeding at 30 and 60 DAS were found effective in enhancing growth, yield attributes and seed cotton yield and reducing dry weight of weeds.

Dynamics of weed flora in major *Rabi* crops

B.S. Gohil, S.K. Chhodavadia*, S.B. Vadhavana and P.K. Chovatia
Junagadh Agricultural University, Junagadh, Gujarat 362001, India
**Email: skchhodavadia@gmail.com*

Life on earth never stands still and it is a continuous process of change and flux. Succession is the interaction of both environmental factors and plant species. The soil is reservoir of weed seeds. All the weed seeds present in soil will not germinate at one time. In general, weed seeds germinate from top 1.25 to 1.5 cm of soil, whereas weed seeds lying below 5 cm soil depth remain dormant and act as a source for future flushes of weeds. Hence, only a fraction of weed seeds present in soil germinate at one time, leaving others to germinate later. Weed succession can occur amongst different weed species themselves in response to long term adoption of an agricultural practice, including the use of herbicides. This leads to the destruction of the susceptible group of weed species, leaving behind few plants of the resistant species to gradually build up their population and finally emerge as the dominant weed flora of the area. Density of weed species can be changed depending on some factors during a long period. Purification of seed, choice of crops, rotations, sowing time and techniques, soil management, harvest time, fertilizing, chemical and mechanical weed control methods are the main factors that influence weed flora. It is often difficult to separate the effects of one factor from another due to reciprocal interactions between all these factors. But, using herbicides, rotations and fertilizing may take into consideration dominant factors responsible for changing in weed flora. During rainy season, weed flushes emerge according to irrigation, fertilization, weed management practice, weather condition, *etc*. The knowledge of weed flora is essential for the management of weeds in crop fields. In view to generate the information about weed flora in different *Rabi* crops, the present experiment was proposed to undertake. A field experiments were conducted during *Rabi* seasons at Junagadh (Gujarat) with an objective *i.e.,* 1) to study the weed species growing in succession throughout the *Rabi* season, 2) to study the density and dry matter of different weed species at different times during *Rabi* season, 3) to evaluate the impact of different crops on weed succession and 4) to study the effect of recommended weed management practices on weed succession. Experiment was laid out in split plot design with four replications with imposed of three treatments (crops) in main plot and four treatments (weed management practices) in sub-plots. The information generated from the experimentation on weed dynamics in groundnut, soybean and pearl millet during *Kharif* season is 1) Total sixteen existing weed species of eleven different families were identified and observed during the *Rabi* season. From total sixteen species of weeds, the families constituted as *Amaranthaceae, Asteraceae, Chenopodiaceae, Cyperaceae, Euphorbiaceae, Leguminosae, Liliaceae, Poaceae, Portulacaceae, Solanaceae* and *Tiliaceae* 2) Total weeds in floristic composition are *Cyperus rotundus, Asphodelus tenuifolius, Echinochloa colona, Eluropus villosus, Dactyloctenium aegyptium, Digera arvensis, Eclipta alba, Euphorbia hirta, Parthenium hysterophorus, Indigofera glandulosa, Portulaca oleracea, Corchorus olitorious, Tridax procumbens, Physalis minima, Amaranthus spinosus and Chenopodium album* 3) The most dominant succession of *Cyperus rotundus, Asphodelus tenuifolius and Echinochloa colona and Digera arvensis* were noted throughout season., 4) *Echinochloa colona* with wheat, *Asphodelus tenuifolius, Indigofera glandulosa and Physalis minima* with chickpea and coriander*; Cyperus rotundus* with all crops throughout *Rabi* season were associated than other weed species., 5) The weed late to emerge were observed i.e., *Eluropus villosus* up to 15 DAS., 6) The most densely weeds *viz., Asphodelus tenuifolius, Echinochloa colona and Cyperus rotundus* and least densely were *Tridax procumbens, Chenopodium album and Corchorus olitorious.*

Effect of herbicidal weed management on yield attributes, and yield of kodo (*Paspalum scrobiculatum* L.)

Harendra Kumar*, Nitish Tiwari and Rama Mohan Savu

Department of Agronomy, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India

**Email: tharendra723@gmail.com*

This study investigates the impact of various herbicidal weed management practices on yield attributes and the overall yield of kodo millet (*Paspalum scrobiculatum* L.), an important minor millet crop cultivated in India, valued for its drought resilience, nutritional properties, and suitability for marginal soils. The experiment was conducted during the *Kharif* seasons of 2021 and 2022 at the Instructional cum Research Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh. The trial was set up using a Randomized Block Design (RBD) with 10 weed management treatments and three replications. Indira Kodo 1, a popular local variety, was used as the test crop to assess how different herbicidal and manual weed control methods affected growth parameters and yield outcomes. The study's key objective was to evaluate yield attributes, including the number of ear heads, ear head length (cm), number of seeds per ear head, ear head weight (g), test weight (g), and the harvest index (%). The analysis revealed that weed control significantly influenced each yield parameter, with the treatment involving Pyrazosulfuron-ethyl 10% at 20 g/ha applied as a pre-emergence (PE) herbicide, followed by Chlorimuron-ethyl 10% + Metsulfuron methyl 10% at 4 g/ha as a post-emergence herbicide, achieving the best results. This treatment consistently outperformed others, producing a significantly higher number of ear heads, greater ear head length, and more seeds per ear head compared to both manual and other herbicidal treatments. The yield attributes achieved with this herbicide combination were followed closely by those observed under the hand weeding treatment, performed twice at 20 and 40 days after sowing (DAS), which also provided substantial yield benefits albeit at higher labor costs. The combined use of Pyrazosulfuron-ethyl (PE) and Chlorimuron-ethyl + Metsulfuron methyl (PoE) herbicides yielded the highest seed and straw outputs across both seasons. On average, the seed yield under this treatment was 2,044 kg/ha, and the straw yield was 4,073 kg/ha, with both values significantly surpassing those of the other treatments. This indicates that effective weed control can not only boost the productivity of kodo millet but also maximize the economic returns from its cultivation. The treatment's superior performance is attributed to its effectiveness in suppressing a wide spectrum of weeds, thereby minimizing competition for nutrients, water, and light and allowing the kodo crop to fully realize its genetic yield potential. This research underscores the economic and agronomic advantages of employing selective herbicide combinations for weed management in kodo millet cultivation. The use of Pyrazosulfuron-ethyl followed by Chlorimuron-ethyl + Metsulfuron methyl provides an efficient alternative that reduces weed density, supports higher biomass accumulation, and enhances both seed and straw yields. This integrated weed management approach could significantly benefit kodo millet farmers by improving productivity while lowering labor inputs. This study's outcomes would offer a valuable resource for agronomists and farmers alike, suggesting that strategic herbicide application could lead to optimized cultivation practices for kodo millet, especially in areas where weed pressure and limited resources hinder crop yields. Further research could explore the long-term impacts of these herbicides on soil health, crop rotation compatibility, and weed resistance, ensuring sustainable and resilient millet farming practices in the future.

Poster 143

Herbicides in modern agriculture: Effective use and sustainable management

Shruti Jaiswal* and Ram Swaroop Meena
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: shrutijaiswal0407@gmail.com*

Herbicides are essential tools in modern agriculture for controlling unwanted vegetation and ensuring higher crop yields. Their widespread use has raised significant environmental concerns, particularly regarding their persistence in soil and water ecosystems. As of 2021, the global herbicide market was valued at USD 29.75 billion, with projections indicating a steady growth due to increasing global demand for efficient and cost-effective weed control practices. The various classes of herbicides, their mechanisms of action, and the environmental challenges they present are explored. Herbicides such as glyphosate, atrazine, and paraquat, despite their effectiveness, have been linked to soil degradation, groundwater contamination, and adverse effects on non-target organisms, including aquatic life and soil microbes. The behavior of herbicides in soil and water is governed by a combination of factors, including the herbicide's chemical properties (e.g., solubility, volatility), soil composition, and environmental conditions. Some herbicides, like glyphosate and atrazine, are highly soluble and prone to leaching into groundwater, while others, such as paraquat, persist in the soil and may contaminate water bodies through runoff. Degradation processes, including microbial metabolism, photolysis, and hydrolysis, also affect herbicide persistence. In soil, herbicides may bind to organic matter and clay particles, which limits their mobility but increases their persistence. Microbial degradation is the primary pathway for herbicide breakdown in soils, but this process is influenced by temperature, moisture, and the composition of the soil's microbial community. The environmental persistence of herbicides poses risks not only to ecosystems but also to human health. Herbicides that leach into groundwater or runoff into surface waters can end up in drinking water supplies, particularly in agricultural regions. Long-term exposure to herbicide residues in water has been associated with various health issues, including cancer, reproductive problems, and endocrine disruption. Regulatory agencies have established limits on herbicide concentrations in drinking water, but contamination remains a concern in areas with intensive agricultural activity. To mitigate the environmental impact of herbicides, sustainable weed management strategies are being explored, including precision agriculture, integrated pest management (IPM), and the development of herbicides with improved degradation profiles. To combat the problem of atrazine contamination in groundwater, the implementation of buffer strips and constructed wetlands around agricultural fields has been suggested. These methods work by slowing runoff and allowing for the natural degradation of atrazine before it enters waterways. Efforts to mitigate glyphosate contamination include vegetative filter strips along waterways and IPM practices that reduce the reliance on herbicides. Studies in India have demonstrated that biochar can significantly reduce paraquat's mobility in soil, preventing it from leaching into groundwater. Constructed wetlands can be used as a biological treatment system for herbicide-laden runoff before it enters natural water bodies. These wetlands filter out contaminants through plant uptake and microbial degradation processes. While herbicides are indispensable for modern agriculture, their environmental and health risks necessitate the development of more sustainable and eco-friendly alternatives. Understanding the behavior of herbicides in soil and water systems is critical to predicting their environmental fate and mitigating their negative impacts. Further research is needed to develop herbicides with lower environmental persistence and to implement effective remediation strategies for contaminated ecosystems.

Poster 144

Weed management in organically grown finger millet

R.P. Dubey*, V.K. Choudhary and C.R. Chethan
ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India
**Email: dubeyrp@gmail.com*

Finger millet (*Eleusine coracana* L. Gaertn.) is an important millet of India cultivated in an area of 1.04 m ha with a production of 1.39 m tonnes having an average yield of 1336 kg/ha during 2023-24 (APEDA, 2024). The demand for organic finger millet is high due to several health benefits. It is either direct-seeded or transplanted under rainfed or irrigated ecologies. Weeds have been considered as one of the important biotic constraints in the cultivation of finger millet. In central India, the yield loss due to weeds in finger millet was estimated to be 46.6 to 68.1%. Under organic cultivation, the choice of weed management options could be cultural and mechanical methods. Therefore, to know the most effective and economical weed management practice, a field experiment was conducted at ICAR- Directorate of Weed Research, Jabalpur during the *Kharif* season of 2022 in an organically cultivated finger millet *var.* GPU-45. The 08 treatments comprised of Reduced spacing (20 cm) *fb* 1 HW 20 DAS, Normal spacing (30 cm) *fb* 1HW 20 DAS, Stale seedbed *fb* 1 HW 20 DAS, Mechanical weeding 20 DAS *fb* 1 HW 40 DAS, *Sesbania in-situ* incorporation at 30 DAS, Wheat residue mulch 6 t/ha *fb* 1HW 20 DAS, Two HW (20 and 40 DAS) and Unweeded check replicated thrice in a RBD. The crop was direct-seeded and raised by providing vermicompost 5 t/ha. The dominant weeds in the experimental field were *Dinebra retroflexa* (84%) and *Cyperus rotundus* (12%) while others present in small numbers were *Eclipta alba, Physalis minima, Phyllanthus simplex, Alternanthera sessilis* and *Commelina benghalensis.* Higher Weed Control Efficiency was recorded under two HW (20 and 40 DAS) (95.8%), mechanical weeding 20 DAS *fb* 1 HW 40 DAS (95.6%) and reduced spacing (20 cm) *fb* 1HW 20 DAS (83.4%). The highest grain yield of 2.15 t/ha was obtained under reduced spacing (20 cm) *fb* 1HW 20 DAS which was significantly similar to stale seedbed *fb* 1 HW 20 DAS, wheat residue mulch 6 t/ha *fb* 1HW 20 DAS, two HW (20 and 40 DAS) and mechanical weeding 20 DAS *fb* 1 HW 40 DAS. Yield reduction under unweeded check was 66.9%. Higher B:C was obtained under reduced spacing *fb* 1 HW (3.26), mechanical weeding 20 DAS *fb* 1 HW 40 DAS (3.09) and stale seedbed *fb* 1 HW 20 DAS (2.99). The study showed that in organically grown finger millet, weeds could be effectively managed by adopting reduced spacing *fb* 1 HW or mechanical weeding 20 DAS *fb* 1 HW 40 DAS or stale seedbed *fb* 1 HW 20 DAS or wheat residue mulch 6 t/ha *fb* 1HW 20 DAS.

Nanoencapsulation in weed management: Precision control for sustainable agriculture

Anjani Kumar Patel* and Saroj Kumar Prasad

Department of Agronomy, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: anjaniagro@bhu.ac.in*

Weeds are a major threat to agricultural productivity, leading to significant yield losses. Weeds contribute roughly 37% of India's annual agricultural produce loss, with insects, diseases, and other pests coming in second and third. Over time, methods for weed control have evolved, from manual labor to the use of chemical herbicides. Herbicides have become widely used in agrochemical-based agriculture. Nevertheless, the appropriate application of herbicides isn't consistently observed. The overreliance on chemical herbicides has resulted in environmental contamination, herbicide resistance, and harm to non-target organisms. To combat these threats, effective weed management is vital for sustaining agricultural productivity. Advances in nanoscience may answer these issues. Nanoencapsulation could be an innovative solution to enhance herbicide performance through controlled release, targeted delivery, and improved solubility. The properties and encapsulation techniques of various nanoparticles, including interfacial polymerization, in-situ polymerization, coacervation, and organic encapsulation, are analyzed to demonstrate how these methods enhance herbicide efficiency and specificity. Nanotechnology enables the modification of the outer shells of any compounds to make the contents encapsulate into the shell which probably will slow the release of the content and increase its efficiency. By employing nanocarriers—such as polymeric, lipid-based, and inorganic nanoparticles—this technology allows for precise herbicide application, minimizing environmental impacts and reducing application frequency. Comprehensive analysis of recent advancements in organic encapsulation, particularly liposomes and polymeric nanoparticles, highlights their ability to increase herbicide efficacy while reducing necessary doses and off-target effects. Nanoherbicides offer promising solutions to combat herbicide resistance by improving stability and promoting microbial diversity in soil. Despite the advantages, challenges such as scalability, cost, and regulatory barriers remain. Future research should prioritize field trials to validate findings and optimize application methods across diverse agricultural settings. By integrating these innovative techniques, farmers can achieve sustainable weed control, enhancing agricultural productivity while mitigating environmental risks. Future research should prioritize field trials to validate these findings and optimize application methods for diverse cropping systems.

Poster 146

Effect of millets intra cropping on weed dynamics and production potential of grain sorghum

Nisha Sapre
ICAR- All India coordinated sorghum Improvement Project, Indore, Madhya Pradesh 452001, India
(Rajmata Vijayaraje Sindhiya Krishi Vishwa Vidhyalaya), Gwalior, Madhya Pradesh, India
Email: toughysingh@gmail.com

Sorghum (*Sorghum bicolor L.*) is the fifth most important cereal crop in the world followed by wheat, rice, maize and barley. In India, it is grown in 3.75 million hectares area with an annual production of about 4 million tonnes and 1000 kg/ha of productivity in the year of 2022-23 (www.ipad.fas.usda.gov). In Madhya Pradesh it is grown in 123 thousand hectare and produces about 236 thousand tonnes with 1919 kg/ha productivity (Agriculture statistics at a glance, 2022). But the area under sorghum has been constantly shrinking after 1985. Weed control in sorghum is one of the region for declining in area. Now a days millets become very popular as nutri-cereal and climate resilience crops, as it have very good nutrition properties and it can grow in hardy climate on poor soils. Weeds are the major constrain in millets production. Intercropping is one of the tool for efficient utilization of growth resources like nutrients, moisture, space and light. It also helps in suppress the initial growth of weeds. It can enhance the yield potential by suppressing the weed growth in initial stage. Keeping in view a field experiment was conducted at research farm of college of Agriculture Indore (M.P.) during *Kharif* season of 2023 to evaluate the Effect of millets intra cropping on weed dynamics and production potential of sorghum during *Kharif* 2023. The experiment was laid out in randomized block design (RBD) with fifteen sole and intercropping combinations, *viz.* Sole sorghum, sole bajra sole proso millet, sole foxtail millet, sole finger millet, sole little millet, sole barnyard millet, sole kodo millet, sorghum + bajra, sorghum + proso millet, sorghum + foxtail millet, sorghum + finger millet, sorghum + little millet, sorghum + barnyard millet sorghum + kodo millet. The main crop was sorghum it was sown in 40 cm and other small millets are sown in 22.5 cm row spacing. In intercropping, small millets were sown between the rows of sorghum (1:1) in additive series. The major weeds were; *Echinochloa colona*, *E.crus-galli*, *Eleusine indica*, *Dactyloctenium aegyptium*, *Cynodon dactylon, Cyperus rotundus*, *C. iria*, *Celosia argentea*, *Commelina benghalensis* and *C. diffussa*. It is revealed that the maximum weed density (15/m^2) and weed biomass (153.45 gm/m^2) was recorded in sole sorghum followed by sole kodo millet (13/m^2) and (104.70 g/m^2), respectively. Whereas, the maximum weed control efficiency 78.13% was found in Sorghum + Bajra followed by Sorghum + Proso millet 76.54%. The maximum sorghum equivalent yield (53.31 q/ha) was found in Sorghum+ Barnyard intercropping with the maximum B:C ratio 4.52 followed by Sorghum + Bajra (5.22 t/ha) with the maximum net monetary returns 80200 Rs./ha. On the bases of data, it can be concluded that 75-78% weed control can be obtained by taking intercropping of bajra or barnyard millet with sorghum along with 36-38% gain in yield.

Integrated weed management for sustainable agriculture production

Vipul Kumar Rawal

Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan 313802, India

Email: vipulrawal06@gmail.com

Integrated Weed Management (IWM) is a holistic strategy that combines multiple methods for effective weed control while minimizing ecological impact. This approach includes cultural, mechanical, biological, and chemical practices, tailored to specific agroecosystems. A review of recent literature underscores the efficacy of IWM in reducing weed populations, enhancing crop yields, and decreasing herbicide dependence, which is essential for mitigating herbicide resistance. Recent studies indicate that practices such as crop rotation, cover cropping, and targeted tillage can significantly suppress weed growth. Additionally, the use of biological controls, such as competitive plant species and natural predators, provides eco-friendly alternatives to traditional herbicides. The review highlights the importance of precision herbicide application, which, when integrated with other methods, maximizes weed control while protecting non-target organisms. Biological control methods, such as introducing competitive plant species and utilizing natural enemies of weeds, further complement these strategies. For example, planting cover crops that outcompete weeds for resources can significantly reduce weed biomass while enhancing soil structure. Additionally, the development of precision herbicide application technologies allows for more efficient use of chemicals, targeting weeds while minimizing impacts on non-target species and the environment. This review emphasizes that IWM not only addresses the challenges of weed management but also promotes sustainable agricultural practices. By enhancing biodiversity and improving soil health, IWM serves as a crucial framework for ensuring long-term food security and environmental sustainability. Future research should focus on developing region-specific IWM strategies to optimize effectiveness across diverse agricultural contexts. IWM addresses immediate weed management challenges while fostering long-term ecological health. By enhancing biodiversity and improving soil quality, IWM represents a crucial strategy for ensuring future food security and environmental sustainability. Future research should prioritize developing region-specific IWM strategies that consider local ecological dynamics and farming practices to optimize effectiveness across various agricultural contexts.

Evaluating herbicide efficacy in suppressing broad-leaved weeds in barley

Sitesh Jha*, U.P. Singh, Anurag Upadhyay, Kajal Verma, Nikhil Kumar Singh and J.P. Singh
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: sitesh.jha@bhu.ac.in*

Barley (*Hordeum vulgare* L.), is one of the major cereal grain after maize, wheat and rice in the world. It is consumed as animal feed, used as malt in whiskey, beer and also as a healthy food. The production volume of barley across India during financial year 2023 was about 1.91 million metric tons, an increase from about 1.37 million metric tons in the previous year. The production volume of barley was estimated to be about 2.22 million tons in fiscal year 2024. Barley has more vigorous growth with profuse tillering as compared to other cereals and covers the vegetation causing smothering effect but still weeds decline its yield by 10-38% under irrigated condition. Chemical method of weed control is being popular among the farmers for effective weed management for better yield with low input cost. As a single herbicide cannot control all broadleaved weeds so there should be the use of suitable combination of herbicides with different mode of action to overcome harmful weeds and weed shift. So herbicide rotation and application of herbicide mixtures with adjuvants are two major strategies to prevent the development of resistant biotypes and problem of weed shift. A field experiment was conducted during the *Rabi* season of 2018-19 at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi to find out the most effective combination of herbicide and surfactants for broad leaved weed management in barley. The experiment was carried out in a randomized block design with eleven treatments in three replications. Halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + surfactant was found to be effective for control of broad leaved weeds at all stages of observation noticing lowest weed index. Halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + surfactant recorded highest weed control efficiency at 60 DAS, 90 DAS and at harvest. 2, 4 D Na (500 g/ha) + carfentrazone (50 g/ha) recorded higher plant height among different herbicidal treatments at 60 and 90DAS but at harvest halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + surfactant recorded maximum plant height. Halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + surfactant was superior among different treatments in terms of dry matter accumulation, number of ear head per m^2, no. of grains per ear head and number of spikes/plant. The results were superior in hand weeded plots as compared to the herbicidal treatments. 2, 4 D Na (500 g/ha) + carfentrazone (50 g/ha) recorded maximum test weight being at par with halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + Surfactant. Halauxifen-methyl + florasulam (24.99 g/ha) + carfentrazone (50 g/ha) + surfactant recorded maximum grain yield and was economically viable options among herbicidal treatments for broad leaved weeds in barley.

Allelopathy effect of sugarcane leaf and root on weeds flora in sugarcane agroecosystems

Vineet Kumar Shukla*, Ram Kumar Singh, Saurabh Raj Pandey, Pawan Verma, Abhishek Patidar and Aishwariya

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: vineetshukla2741@gmail.com*

Allelopathy, the chemical inhibition of one plant species by another, has gained attention as a sustainable strategy for weed control in agricultural systems. In sugarcane agroecosystems, managing weed growth is crucial for optimizing yield and reducing the dependence on chemical herbicides. The allelopathic potential of sugarcane residues, including leaves and roots, which may contribute to natural weed suppression. Allelopathic effects of sugarcane leaf and root extracts on weed growth and development within sugarcane agroecosystems, evaluating their potential as a non-chemical weed management strategy. The sugarcane leaf is an agricultural waste product that has been reported to have allelopathic potential. The allelopathic impact of sugarcane leaf and root extracts on the germination and growth of common weed species, including *Amaranthus viridis* L., *Portulaca oleracea* L., and *Cyperus rotundus* L. Both leaf and root tissues were collected from mature sugarcane plants, and aqueous extracts were prepared. Sugarcane leaf extract was a selective inhibitor, especially in a monocotyledonous plant species. The extracts were tested in a series of germination bioassays and growth inhibition trials under controlled conditions. Further, the allelopathic effects were evaluated under field conditions by applying the extracts in situ and monitoring the response of weeds in sugarcane plots. Results indicated that both sugarcane leaf and root extracts exhibited significant allelopathic effects, with varying degrees of inhibition on weed germination and biomass accumulation. Leaf extracts showed stronger inhibitory effects on weed seedling growth compared to root extracts. The allelopathic action was most pronounced in the early stages of weed growth, suggesting that sugarcane residues could effectively suppress weed establishment in the sugarcane cropping system. In addition, chemical analysis of the extracts identified key allelopathic compounds, including phenolic acids such as ferulic acid, vanillic acid, and syringic acid, which have been previously associated with plant growth inhibition. Field trials further confirmed the potential of sugarcane leaf and root extracts as effective weed management tools. In sugarcane plots treated with leaf extract, weed density and biomass were significantly reduced compared to untreated control plots, without adversely affecting the growth and development of the sugarcane crop. The allelopathic properties of sugarcane residues could contribute to sustainable weed control, minimizing the need for chemical herbicides and reducing environmental impacts.

Integrated weed management; an approach towards conservation of agroecosystem

Saurabh Kumar*[1], Arun Kumar[2], Balveer Gautam[3], Arushi Chandel[2], Piyush Singh[2] and Amit Kumar Maurya[4]

[1]*Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh 250110, India*
[2]*Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India*
[3]*Acharya Narendra Deva University of Agriculture And Technology, Ayodhya, Uttar Pradesh 224229, India*
[4]*Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Uttarakhand 263145, India*
**Email: shagirdsaurabh@gmail.com*

Integrated weed management (IWM) can be defined as a holistic approach to weed management that combines different methods of weed control to provide the crop with an advantage over weeds. It is practiced globally at varying levels of adoption from farm to farm. Integrated weed management research has focused on how crop yields and weed interference are affected by changes in management, e.g., tillage, herbicide application timing and rates, cover crops, and planting patterns. Integrated Weed Management indeed offers a multifaceted approach to controlling weed populations, emphasizing sustainability and reduced reliance on herbicides. As herbicide-resistant weed species become more prevalent, the shift toward IWM is increasingly recognized as essential for long-term agricultural viability. The integration of diverse practices-such as crop rotation, cover cropping, and mechanical weed control-can help manage weed populations more effectively and sustainably. This diversification not only helps reduce the environmental impacts associated with herbicide use but also mitigates the selection pressure that leads to resistance. While there is ongoing debate regarding the pace at which traditional herbicidal methods are being replaced by IWM practices, the urgency created by resistant weed populations has spurred significant interest in IWM research among weed scientists. This research aims to develop and refine strategies that can be implemented in various cropping systems, promoting resilience and sustainability in agriculture. Ultimately, while challenges remain in fully transitioning to IWM, the growing recognition of its benefits could pave the way for more widespread adoption in the face of evolving weed resistance issues. However, IWM needs to move from a descriptive to a predictive phase if long-term strategies are to be adopted. Linking management changes with crop-weed modeling that includes such components as weed population dynamics and the ecophysiological basis of competition will help predict future weed problems and solutions and the economic risks and benefits of intervention. Predictive approaches would help incorporate IWM into models of the processes that occur in agricultural systems at wider spatial and temporal scales, i.e., in agroecosystems comprised of the interactions among organisms (including human beings) and the environment. It is at these larger scales that decisions about management are initiated and where questions about the long-term consequences and constraints of IWM and agriculture are often asked. These questions can be addressed by agroecosystem health, an approach that integrates biophysical, social, and economic concerns and recognizes that agriculture is part of a world with many complex subsystems and interactions. Indicators are used to examine the status of an agroecosystem, e.g., whether or not it contains all that is necessary to continue functioning. Indicators include soil quality, crop productivity, and water quality; all of these are related to the rationale of IWM, hence IWM can be linked to agroecosystem health.

Effect of pre-mix herbicide on weed dynamics, growth and yield of barley under guava Agri-horti system

Arvind Kumar, M.K. Singh, Brijesh Kumar*, Ambikesh Tripathi, Prajjwal Agnihotri and Sharda Sharan

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: brijeshkumarbuat442@gmail.com*

Barley (*Hordeum vulgare*) is the fourth major cereal in terms of production globally after wheat, maize, and rice. Barley is grown for fodder, brewing, human food, and in the production of malt around the world. Barley is cultivated in 100 different countries. It performs better in low rainfall areas where other crops fail to establish and can survive under adverse environmental and conditions. However, it gives better production on moderately saline soils and higher salinity could obstruct its growth leading to reduced yield. Weed infestation is a major constraint in barley (*Hordeum vulgare*) production, causing significant yield losses and affecting crop quality. Effective weed management is crucial to ensuring high productivity and profitability for barley farmers. Weed control remains one of the most significant challenges in barley production, affecting both yield and quality. Traditional herbicide programs often face issues related to resistance, environmental impact, and crop safety. This study investigates the use of pre-mix herbicides as an alternative strategy for weed management in barley cultivation. Pre-mix herbicides, which combine two or more active ingredients, aim to improve weed control efficacy, delay resistance development, and reduce the application frequency. Field trials were conducted to evaluate the effectiveness of various pre-mix formulations on different weed species in barley. The present research was conducted during *Rabi* season of 2020-21 at agricultural research farm, RGSC, BHU, Barkachha, Mirzapur, (U.P.), India. The experiment was conducted in RCB Design, having 3 pre-mix herbicide mixtures *i.e.* CP+MM (400 g/ha), SS+MM (40 g/ha) and MBZ + CP (500 g/ha) were tested along with 2- HW (30 and 45 DAS), weed free and weedy check. Based on the one-year study, it was concluded that among the various weed management treatments tested, the most efficient weed suppressants were weed- free and 2-HW (30 and 45 DAS). These treatments also having positive impact on crop development and production, but they were not cost effective as compared to the other herbicide mixtures. Among the herbicide mixture treatment, the application of CP+MM (400 g/ha) followed by SS+MM (40 g/ha) minimize the cost of cultivation and found effective to control weed population and increase yield of the crop.

Sustainable weed management strategies for ashwagandha cultivation

Ambikesh Tripathi*, Sudhir Kumar Rajpoot, Sanju Choudhary, Saurabh Raj Pandey, Kanhaiya Singh and Prajjwal Agnihotri

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: tripathi2007@bhu.ac.in*

Ashwagandha or Asgand (*Withania somnifera*), Ashwagandha is a native medicinal plant grown all over central and north-western India, belonging to the Solanaceae family known as Indian ginseng or winter cherry. It is an important ancient plant, in the traditional Indian systems of medicine, Ayurvedic and Unani, the roots were placed. It is in use for a very long time for all age groups and both sexes and even during pregnancy without any side effects. It is a vertically growing, branching shrub, usually 1.50 m tall. In dry and sub-tropical areas, it grows well. Ashwagandha is a plant that is robust and drought resistant. Integrated Weed Management (IWM) is a comprehensive approach that combines multiple strategies eg. cultural, mechanical, biological, and chemical to manage weed populations in a sustainable and environmentally friendly manner. In the cultivation of Ashwagandha (*Withania somnifera*) an important medicinal plant with high economic and therapeutic value. The weed management is critical to ensuring optimal growth and yield. Ashwagandha is highly susceptible to competition from weeds, especially during its early growth stages which can significantly reduce both its biomass and root yield compromising its medicinal quality. Cultural practices such as proper seedbed preparation, timely sowing and optimal plant spacing are essential to give Ashwagandha a competitive edge over weeds. Crop rotation and intercropping with legumes or other compatible crops can improve soil fertility and disrupt weed life cycles. Mechanical control methods including hand weeding and inter-row tillage remain vital especially in organic farming or small-scale farming systems. Mulching with organic or biodegradable materials helps suppress weed emergence, conserve soil moisture, and improve soil health. Selecting herbicides that are compatible with Ashwagandha's growth cycle along with precise application methods can minimize herbicide resistance and environmental contamination. The potential of biological control methods such as using cover crops or natural weed suppressants which align with sustainable farming principles. By integrating these diverse approaches IWM provides an effective and sustainable weed control strategy for Ashwagandha cultivation. It not only helps reduce the crop's dependence on chemical herbicides but also promotes ecological balance, ensuring long-term productivity and environmental sustainability in medicinal plant farming.

Integrated weed management options for changing climate

Krishn Shankar Tripathi* and Smriti Singh
Jawaharlal Nehru Krishi Vishwavidayala, Jabalpur, Madhya Pradesh 482004, India
**Email: krishnshankart@gmail.com*

Weeds are ubiquitous in all cropping situations and can inflict major losses in yield and production quality. In recent years, climate variability has caused major impacts on natural and human ecosystems. In all agricultural environments, weeds are common and can cause significant losses. Ecosystems, both natural and human-made, have been severely impacted by recent climatic fluctuation. The growth and physiology of crops and weeds are significantly impacted by climate change, which is accompanied by increased temperatures, rising atmospheric CO_2, and altered rainfall patterns. Unlike other pests, weeds compete with crop plants for vital resources since they are at a comparable trophic level, which dramatically reduces crop yields. Crop-weed interactions are impacted by climate change, which provides significant production penalties and favors weeds in scenarios with higher temperatures. Weed management is critical for agricultural productivity and climate resilience. Climate change alters weed ecology, distribution, and growth, necessitating adaptive strategies. With improved resource conservation and yield stability, climate-smart agriculture-based management techniques are emerging as a practical and sustainable substitute for traditional for management of weeds in different cropping systems throughout the globe. Apart from the practices of zero-tillage and crop residue retention, other crucial markers of climate-smart agriculture include crop variety, accurate management of water and nutrients, and timely interventions. Climate-smart weed management is a progressive approach that integrates sustainable agricultural practices with adaptive strategies to address the challenges posed by climate change. As global temperatures rise and weather patterns become increasingly erratic, traditional weed control methods may become less effective, necessitating innovative solutions. This framework emphasizes the use of ecological principles to enhance resilience against weed proliferation while minimizing environmental impact. Key strategies include the adoption of integrated weed management (IWM) techniques, which combine mechanical, cultural, biological, and chemical control methods tailored to specific agro-ecosystems. Integrated weed management (IWM) components including weed prevention, optimal fertilizer schedule, summer tillage, crop rotation, modified land preparation, altering crop geometry, seed rate and sowing time, stale seedbed technique, use of weed competitive cultivars, cover crops, residue, allelopathy, *etc*., which complement reduced and judicious herbicide application should be promoted to combat weed problems under changing climate.. Additionally, the implementation of precision agriculture tools can optimize herbicide application, reducing chemical usage and preventing resistance development. Climate-smart practices also promote soil health, biodiversity, and the efficient use of water and nutrients, creating a holistic approach to crop management. By fostering collaboration among farmers, researchers, and policymakers, climate-smart weed management can contribute to food security, ecological sustainability, and the overall resilience of agricultural systems in the face of climate change.

Poster 154

Herbicidal activity of dimethenamid-P 720 g/L EC in managing weed populations in sugarcane

Rajesh Kumar Singh, Kumbhar Rohan Prakash, Nihal Chandra Mahajan and N. Anthony Baite*

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: baiteanthony@gmail.com*

Weed management remains a critical challenge in sugarcane (*Saccharum officinarum* L.) cultivation, where uncontrolled weed growth can severely impact crop productivity. Effective herbicide use is essential in controlling weed populations and enhancing crop yields. Dimethenamid-P, a pre-emergent herbicide from the chloroacetamide group, has gained attention for its ability to control a broad spectrum of annual grasses and certain broadleaf weeds. With this background, a two-year field experiment was conducted at the Agricultural Research Farm of Banaras Hindu University using a randomized block design to evaluate the effectiveness of dimethenamid-P along with various herbicides in controlling weeds in sugarcane. The treatments included five different rates of dimethenamid-P (720 g/L) applied at 370, 470, 570, 600, and 670 g/ha; topramezone; atrazine; weed-free plot; and untreated control. The results demonstrated significant variation in weed control efficacy and crop performance across different treatments. The application of dimethenamid-P at higher rates, particularly at 670 g/ha, showed superior control over both annual grasses and key broadleaf weeds among all the herbicidal treatments, displaying a weed control efficiency of 91.56%. Comparatively, topramezone and atrazine provided adequate weed control but were less effective against certain species and recorded a weed control efficiency of 82.28 and 76.09%, respectively. Application of dimethenamid-P 720 670 g/ha also resulted in the highest plant height (374.86 cm), dry matter accumulation (414.86 g), cane yield (103.30 t/ha) and biological yield (146.49 t/ha) among all the herbicidal treatments. Additionally, the weed-free treatment displayed the highest cane yield (130.60 t/ha) and biological yield (164.53 t/ha), while the weedy check resulted in lowest yield (57.75 and 82.96 t/ha, respectively). Dimethenamid-P offers a promising solution for pre-emergent weed control in sugarcane, particularly when applied at optimized rates. Its ability to inhibit cell division in susceptible weed species prevents early weed competition, thus enhancing crop establishment and productivity. The findings suggest that dimethenamid-P, when integrated into a comprehensive weed management strategy, can contribute to sustainable sugarcane cultivation. Further research is recommended however, to explore its long-term effects on weed dynamics, soil health, and potential resistance development.

Allelopathy: A promising environment friendly tool for weed management in agriculture

Dendukuri Udaya Lakshmi*[1], M.K. Singh[2], P.H.Patel[3], Nilutpal Saikia, Kareti Harika[1] and Prathap Reddy[1]

[1,2]Dept. of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

[3]Dept. of Seed Technology, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat 385505, India

[4]Dept. of Agronomy, indian Agricultural Research Institute, New Delhi 110012, India

**Email: udayalakshmi@bhu.ac.in*

International Allelopathic Society (IAS) has defined allelopathy as 'to any process involving secondary metabolites produced by plants, microorganisms and viruses that influence the growth and development of agricultural and biological systems'. These secondary metabolites called allelochemicals are released into atmosphere in various forms such as vapour leachates, exudates from roots, breakdown or decomposition of dead plant parts and seed extract. Herbicides production and pesticide utilization in the fields every year is causing a very high carbon footprint in the world and depletion of natural resources simultaneously. Using herbicides of same mode of action from the initial decades of herbicide invention in the agriculture fields has caused the development of several herbicide resistant weeds in the fields and human ecosystem. This has given agronomists and agricultural scientists a challenge to found out a potential way which is climate smart, sustainable and environmentally friendly in solving this problem. Therefore, the focus shifted towards integrated weed management using climate smart practices. Allelopathy is one such emerging and future technology which needs the attention as it can minimise the dependence on herbicides for weed control, reduce the percent contribution of agriculture towards environmental pollution without any ill effect on global food production and slow down the weed shift and the emergence of herbicide resistant weeds. Some potential areas of research on allelopathy for weed management with satisfactory weed control efficiency include identifying allelopathic chemicals that has wide spectrum of weed control in terrestrial and aquatic ecosystems, finding the allelopathic basis of suppression and genes responsible for such effects and development of transgenic lines of crops for weed control, development of allelochemicals as herbicide formulation. Agronomically, on field, focus of research should be in discovering the beneficial intercrop combinations of agricultural crops, potential allelopathic crop cultivars, residues, cover crops, and combination of plant extracts solely or with reduced dose of herbicides. These findings eventually will help in developing a scientifically recommended practice with combination of these techniques. This way, on farm resources such as crops or weeds can be best utilised by farmers once that has potential allelopathic nature is explored scientifically. Thus, the implementation of allelopathy in weed management of field crops under a guided, planned research and implementation could be a sustainable, profitable and climate smart approach.

Efficacy of herbicides on nutrient uptake, commercial cane sugar and cane yield of sugarcane

Deeptirekha Mahapatra*, Udai Pratap Singh, Nikhil Kumar Singh and Shiv Poojan Yadav
Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: deeptirekha@bhu.ac.in*

Crop losses, particularly in sugarcane, are due to heavy weed infestations at the initial growth stages that compete with the main crop for nutrients, light and space. It is one of the major biotic constraints in sugarcane production. Sugarcane by virtue of its long duration has longer critical period of 60-120 days for weed competition. Hence, proper choice of weed management practices is required that would be economical, effective and viable with the varying intensity of weed population and their effect on sugarcane. Although manual weeding and mechanical weed control are highly effective, they have faced many challenges in recent years due to workforce shortage and rising costs. Therefore, chemical methods of weed control are cheaper, quicker and easier. Keeping this in view these practices were evaluated at Agriculture Research Farm, Banaras Hindu University, Varanasi located in the Eastern Indo-Gangetic Plains of India in spring season to study the efficacy of various herbicides on nutrient uptake, commercial cane sugar (CCS) and cane yield of spring planted sugarcane (*Saccharum officinarum* L.). The field was infested with *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Chenopodium album*, *Cyperus rotundus*, *Digitaria sanguinalis*, *Solanum nigrum*, *Setaria glauca*, *Panicum repens* and *Phyllanthus niruri* as major weed species. Hand weeding was found to be significantly superior to the other treatments among all weed management techniques. Amongst herbicides, diuron 3.2 kg/ha at 2-4 leaf stage of weed recorded significantly higher nutrient uptake (Nitrogen uptake -269.39 kg/ha , Phosphorus uptake - 34.28 kg/ha , Potassium uptake -335.68 kg/ha) , commercial cane sugar (9.80 t/ha) and maximum cane yield (79.60 t/ ha) followed by diuron 2.4 kg/ha at 2-4 leaf stage of weed and diuron 3.2 kg/ha as PE (Pre-emergence) which was statistically on par with diuron 2.4 kg/ha as Pre-emergence , paraquat 0.5 kg/ha as early post-emergence, and metribuzin 1.5 kg/ha as pre-emergence except superior to 2, 4-D Na+ salt 2.6 kg/ha at 2-4 leaf stage of weed. So, it can be concluded that diuron 3.2 kg/ha should be applied at the 2-4 leaf stage of weeds for improving cane yield and qualitative attributes.

Novel weed control strategy in *Kharif* maize under Bael (*Aegle marmelos*) based Agri-horti system in Eastern Uttar Pradesh

Tridib Sonowal, Pratik Sanodiya and Vaishnavi Pandey
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
Email: oxoacidh2so4@gmail.com

Maize (*Zea mays*), the second most widely grown crop globally, is now finding place in the agroforestry system as well, which integrates trees with agronomic crops to maximize land and resource use efficiency. The versatile nature of maize makes it a promising crop in such systems to augment overall productivity. Weeds pose a major threat in maize, estimated to cause about 37% yield loss worldwide. The initial slow growth and wider row spacing coupled with congenial weather for weed growth may reduce yield by 28–100%. Weeds not just compete with the crop for resources but also attract other insects and animals (Wild boar and Nilgai in the region) causing further loss. Thus, consideration of the ecological interactions of weed, limiting labour availability are of significant importance in order to shift towards chemical means to curb the weed losses. In that line, Topramezone and Halosulfuron are recently introduced selective, post-emergence herbicides in maize. These HPPD (4-hydroxyphenylpyruvate dioxygenase) inhibiting herbicides inhibit the weeds by bleaching of developing tissues. A field experiment was conducted at Agricultural Research Farm, Rajiv Gandhi South Campus, Banaras Hindu University, Barkachha, Mirzapur, Uttar Pradesh to evaluate effect of establishment methods and HPPD inhibitors on weeds and productivity of *Kharif* Maize in 2022. The factorial experiment conducted in Randomized Block Design with two establishment methods *i.e.*, M1: Conventional method and M2: Ridge and furrow method in one factor effect and four herbicidal treatments *i.e.*, W1: atrazine 1.0 kg/ha *fb* by topramezone 25.2 g/ha at 25-30 DAS, W2: atrazine 1.0 Kg/ha *fb* by halosulfuron methyl 67 g/ha at 25-30 DAS, W3: two hand weedings at 20 and 40 DAS and W4: weedy check in second factor with three replications. Weed density and weed dry matter were recorded at 40 DAS by placing quadrate at 1.0 m^2 area at two places per plot. The grain yield and stover yields were recorded from the net plot area and converted into hectare for comparison. In addition, the weed control efficiency and weed index were also calculated. At 40 DAS, In M2, total weed density and total weed dry matter were observed lesser as compared to M1. However statistically, they were at par in total weed dry matter. Amongst the weed control treatments, W1 recorded significantly lesser weed density and dry matter than other treatments except the two hand weedings (W3). When considering yield attributes, M2 found higher grain (4.106 t/ha) and stover yields (4.994 t/ha) while among the weed control treatments. Moreover, W1 exhibited higher grain (4.842 t/ha) and stover yields (5.833 t/ha) over W1 with higher weed control efficiency and lesser weed index. Treatments' effect on crop economics showed the same trend for both *Kharif* maize and *Kharif* maize + Bael combined *i.e.*, M2W1 being the most profitable treatment combination with B:C of 3.03 and 3.49 respectively. Hence, it was concluded that herbicidal application of atrazine 1.0 kg/ha *fb* by topramezone 25.2 g/ha at 25-30 DAS gave significantly better weed control, enhanced yields and monetary returns of *Kharif* maize.

Crop diversification for weed management

S.K. Parmar* and B.B. Tandel

Department of Agronomy, N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat 396450, India

**Email: skparmar@nau.in*

Crop diversification refers to the addition or replacing of new crops or cropping systems to existing farmland taking into account the different returns on investment. It is shifting from traditionally grown less profitable crops to more profitable crops. It promotes, crop diversity by crop rotation, multiple cropping, intercropping, alley cropping, green manuring, relay cropping, mixed cropping, agroforestry and so on with the goal of improving productivity, sustainability and supply chain management of natural resources. The losses in crop yield due to weeds is about 33% which is very much higher than other pest and diseases. Weeds compete with crops for nutrient, moisture, light and space. Also, some weeds have allelopathic effect on crops. Sometimes weeds act as a host of some pest and disease. Rotating crops with different life cycles can disrupt the development of weed crop associations, different planting and harvesting dates preventing weed establishment and therefore weed seed production mainly affected by smothering and allopathic effect. Growing of different plant types together which enhances weed control by capturing a great share of available resources and probability by increasing shade and crop competition with weeds in tighter crop spacing (Praveen and Bhanu 2005). Cover crop germinates very quickly and develop large canopy, capable of efficient photosynthesis within short period. They possess both surface and deep roots. Competitive crops smother the ground quickly than non-competitive crop. Many short duration pulses like cowpea and soybean effectively smother weeds without causing reduction in the yield of main crop. Green manuring act as cover and have potential to conserve soil and moisture, enhancing soil nutrient status, total biomass production, reducing density and dry matter accumulation of weeds and increased yield.

Poster 159

Efficacy of sequential application of pre- and post-emergence herbicides for integrated weed management in sesame

K. Ramesh*, B. Padmaja*[1], C. Harisudan[2], Ratna Kumar Pasala, Aziz Qureshi and T. Dilip
ICAR-Indian Institute of Oilseeds Research, Rajendra Nagar, Hyderabad, Telangana 500030, India
[1]AICRP Weed Management, Professor Jayashankar Telangana State Agricultural University, Hyderabad, Telangana 500030, India
[2]AICRP-Sesame, Tamil Nadu Agricultural University, RRS, Vridhachalam, Tamil Nadu 606001, India
**Email: kragronomy@gmail.com*

Sesame is one of the oldest oilseeds crops of the world and India ranks first in both acreage and production of sesame, albeit the productivity is too low as compared to its potential. India exports a large quantity of sesame to other countries. Wherever raised as an irrigated crop weed management is a serious concern which hampers the productivity. India produces a wide range of sesame seed varieties and grades, each peculiar to the region where they are grown. Although, Gujarat, Madhya Pradesh, Rajasthan, Odisha and Uttar Pradesh cultivate sesame as a *Kharif* (70%) crop, productivity of summer crop is always high. With this backdrop, a field experiment was carried out during the late *Rabi* season of 2024 at ICAR-Indian Institute of Oilseeds Research, Hyderabad to assess the efficacy of the sequential application of pre- and post-emergence herbicides for managing weed flora in line sown sesame (*Sesamum indicum* L.) cv 'CUMS 17'. There were 22 weed management treatments replicated thrice in a randomized block design, *viz*. pendimethalin 30% EC 0.75 kg/ha, pyroxasulfone 85% w/w WG 127.5 g/ha and pendimethalin 30% + imazethapyr 2% EC (750+50) g/ha as pre-emergence herbicide spray on 3 DAS and post-emergence herbicides *viz*., bentazone 48% SL at 480,760 and 960 g/ha as, clethodium 25% EC at 60, 90 and 120 g/ha, haloxyfop-r-methyl 10.5% w/w EC at 54, 81 and 108 g/ha, metribuzin 70% WP at 0.3, 0.4 and 0.53 kg/ha, fluazifop-p-butyl 11.1% w/w + fomesafen 11% w/w SL (premix) at 125 g and 187.5 g/ha, propaquizafop 2.5% + imazethapyr 3.75% (premix) at (25 + 37.5 and 56.25) g/ha and pyrithobac-sodium 6% w/w + quizalofop-ethyl 4% w/w EC (premix) at (60+40) g/ha as PoE at 2-3 leaf stage of weed. All the post-emergence herbicides were preceded by Pendimethalin 30% EC 0.75 kg/ha at 3 DAS. A weedy and weed free control was also maintained. While weed free check has recorded significantly highest seed yield (0.66 t/ha), among the herbicide management treatments, pendimethalin 30% + imazethapyr 2% EC (750+50) g/ha (Premix) as a pre-emergence herbicide has recorded significantly highest yield (0.56 t/ha). This was followed by sequential application of pendimethalin 30% as PE followed by haloxyfop-r-methyl 10.5% w/w EC at 54 g/ha as a PoE (0.42 t/ha). Application of only pyroxasulfone 85% w/w WG 127.5 g/ha as PE was at par with the sequential application of herbicides. The uncontrolled weeds in weedy check reduced sesame yield to just 33% of the weed free yield. The minimum weed index of 0.12 was recorded for the pendimethalin 30% + imazethapyr 2% EC (750+50) g/ha (premix) with 72% weed control efficiency (based on weed dry weight at 60 DAS) as a pre-emergence herbicide, exhibiting superiority in weed management in sesame.

Effect of weed management practices on growth, yield attributes and yield of *Rabi* potato under northern hill zone of Chhattisgarh

Sandeep Sharma*, Dinseh Kumar Gupta and O.P. Rajwade
Krishi Vigyan Kendra, Mainpat, Dist-Surguja, Indira Gandhi Agricultural University, Raipur, Chhattisgarh 492012, India
**Email: sameer_sandy2002yahool.com*

The field experiment was carried out at Potato Research Station, Mainpat, IGKV (C.G.) during *Rabi* 2019-20 and 2020-21. An experiment entitled "Effect of weed management practices on growth, yield attributes and yield of *Rabi* potato under Northern Hill Zone of Chhattisgarh'' was laid out in Randomized Block Design having eight weed management practices *viz*. W1-metribuzin 70% WP 0.75 kg/ha, PE, W2-pendimethalin 38.7% CS 1.0 kg/ha, PE, W2-oxyflourfen 23.5% EC 0.1 kg/ha, PE, W4-atrazine 50% WP 1.0 kg/ha, PE, W5-paraquat 24% SL 0.5 kg/ha early PoE after 10% germination of potato, W6-mechanical weeding 40 DAP, W7- hand weeding 20 and 40 DAP and W8- unweeded check. The predominant weeds were *Cyperus rotundus*, *Cynodon dactylon*, while among broad-leaf weeds *Chenopodium album*, *Anagallis arvensis* and *Medicago denticulata*. Significantly lowest weed density and dry matter of weeds were recorded under hand weeding (20 and 40 DAP) treatment. The result of the experiment revealed that all growth parameters *i.e*. emergence, plant height, number of shoots plant-1, shoot fresh and shoot dry weight plant-1, yield attributes and yield were maximum under hand weeding (20 and 40 DAP). Total tuber yield was increased 71% over the unweeded check.

Poster 161

A study on forage sorghum: the intersection of weed management and climate resilience

Diksha Sharma*, Rupam Bharti, Vipin Dixit, Jagdish Choudhary and Kapila Shekhawat
ICAR -Indian Agricultural Research Institute, New Delhi 110012, India
**Email: dikshasharma01081998@gmail.com*

Sorghum (*Sorghum bicolor* L. Moench) has rapidly ascended as a critical forage crop, esteemed for its remarkable resilience, superior nutritional value and extraordinary adaptability to a range of climatic conditions. Its cultivation, coupled with climate-smart weed management strategies, holds immense potential in addressing global food security challenges. In light of this, a detailed experiment was conducted during the *Kharif* season of 2022 at the Rajasthan College of Agriculture, Udaipur, with the objective of evaluating the impact of diverse weed management practices on forage sorghum. The study employed a RBD with 12 treatment combinations, each replicated three times. The experimental treatments included: atrazine 50% WP 0.50 kg/ha as pre-emergence (PE), metolachlor 50% EC 1.00 kg/ha as PE, pyroxasulfone 85% WG 0.1275 kg/ha as PE, 2,4-D Na salt 80% WP 0.75 kg/ha as post-emergence (PoE) at 20 days after sowing (DAS), a combination of + atrazine 50% WP 0.50 kg/ha as PoE, 2,4-D Na salt 80% WP 0.75 kg/ha as PoE, intercropping sorghum with cowpea (1:1 additive series) without herbicides, intercropping sorghum with cowpea+pendimethalin 30% EC 0.75 kg/ha as PE, intercropping with black gram without herbicides, intercropping with black gram + pendimethalin 30% EC 0.75 kg/ha as PE, a weed-free treatment consisting of manual weedings at 15 and 35 DAS, and an untreated weedy check. The results revealed that the weed-free treatment led to the highest growth parameters and forage yield, underscoring the profound impact of stringent weed control measures. Among the herbicidal treatments, the application of atrazine 50% WP at 0.50 kg/ha as both PE and PoE demonstrated superior efficacy. This treatment achieved the maximum plant height (246.13 cm), stem girth (3.18 cm), and the highest green and dry fodder yields of 66.49 t/ha and 14.84 t/ha, respectively. Additionally, the total weed dry matter at 20 and 40 DAS, as well as at harvest, was significantly reduced under, indicating its exceptional weed suppression capabilities. The highest weed control efficiency (62.43%) was recorded at 50 DAS under the treatment, which also resulted in the lowest weed index (0.28) at harvest. These findings underscore the strategic importance of integrating advanced herbicidal treatments, in enhancing the productivity of forage sorghum while minimizing weed competition. Beyond improving livestock nutrition, such practices are pivotal in bolstering the sustainability of agricultural systems, particularly in the face of mounting climatic variability. The widespread adoption of these innovative weed management techniques, supported by collaborative efforts among farmers, researchers and policymakers, is essential for scaling their benefits, ensuring sustainable sorghum production, and safeguarding food security on a global scale.

Effect of mulching and herbicides on weed interference in sugarcane

Lalit Kumar Mainway*[1], S.K. Verma[2], T.K. Das[3], Ruchi Rajpoot[4] and Gunturi Alekhya[1]

[1,3]Division of Agronomy, ICAR- IARI, Pusa, New Delhi 110012, India

[2]Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

[4]Department of Agronomy, Rani Lakshmibai Central Agricultural University, Jhansi, Uttar Pradesh 284003, India

Emai: lalitmainway@gmail.com

This study has investigated the impact of mulching with parthenium (*Parthenium hysterophorus*) and water hyacinth (*Eichhornia crassipes*) in combination with herbicide application on the weed interference in sugarcane (*Saccharum officinarum*). Mulching is a sustainable agricultural practice known to suppress weeds, conserve soil moisture and regulate temperature. The factorial experiment was conducted during the growing seasons of 2021-22 and 2022-23 at Institute of Agricultural Sciences, BHU, Varanasi with two mulching treatments supplemented with five herbicides/weed control treatments in a randomized block design with three replications. The mulching included water hyacinth mulch 6 t/ha (M1) and parthenium mulch 6 t/ha (M2). Herbicidal treatments were 2,4-D-Na salt (95%WP) 2.76 kg/ha at 30 days after planting (DAP) followed by *(fb)* the ready-mix of ametryn (73%) + trifloxysulfuron-Na (1.8%) 3 kg/ha at 45 DAP (W1), 2,4-D-Na salt (95%WP) 3.74 kg/ha at 30 DAP *fb* ready-mix of ametryn (73%) + trifloxysulfuron-Na (1.8%) 3 kg/ha at 45 DAP (W2), metsulfuron methyl (20%WP) 0.006 kg/ha at 30 DAP *fb* ready-mix of ametryn (73%) + trifloxysulfuron-Na (1.8%) 3 kg/ha at 45 DAP (W3), weed-free check (W4), and weedy check (W5). The results revealed that both the mulching treatments (M1 and M2) led to significant reduction in density and dry weight of weeds compared to the control in 2021-22 and 2022-23, but the water hyacinth mulch (M1) resulted in much higher weed suppression than even parthenium mulch (M2). It resulted in significantly lower total weed density (67.24 and 56.02/m^2) and dry weight (45.00 and 37.48 g/m^2) than M2. Among herbicides, the treatment W2 resulted in significantly lower weed density (48.90 and 33.60/m^2) and dry weight (28.62 and 18.25 g/m^2) than in other treatments except W4 treatment. Among the combinations of mulching and herbicides, the M1W2 led to significantly lower total weed density (42.34 and 27.13/m^2) and dry weight (21.99 and 11.57 g/m^2) during both years than other herbicides treatments. Thus, this study highlights that the invasive weed water hyacinth can be effectively utilized as mulch in sugarcane and supplemented with 2,4-D-Na salt 3.74 kg/ha at 30 DAP and ready-mix of ametryn + trifloxysulfuron-Na 3 kg/ha at 45 DAP for effective weed control and enhancing sugarcane production. Research may be continued further to evaluate the long-term impacts of the mulching and herbicides on soil health and crop productivity.

Poster 163

Next-generation solutions for weed science/management

Jigyasa Ninama[1], Raghuveer Meena[2] and Vikram Pal[3]

[1-2]Department of Agronomy, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan 334006, India

[3]Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh 211007, India

**Email: jigyasaninama9@gmail.com*

The field of weed science and management has witnessed significant advancements in recent years, driven by the integration of novel technologies. These innovations aim to address the growing challenges posed by herbicide resistance, environmental sustainability, and the need for precision in agricultural practices. Key developments include the application of artificial intelligence (AI) and machine learning (ML) in weed detection and classification, enabling the creation of precision-guided robotic weeders that reduce the reliance on chemical herbicides. Drones and remote sensing technologies provide real-time data on weed populations and their spatial distribution, enhancing early detection and targeted interventions. Genomic tools such as CRISPR-Cas9 and RNA interference (RNAi) offer potential for controlling invasive weed species at the molecular level by targeting specific genes responsible for herbicide resistance or plant growth. Furthermore, bioherbicides and plant-based extracts are emerging as sustainable alternatives to synthetic chemicals, minimizing the environmental impact of weed control. This abstract contains the convergence of these cutting-edge technologies and their potential to transform weed management by making it more efficient, sustainable, and adaptable to the challenges of modern agriculture.

Impact of weed flora on crop yield and nutrient depletion in diversified Cropping systems

Shivali Rana*, S.S. Rana and Shabnam Thakur
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh 176062, India
**Email: rshivali1998@gmail.com*

Weeds are probably the most ever-present class of crop pests and are responsible for marked losses in crop yields. They reduce the crop yield and deteriorate the quality of produce and hence reduce the market value of the turnout. Weeds inflict huge yield and nutrient losses depending upon the crop variety, management practices and type and intensity of weed flora. The crop, cropping systems and varying management practices like organic inputs, tillage conditions, water control, crop rotation, fertilizer application and herbicide use have been reported to affect significantly weed communities in a range of agro-ecosystems. Therefore, the present study was planned to estimate yield and nutrient losses by weeds in different cropping systems. The field experimentation work was carried at a continuing experiment under AICRP-IFS at Bhadiarkhar farm CSK Himachal Pradesh Krishi Vishwavidyalaya Palampur at 320 6' N latitude, 760 3' E longitude, and 1290 m elevation in the North-West Himalayas. The field experiment was laid out in a Randomized Block Design (RBD) with 10 treatments and was replicated thrice. Ten cropping systems C1–"maize – wheat", C2 – "maize –gobhisarson + toria", C3– "dhaincha–early cabbage – frech bean", C4– "sunhemp – vegetable pea - french bean", C5–"maize + soybean – chickpea + linseed", C6– "rice – wheat + gram", C7– "hybrid sorghum + hybrid Bajra – oats + sarson", C8 – "hybrid sorghum + hybrid bajra – ryegrass + berseem", C9 – "baby corn – broccoli - french bean", C10 "okra – turnip - Tomato" were evaluated for appraisal on weeds floristic diversity, NPK depletion and yield loss due to weeds . The experimental field at the Bhadiarkhar farm was closely observed to check for the presence of weed species during *Kharif* 2021-Rabi 2022. Soil of experimental field was silty-clay loam in texture and acidic in reaction with PH 5.38. Weed flora was composed of 13 species in *kharif* 2021, *viz. Ageratum conyzoides, Cyperus spp., Phyllanthus niruri* and *Galinsoga parviflora* were the dominating weed species and remaining weed species were *Alternanthera philoxeroides*, *Artemesia vulgaris, Commelina bengalensis, Coronopus didymus*, *Digitaria sanguinalis*, *Echinochloa* spp., *Ipomoea* spp. and *Monochoria vaginalis*. During *Rabi* 2022, 13 weed species were reported, out of them dominating weed species were *Poa annua*, *Coronopus didymus, Spergula arvensis* and *Trifolium repens* and the other weed species were *Anagallis arvensis, Avena fatua*, *Cynodon dactylon*, *Phalaris minor*, *Lolium temulentum, Raphanus* spp., *Stelleria media* and *Vicia sativa*. Nutrient depletion by weeds is minimum under cropping system C1 – "maize – wheat" for N, C2 – "maize –gobhisarson + toria" for P and C7 – "Hybrid Sorghum + Hybrid Bajra – Oats + Sarson" for K and maximum under cropping systemC7 – "hybrid sorghum + hybrid bajra – oats + sarson" for N, C10 "okra – turnip - tomato for P and C3– "dhaincha – early cabbage – frechbean" for K. For *Kharif* season, percent yield loss was found to be higher in C6 – "rice – wheat + gram" and for *Rabi* season it was higher in C9 – "baby corn – broccoli – french bean" cropping system. Weeds inflicted huge yield losses ranging from 38.46% to 82.20%.

Integrated weed management

Puja Vishnoi*, U.N. Shukla, Ramdev Sutaliya and Rakesh Kumar
Department of Agronomy, College of Agriculture, Agriculture University, Jodhpur, Rajasthan 342304, India
**Email: bishnoipuja409@gmail.com*

Integrated weed management (IWM) means integrating multiple weed control strategies into a single weed management program, optimizing control of a particular weed problem. The past several decades has seen simplified weed control practices that rely heavily on a few popular herbicides. However, the rapid spread of herbicide-resistant weeds has required farmers to incorporate alternative weed management approaches. While many farmers are incorporating different herbicides, this is likely to have only short-term success. Using non-herbicide approaches in combination with multiple, effective sites of action is needed for long-term success. Integrated weed management is the coordinated use of a variety of control methods, reducing reliance on herbicides alone, and increasing the chances of successful control or eradication. Integrated weed management programs require long-term planning, knowledge of a weed's biology and ecology and appropriate weed control methods. IWM is a science-based decision-making process that coordinates the use of macro and micro-environment information, weed biology and ecology, and all available technologies to control weeds by the most economical and ecologically viable methods. Limited ecological studies were carried out on certain problematic weeds. Majority of the research in India on IWM was herbicide-based. Economic analysis revealed that herbicides use in combination with hand weeding was most economical. Weeds are dynamic and it is required to redesign the strategies from time to time for the successful management of ever-increasing problem of weeds. IWM research in India must broaden beyond herbicide-centred weed management. Future IWM research in India must focus on decision-making processes, weed biology and ecology, environmentally and economically viable components of IWM practices in cropping systems, herbicide resistance, environmental issues related to transgenic plants, and potential benefits of weeds. Herbicide application is the main weed control strategy used. Reliance on this one method has led to the development of herbicide-resistant weeds. There are a limited number of herbicides available to use and cases of herbicide resistance are rapidly increasing in the US. As a result, herbicides are in need of extra help to continue to ensure adequate weed control. IWM tactics span a wide range of options and complexity. Many IWM tactics can be integrated without substantial change to current management programs, while others require more extensive planning and implementation.

Poster 166

Weed management in seed spices

Ruchika Choudhary* and Arvind Verma
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: ruchikachoudhary518@outlook.com*

Seed spices are globally recognized for their significant contributions to enhance the sensory attributes of various products, including food, beverages, pharmaceuticals, cosmetics and perfumes. Seed spices are typically grown in semi-arid and arid areas with dry or wet cool weather condition. The slow initial growth of seed spices such as fenugreek, coriander, fennel, cumin, ajwain, nigella, aniseed, celery and dill making them highly susceptible to weed competition. The degree of yield reduction is influenced by several factors including specific weed species, intensity of infestation, timing of weed growth relative to the crop, competition from neighbouring crops, soil composition, prevailing climate conditions and the effectiveness of management practices. Weeds are the major hindrance in maximizing seed spices productivity, jeopardizing about 34% of potential production globally surpassing both insect pests (18%) and pathogens (16%). Speed spices suffer considerable yield losses ranging from 14% to over 90% due to weeds. Weeds compete for essential resources like water, nutrients, and sunlight, severely impacting crop productivity and quality. The variety of weed species present and the level of competition they pose to crops can fluctuate based on soil composition, weather patterns, geographical location and agricultural practices employed in the field. Seeds are commonly infested with *Chenopodium murale*, *Chenopodium album*, *Cynodon dactylon*, *Phalaris minor*, *Cyprus rotundus*, *Amaranthus viridis etc*. Therefore, they need to be controlled within critical period of crop weed competition which ranges from 15-60 DAS in various seed spices using appropriate strategy. The dynamics of competition between crops and weeds are shaped by a multitude of factors encompassing weed type, crop diversity, row spacing, fertilizer distribution and soil moisture levels. Timely weed removal during the critical weed control period is imperative to mitigate crop losses. The competition for nutrients becomes more intense when both the crop and weeds are actively growing and taking up nutrients from the soil. Weeds can be particularly aggressive in nutrient acquisition, which results in nutrient deficiencies in the crop. Studies have shown that nitrogen, phosphorus and potassium content in weed tissues can be 1.8 to 2 times higher than that of nigella. Additionally, high uptake of these nutrients by weeds has been observed in competition with cumin. Effective weed management strategies tailored to the specific weed species and crop requirements are crucial for successful seed spice cultivation in this region. Weed control is a critical component of seed spice production vital for optimizing crop yield and sustainability in agricultural systems. Infestation with diverse weed flora makes it difficult to manage the weeds with any single method, hence strategic selection and integration of different methods is required. Strategies may include cultural practices, mechanical methods, herbicide applications, mulching and intercropping to minimize weed competition and maximize crop productivity. Additionally, integrated approaches that combine multiple weed management techniques are often necessary to address the diverse range of weed species present in these agricultural systems ensuring more sustainable, environmentally friendly and effective weed control in seed spice cultivation. This holistic approach helps minimize weed competition and enhances the overall productivity and profitability of seed spice farming.

Poster 167

Effect of pre- and post-emergence herbicides on weed dynamics and yield of white onion

G.K. Mote*, T.N. Thorat, P.S. Bodake, K.S. Raut, V.A. Rajemahadik and G.V. Mitkar
Department of Agronomy, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, Maharashtra 415712, India
**Email: girijamote98@gmail.com*

Weeds pose a significant challenge to white onion (*Allium cepa* L.) cultivation, competing with crop for essential resources leading to substantial yield losses. Due to the unavailability of labours during critical periods, mechanical methods have become inefficient and economically unsustainable. In this context, chemical weed control offers a viable alternative. Thus, an investigation was carried out at Department of Agronomy, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during *Rabi* 2023-24 to study the effect of pre- and post-emergence herbicides on weed dynamics and yield of white onion. Twelve treatments including ten herbicide treatments like pendimethalin as pre-plant incorporation and pre-emergence, oxyfluorfen as pre-emergence and early post-emergence and herbicide combinations (ready-mix) like propaquizafop + oxyfluorfen, quizalofop-ethyl + oxyfluorfen and fenoxaprop p-ethyl as post-emergence herbicides with weed free check (hand weeding at 20 and 40 DAT) and weedy check (control) were assessed using randomized block design and were replicated thrice. The white onion variety 'Alibaug local' was transplanted at 20 cm × 15 cm spacing. Recommended dose of 100:50:50 N; P2O5; K2O kg/ha was given uniformly to all the treatments. The experimental plot was infested with grassy weeds like *Digitaria sanguinalis*, *Echinochloa colona* and broadleaf weeds like *Cardiospermum halicacabum, Physalis minima, Celocia argentea, Cleome viscosa* and *Hibiscus trionum*. The results of the experiment revealed that oxyfluorfen 23.5% EC at 120 g/ha pre-emergence *fb* propaquizafop 5% + oxyfluorfen 12% EC at (43.75+105) g/ha post-emergence and oxyfluorfen 23.5% EC at 120 g/ha pre-emergence *fb* quizalofop-ethyl 4% + oxyfluorfen 6% EC at 100 g/ha post-emergence provided wide spectrum of weed control with lower weed density and weed biomass at 40 DAT, 60 DAT and at harvest which was comparable to two hand weeding at 20 and 40 DAT. Weed control efficiency was recorded to the tune of 10.58% to 78.62% at harvest with highest in pre-emergence application of oxyfluorfen 23.5% EC at 120 g/ha *fb* post-emergence application of propaquizafop 5% + oxyfluorfen 12% EC at (43.75+105) g/ha (78.62%). Hand weeding at 20 and 40 DAT recorded significantly higher bulb yield (138.76 q/ha) *fb* oxyfluorfen 23.5% EC at 120 g/ha pre-emergence *fb* propaquizafop 5% + oxyfluorfen 12% EC at (43.75+105) g/ha post-emergence (135.51 q/ha) and pre-emergence oxyfluorfen 23.5% EC at 120 g/ha *fb* post-emergence quizalofop-ethyl 4% + oxyfluorfen 6% EC at 100 g/ha (133.13 q/ha). Also, lowest weed index was obtained with the same treatments (2.38% and 4.08%, respectively). Thus, it could be concluded that oxyfluorfen 23.5% EC at 120 g/ha pre-emergence *fb* propaquizafop 5% + oxyfluorfen 12% EC at (43.75+105) g/ha post-emergence or oxyfluorfen 23.5% EC at 120 g/ha pre-emergence *fb* post-emergence quizalofop-ethyl 4% + oxyfluorfen 6% EC at 100 g/ha could be used as better alternative to hand weeding for obtaining higher yield and weed control efficiency in white onion.

Recent trends in nanotechnology used for weed management

Prajjwal Agnihotri*, Rajesh Kumar Singh, Ambikesh Tripathi, Brijesh Kumar and Sharda Sharan

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: prajjwalagnihotri8549@gmail.com*

Weed management in agriculture is a critical juncture. The global crop productivity is declining due to a number of issues. However, weed infestation is the major biotic constraint. Weeds compete with crops for nutrients, space, water, and light, depleting the crop environment. The agricultural production is significantly reduced as a result of this competition. A weed-free environment is crucial for obtaining the highest yield during the crucial phase of crop weed competition. It is possible to manage weeds successfully using biological, chemical, physical, and cultural techniques. All those methods of weed control have its own advantage and disadvantages. Out of all those techniques, hand weeding is the most successful way to control weeds. At the same time increasing laborer cost and scarcity of laborer during peak period of agricultural operation led to search for alternative methods. Now a days new advanced technologies are coupled with chemical weed management for increase its efficiency. Nanotechnology is emerging out as the greatest imperative tools in recent agriculture and predictable to become a driving economic force in the near future. It is the science of nano-scale material manipulation. While nanotechnology uses new delivery methods and chemical agents to increase crop yield and reduce the need for bulk agrochemicals, it also has the ability to provide more intelligent solutions for today's agricultural issues. The reduced use of herbicides with increased efficiency, controlled release and targeted delivery will lead to precision farming. Improvement of crops in agriculture is a continuous process. Nano-herbicides are being developed to address the problems in perennial weed management and exhausting weed seed bank. These modern technologies are employed to expedite timely agricultural operations and control the labor scarcity. Thus, these new technologies contribute to lower herbicide dosages, less environmental contamination, and higher profitability.

Productivity and weed dynamics as influenced under herbicidal weed management in onion

V.V. Goud*, Prerna Hinge, N.W. Raut and A.P. Karunakar
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra 444104, India
**Email: vikasgoud08@yahoo.com*

The experiment was carried out to study the relative efficacy of herbicides on weed control in onion as well as to study its effect on growth and yield of onion during *Rabi* 2023 and 2024. The experiment was laid out in Randomized Block Design with three replication and eight treatments. The treatments comprised of oxyfluorfen 23.5% EC at 0.100 kg/ha PE (0-5 DAT), oxyfluorfen 23.5% EC at 0.100 kg/ha PE (0-5 DAT) *fb* quizalofop-ethyl 4% + oxyfluorfen 6% EC at 0.100 kg/ha (RM) PoE (2-3 leaf stage of weed), oxyfluorfen 23.5% EC at 0.100 kg/ha PE (0-5 DAT) *fb* propaquizafop 5%+ oxyfluorfen 12% EC at 0.148 kg/ha (RM) PoE (2-3 leaf stage of weed), pendimethalin 38.7% CS at 0.677 kg/ha PE (0-5 DAT), pendimethalin 38.7% CS at 0.677 kg/ha PE (0-5 DAT) *fb* quizalofop-ethyl 4% + oxyfluorfen 6% EC at 0.100 kg/ha (RM) PoE (2-3 leaf stage of weed), pendimethalin 38.7% CS at 0.677 kg/ha PE (0-5 DAT) *fb* propaquizafop 5%+ oxyfluorfen 12% EC at 0.148 kg/ha (RM) PoE (2-3 leaf stage of weed), farmers practice (Hand weeding at 20, 40 & 60 DAT) and Weedy check respectively. The soil of experimental field characterized as clayey in texture, having slightly alkaline pH (7.9), moderate in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium. Onion (Akola safed) was transplanted at 10 x 10 cm spacing with 100:50:50:30 NPKS kg/ha. Predominant weed flora were *Cyperus rotundus* L., *Commelina benghalensis*, *Parthenium hysterophorus*, *Digitaria sanguinalis*, *Dactyloctenium aegyptium*, *Portulaca oleracea* L., *Phyllanthus niruri* L, *Ipomea* sp., *Digera arvensis*, *Argemone mexicana*, *Echinochloa colonum*. Considering the weed management strategies significantly minimum weed density, weed dry weight, weed index and relatively maximum weed control efficiency were recorded in farmers practice (hand weeding at 20, 40 and 60 DAS) followed by oxyfluorfen 23.5% EC 0.100 kg/ha pre-emergence (0-5 DAT) *fb* propaquizafop 5%+ oxyfluorfen 12% EC 0.148 kg/ha (RM) post-emergence. Among the herbicidal treatments, application of oxyfluorfen 23.5% EC 0.100 kg/ha pre-emergence (0-5 DAT) *fb* propaquizafop 5%+ oxyfluorfen 12% EC 0.148 kg/ha (RM) post-emergence produced higher plant height, dry matter accumulation, polar and equatorial diameter of onion bulb and bulb yield (t ha-1). However, highest gross return was recorded with farmers practice i.e. thrice hand weeding while maximum net return and benefit, cost ratio was obtained with application of oxyfluorfen 23.5% EC 0.100 kg/ha pre-emergence (0-5 DAT) *fb* propaquizafop 5%+ oxyfluorfen 12% EC 0.148 kg/ha (RM) post-emergence.

Weed flora dynamics and growth response of high value and climate crops under varied agri-horti system and climate smart weed management practices in Vindhyan region

Rajashree Krishna Bharadwaj*, Sudhir Kumar Rajpoot and Ambikesh Tripathi

Department of Agronomy, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India

**Email: rkb0706@gmail.com*

Mirzapur is located in Uttar Pradesh's foothill of Vindhyan region and has subtropical climate with hot and dry summers and very cold winters. The growing global population and changing dietary patterns are the driving forces that have induced increased food production. Horizontal expansion of climate smart crops can be achieved by introduction of short duration and climate smart pulse crop like cowpea (*Vigna unguiculata*), cluster bean (*Cyamopsis tetragonoloba*) and high value crops like okra (*Abelmoschus esculentus*), ashwagandha (*Withania somnifera*), and finger millet (*Eleusine corocana*) under different agri-horti systems. Response of climate smart crops under different agri-horti system and weed management is lacking. Therefore, an agronomic trial was conducted during monsoon season of 10 July 2024 at Agricultural Research Farm, Rajeev Gandhi South Campus, Banaras Hindu University, Barkaccha, Mirzapur, Uttar Pradesh under " All India Coordinated Research Project on Dryland agriculture" in randomized block design, consisting of two 17 years old agri-horti system (Bael and Custard Apple) with three replications of each crop. The crops were grown as alley under the agri-horti system. The most common weeds observed were *Digitaria* spp, *Cleome viscosa*, *Eichnochloa colona*, *Parthenium hysterophorus*, *Phyllanthus niruri*, *Cyperus rotundus* majorly along with other weeds in almost all crops with some species of weed dominating the other in crop specific manner. One hand weeding (1-HW 20DAS), two hand weeding (2-HW 15 and 30DAS) and weekly checks were assigned. Agri-horti system significantly ($P<0.05$) affected the growth, yield attributes, yield and nutrient content of crops. The weed management practices significantly affected CGR, RGR and yield of five crops.2-hand weeding effectively reduced weed biomass and showed highest yield, RGR and CGR. Climate change not only directly impacts food production through physical disruption, but also indirectly through biological stressors including weeds. The efficacy of many weed management tactics necessitates specific environmental conditions that are becoming less predictable at local level. To develop climate-smart agriculture with climate smart weed management that can meet the needs of growing global population, a deeper understanding of how climate change affects weed biology, ecology and management is essential.

Integrated weed management

Chetram Meena*, Ramdev sutaliya, Nalini Ramawat and Uma Nath Shukla
Department of Agronomy, College of Agriculture, Agriculture University, Jodhpur, Rajasthan 342304, India
**Email: che0trammeena76@gmail.com*

A broad approach to weed control that utilizes various weed-control strategies to provide the crop a benefit against weeds also known as integrated weed management (IWM). It is used on farms all around the world, although adoption rates vary. According to their competition with agricultural crops for supplies such as water, nutrients, light, and space, weeds are famous for their negative characteristics. The majority of weeds have the capacity to spread swiftly and eventually take over farms. They raise farm operational costs, slow harvest, lower profitability, and have an adverse effect on crop yields. The interactions between weeds, crops, and other elements of the agricultural production system will determine how weeds affect crop survival. Weeds can be classified into three types on the basis of growing seasons like annual, biennial and Perennial weeds. Weeds can also be classified based on their leaf and root type systems example, dicot (broadleaf) and Monocot (narrowleaf) weeds with tap and fibrous root system. Method of IWM practices like that preventative, cultural, physical, chemical and biological. IWM has the ability to lower weed populations to levels that can be controlled, lessen the negative effects of various weed management strategies on the environment, improve the long-term sustainability of cropping systems, and minimize the impact on weeds to develop resistance to various herbicides. Herbicides used in connection with hand weeding proved to be the lowest-cost strategy, according to economic analysis. Mechanization and innovations in technology may lessen the need for manual labor, which could have an impact on rural communities and economies. A lack of skills, high costs, and insufficient support from institutions can all limit the adoption and access of cutting-edge weed management technologies, hence increasing the imbalance in resources between farmers with more and those with less. Providing socially sustainable weed management will depend on initiatives to promote fair access to and utilization of these technologies. Innovations in technology are also generating new IWM ideas. Drones, sensors, and images from satellites are examples of precision agricultural instruments that farmers can use to map and track weed infestations precisely in real time. These technologies give farmers access to useful data for decision-making, enabling them to precisely target certain areas with treatments. Furthermore, novel options for dealing with conventional chemical herbicide-resistant crops and weeds are provided by developments in biological control techniques (e.g., allelopathy, microbial bioherbicides, and the use of beneficial insects). Future of Integrated Weed Management have to focus on decision-making procedures, the biology and ecology of weeds, the economically and environmentally sustainable IWM approaches in agricultural systems, herbicide resistance, environmental problems associated with transgenic plants, and possible benefits of weeds.

Poster 172

Bio-efficacy of herbicides against complex weed flora in *Kharif* sorghum

K Chavda*, J.V. Suthar, D.D. Chaudhary, H.K. Patel and P.H. Rathod
Department of Agronomy, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat 388110, India
**Email: krishnachavda2022@gmail.com*

In order to investigate the efficacy of different pre- and post-emergence herbicides against weeds in sorghum, a field study was conducted in *Kharif* season of the year 2023 at Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. The experiment was set up in a randomized block design with three replications and twelve treatments including atrazine, pendimethalin, 2,4-D sodium salt, tembotrione and mesotrione as a sole application and in combination with each other. During course of investigation the experimental field was invaded by thirteen different weed species. Among them, *Eleusine indica* L. Gaertn, *Dactyoctenium aegyptium* L. Willd, *Digitaria sanguinalis* L. Scop., *Setaria tomentosa* (Roxb.) Kunth. *Commelina banghalensis* L. and *Eragrostis major* L. were monocots; *Cyperus rotundus* L. and *Cyperus iria* L. were notable sedges; whereas, *Oldenlandia umbellate* L., *Mollugo nudicaulis* Lam., *Phyllanthus niruri* L., *Trianthema monogyna* L. Mant and *Digera arvensis* Forsk., were the dominating dicots. Results of the study revealed that initially interculturing *fb* hand weeding at 15 and 30 DAS resulted cent per cent control of weeds. Mechanical weeding remains consistent in their performance at 60 DAS with significantly lowest weed density (7.46/m2) and dry biomass (9.79 g/m2) which resulted highest WCE (78.06%) among tested weed management practices. At 60 DAS pre-emergence application of atrazine, pendimethalin and their tank mixture remains at par with mechanical weeding. Significantly highest number of weeds and their dry biomass was recorded under weedy check at 30 and 60 DAS. Novel molecules tembotrione and mesotrione exert mild to severe phytotoxic effect on sorghum. Residues of all the tested herbicides in sorghum grain and soil after harvest of crop were found below limit of quantification (LOQ) level.

Integrated weed management: A sustainable strategy for weed control

Devrani Gupta*[1], Aniket H. Kalhapure[2], Shravan Kumar Maurya[3], Rahul verma[4] and Anchal Singh[5]

[1,2,4,5]*Department of Agronomy, Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India*

[3]*Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208002, India*

**Email: dev.gupta17072000@gmail.com*

Weed management is essential for sustainable agriculture, as weeds compete with crops for critical resources such as water, nutrients, and sunlight, leading to reduced crop yields. Traditional weed control methods have primarily relied on chemical herbicides, which, while effective, pose significant challenges, including the development of herbicide-resistant weed populations, environmental pollution, and harm to non-target species. Integrated Weed Management (IWM) presents a holistic approach to weed control by incorporating various strategies-cultural, mechanical, biological, and chemical—to reduce weed populations while minimizing the negative impacts of herbicide use. Cultural practices like crop rotation and cover cropping disrupt weed growth by diminishing weed seed banks and creating less favourable conditions for their proliferation, simultaneously enhancing soil health and biodiversity. Mechanical methods such as tillage, mowing, and mulching physically remove weeds and prevent their spread, though they may require more labour and can disturb soil structure. Biological control utilizes natural predators, pathogens, or competitors to manage weed populations sustainably, offering long-term control of invasive species without the adverse effects of chemical herbicides, although it necessitates careful management to prevent introduced organisms from becoming invasive. Chemical control remains a critical component of IWM but is applied judiciously in conjunction with other methods; rotating herbicides with different modes of action and targeting specific weed species at their most vulnerable growth stages helps reduce herbicide resistance and maintain effectiveness. The multifaceted nature of IWM not only mitigates herbicide reliance and decreases environmental contamination but also promotes biodiversity and soil health. Furthermore, by balancing economic viability with ecological responsibility, IWM enables farmers to achieve effective weed control while reducing costs associated with chemical inputs. In an era of evolving agricultural challenges, IWM offers a flexible and resilient strategy that enhances long-term sustainability and productivity, positioning itself as a vital approach to managing weeds in contemporary farming systems.

Poster 174

Effect of mulch-based weed management in turmeric under organic farming conditions

M.M. Chaudhary*, C.K. Patel and J.D. Bawa
Sardarkrushinagar Dantiwada Agricultural University , Dantiwada, Gujarat 385506, India
**Email: mahendrachaudhary349@gmail.com*

A field experiment was conducted during the *Kharif* seasons of the years 2022-23 and 2023-24 on loamy sand soils of Centre for organic and natural farming research, CNRM, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat to study the effect of mulch-based weed management in turmeric (*Curcuma longa* L.) under organic farming conditions. Weed management in organic production systems involve the use of many techniques and strategies, all with the goal of achieving economically acceptable weed control and crop yields. The ten treatments, *viz*. T1: Wheat straw mulch 7.5 t/ha at 0-3 DAP *fb* HW 60, 90 and 120 DAP, T2: Castor shell mulch 7.5 t/ha at 0-3 DAP *fb* HW 60, 90 and 120 DAP, T3: Mustard straw mulch 7.5 t/ha at 0-3 DAP *fb* HW 60, 90 and 120 DAP, T4: Turmeric + sun hemp intercropping *fb* HW at 30 DAP + green sun hemp mulch at 60 DAP *fb* HW at 120 DAP, T5: Turmeric + cowpea intercropping *fb* HW at 30 DAP + green cowpea mulch at 60 DAP *fb* HW at 120 DAP, T6: HW at 30 DAP *fb* IC at 60 DAP + WSM 7.5 t/ha (30 DAP) *fb* HW at 60,90 and 120 DAP, T7: HW at 30 DAP *fb* IC at 60 DAP + CSM 7.5 t/ha (30 DAP) *fb* HW at 60,90 and 120 DAP, T8: HW at 30 DAP *fb* IC at 60 DAP + MSM 7.5 t/ha (30 DAP) *fb* HW at 60,90 and 120 DAP, T9: HW at 30 DAP *fb* IC + HW at 60 DAP *fb* HW at 90 and 120 DAP and T10: Weedy check. In treatments T4 and T5 green biomass of intercrops will be utilized as green mulch. The experiment was laid out in randomize block design with three replications. Significantly higher yield of turmeric (18.5 t/ha) was recorded by treatment T2 (Castor shell mulch 7.5 t/ha at 0-3 DAP *fb* HW 60, 90 and 120 DAP) followed by treatment T6, T7 and T8. Significantly lower weed count at 100 DAP was recorded with treatment T6 (HW at 30 DAP *fb* IC at 60 DAP + WSM 7.5 t/ha (30 DAP) *fb* HW at 60,90 and 120 DAP) whereas significantly highest total weed count at 100 DAP was recorded under weedy check. Highest weed-control efficiency was recorded with treatment T6 (HW at 30 DAP *fb* IC at 60 DAP + WSM 7.5 t/ha (30 DAP) *fb* HW at 60,90 and 120 DAP). Net return (Rs. 427155/ha) with benefit cost ratio (4.34) were found maximum under treatment T2 (Castor shell mulch 7.5 t/ha at 0-3 DAP *fb* HW 60, 90 and 120 DAP) which was at par with treatment T6, T7 and T8.

Intercropping in sugarcane: A proven technology toward the doubling income of sugarcane growers in Southern part of Gujarat

K.A. Shah*, S.R. Salunkhe, P.G. Rathawa and A.N. Lad

Krishi Vigyan Kendra, Navsari Agricultural University, Navsari, Gujarat 394730, India

**Email: sahkinjal@yahoo.co.in*

Sugarcane being the most important commercial crop after cotton is the efficient converters of solar energy into sugars and other renewable forms of energy. India is the second largest producer of sugar after Brazil with a global share of 17% (2014-15). Over five million farmers are involved in the cultivation of sugarcane in tropical and subtropical part of India. Sugarcane (Saccharum complex hybrid), an important agro-industrial crop in the country, plays a pivotal role in national economy by contributing 1.9 per cent to gross domestic product. However, plateauing yield level, declining factor productivity, increasing production cost, slashing sugar prices in international market and decreasing profitability in recent years indeed pose the real concerns before cane growers and mill owners. Sugarcane is a long duration crop and takes about 90-120 days for canopy development, which allows for growing intercrops during the early stage. The productivity of sugarcane decline in last two decay due to imbalance use of fertilizers, mono cropping, excess use of irrigation water, pest and disease incidence *etc*. Rapidly increasing population, increased demand for food, limited scope for extension of cultivation to new areas, diversified needs of small farmers for food and cash *etc*. have necessitated the adoption of intercropping systems. Therefore, ICAR-NAU KVK Navsari conducted front line demonstration on farmer's fields to encourage the farmer for growing the inter crops in sugarcane in aim to increase the production and profitability from per unit area. There were total 25 demonstration of intercrop with chickpea was conducted in the sugarcane with an area of 5 ha in Navsari district during the year 2017-18. The average yield of sugarcane was found 94.8 q/ha in demonstration plots having intercrop of chickpea over control (sugarcane alone) of only 81.7 q/ha, which was 16.03% higher. It was also found that the intercrop reduce the weed infestation about 68% as compared to control. The higher B: C ratio of 3.00 was also recorded in intercrop of chickpea in sugarcane.

Live mulching and stale seedbed: Climate smart weed management practices for finger millet

VS Vandana Devi*, Sheeja K. Raj, D. Jacob, B. Aparna and P. Shalini Pillai
College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram, Kerala 695522, India
**Email: vslv4321@gmail.com*

Live mulches are crops grown simultaneously with the main crop and suppress the weed growth through fast growing nature without causing reduction in crop yield. The stale seedbed technique operates on the principle of eliminating germinated weed seeds before crop planting, thereby reducing the weed seed bank in the soil surface and limiting further weed emergence. This method reduces the weed seed bank by destroying the emerged weeds through shallow tillage, application of non-selective herbicides, or flaming. Weeds are the major constraint in finger millet especially in the initial stages of plant growth, therefore, it is very crucial to maintain the field weed free for the first five weeks to enhance the productivity. With this background the field experiments were conducted in the organic field at College of Agriculture, Vellayani during *Kharif* 2022 and *Rabi* 2022-23 with an objective to access the effect of land preparation and live mulches on weed control and grain yield of finger millet. The experiment was conducted in randomized block design with two factors. The first factor is land preparation which comprised of normal seedbed (L1), stale seedbed with light raking (L2) and stale seedbed with flaming (L3). Stale seedbed was conducted for a period of 14 days. The second factor is live mulches which comprised of no mulch (M1), cowpea (M2), green gram (M3) and cluster bean (M4). One row of live mulch was maintained in between each row of finger millet. Live mulches were incorporated into the soil by wheel hoe weeding at 45 DAS. The finger millet variety PPR2700 (Vakula) was planted at a spacing of 25 cm x 15 cm. During both seasons, the predominant weed flora observed in the experimental field were *Phyllanthus niruri, Ageratum conyzoides, Commelina benghalensis, Synedrella nodiflora, Oldenlandia umbellata, Boerhaavia diffusa, Cleome viscosa, Alternanthera sessilis* and *Physalis minima* among the broad leaf weeds, *Panicum maximum*, *Eleusine indica* and *Setaria barhata* were among the grasses and Kyllinga monocephala amongst sedges. Results of *kharif* and *Rabi* season revealed that stale seedbed with light raking followed by cowpea live mulching and its incorporation by wheel hoe weeding at 45 DAS resulted in the lowest total density of weeds (56 no./ m² and 89.3 no./ m²), lowest dry weight of weeds (10.2 and 12.67 g/m²), highest weed control efficiency (91.4 and 88.5%), highest grain yield (865 and 832 kg/ha) and the lowest weed index. Results on the economics of cultivation revealed that stale seedbed with light raking followed by cowpea live mulching and its incorporation by wheel hoe weeding at 45 DAS resulted in the highest gross return (Rs 86467 and Rs 83200 per ha), net return (Rs 3275 and Rs 29458 per ha) and benefit cost ratio (1.61 and 1.55) during both the seasons. It was also revealed that stale seedbed with flaming followed by live mulching with green gram resulted in the highest crude protein and stale seedbed with flaming followed by live mulching with cowpea had the highest starch content of the grain. It could be concluded that stale seedbed with light raking followed by live mulching with cowpea in 1:1 proportion and its incorporation at 45 DAS by wheel hoe weeding could be recommended as a climate smart weed management practice for better weed control, yield and quality in finger millet.

Integrated weed management

Sampat Choudhary* and Pushpa Choudhary
Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: choudharysampat344@gmail.com*

Integrated Weed Management (IWM) is an innovative approach that synergizes traditional agricultural practices with modern ecological principles to enhance weed control while minimizing environmental impact. This strategy emphasizes the integration of mechanical, biological, and chemical methods, creating a holistic framework that optimizes resource use and promotes sustainable farming. Key components of IWM include the strategic use of cover crops, crop rotation, and mulching to suppress weed growth, alongside targeted herbicide applications that prioritize selective action. Additionally, IWM incorporates the use of natural predators and competitive plants to enhance ecosystem resilience. This multifaceted approach not only improves weed management efficacy but also fosters soil health, biodiversity, and crop yield. By reducing reliance on chemical herbicides, IWM addresses growing concerns about herbicide resistance and environmental degradation, paving the way for sustainable agricultural practices in diverse farming systems. Ultimately, Integrated Weed Management represents a significant shift toward more sustainable agriculture, aligning with global efforts to promote food security and ecological balance.

Crop protective herbicide applicator- A novel machinery to minimize off-target herbicide drift

Sheeja K. Raj, D. Jacob, P. Shalini Pillai, Dhanu Unnikrishnan and S.R Sneha
College of Agriculture, Vellayani, Kerala Agricultural University, Thiruvananthapuram, Kerala 695522, India
**Email: sheeja.raj@kau.in*

Herbicide drift, the movement of herbicide particles away from their intended target, often causes damage to crop plants. Crop protective herbicide applicator is a machinery designed for the directed application of herbicides to row planted crops while simultaneously minimizing herbicide spray drift and the subsequent harm to crop brought on by phytotoxicity. The technology has been granted patent by the Government of India (No.506746 dated 02/02/2024). Main part of the machinery is crop protective hood, with skirt attached to shield the crop from spray drift. The hood protects the upper canopy, while the skirt glides along the field, protecting the base of the crop. Other parts include spray hood and spray nozzle. A spray tank and electric pump store and pressurize the herbicide solution. The crop protective hood is longitudinally attached beneath a rigid frame with ground-engaging wheels. The spray nozzle is placed outside the crop protective hood and directed at weeds present between crop rows. The spray hood covers the nozzle and is transversely attached to the rigid frame. When the machinery is in operation, the crop is drawn inside the crop protective hood, where it is shielded from the spray droplets emanating from the nozzle outside. Weeds are drawn inside the spray hood and are wetted by the spray droplets from the nozzle inside the spray hood. The spray hood confines the air borne spray droplets within. Spray drift and the consequent harm to the crop (phytotoxicity) are significantly reduced by using crop protective hood in conjuction with the spray hood. The effectiveness of crop protective herbicide applicator was evaluated in field trails with sesame during 2021-22 and 2022-23 summer seasons and with finger millet during 2021-22 summer season. The study used a spray volume of 500l/ha. The treatments in sesame included post-emergence application of glufosinate ammonium 375g/ha and carfentrazone-ethyl 20g/ha at 20 DAS followed by wheel hoe weeding at 45 DAS, pre-emergence application of pendimethalin 500g/ha followed by post-emergence application of glufosinate ammonium 375g/ha and carfentrazone-ethyl 20 g/ha, and a control. Results revealed that pre-emergence application of pendimethalin and post-emergence application of glufosinate ammonium and carfentrazone-ethyl did not produce any phytotoxicity symptoms in sesame. Among the treatments, post-emergence application of carfentrazone-ethyl 20g/ha followed by wheel hoe weeding at 45 DAS resulted in the lowest density of weeds, weed dry weight, the highest weed control efficiency, the highest seed yield and the lowest weed index. In finger millet, the treatments included pre-emergence application of pretilachlor+bensulfuron-methyl 495g/ha, oxyfluorfen 50g/ha, pyrazosulfuron-ethyl 20g/ha followed by bispyribac sodium 20g/ha, penoxsulam + cyhalofop butyl 125 g/ha and wheel hoe weeding at 25 DAS. Results revealed that application of pre-emergence and post-emergence herbicides did not produce any phytotoxic symptoms. Among the treatments, pre-emergence application of pyrazosulfuron-ethyl 20g/ha followed by wheel hoe weeding resulted in the lowest weed density, dry weight, the highest grain yield and the lowest weed index. These results conclusively showed that the crop protective herbicide applicator can be used for the safe application of both contact and systemic herbicides to row planted crops, achieving high weed control efficiency.

Poster 179

Effect of pre- and post-emergence herbicide application on growth and yield of pearlmillet

S.C. Wadile*, Prashant P. Pawar, P.D. Sonawane and J.V. Kathepuri
Agronomy section, College of Agriculture, Dhule, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413722, India
**Email: scwadile72@gmail.com*

An experiment was conducted during *Kharif* 2020 at Post Graduate Research Farm, Agronomy Section, College of Agriculture, Dhule. Experiment consisted of nine treatments laid out in randomized block design with three replications. The different weed control treatment was significantly influenced the weed population, growth and yield of pearlmillet. Growth characters *viz*. plant height (cm), number of leaves per plant, leaf area per plant (dm2), number of tillers per plant, number of effective tillers per plant, dry matter per plant (g) were observed significantly more under weed free treatment than those in registered in rest of weed control treatments in study, while it was recorded lower in weedy check treatment. In respect of growth characters, application of pendimethalin 750 g/ha PE *fb* 2, 4-D (Na Salt) 0.5 kg/ha at 30 DAS PoE was in the second order and significantly superior over other chemical weed management treatments but it was at par with pendimethalin 750 g/ha PE *fb* 2,4-D (Dimethyl amine) 0.5 kg/ ha at 30 DAS PoE. The important growth and yield contributing characters like earhead length per plant (cm), earhead girth per plant (cm), weight of earhead per plant (g), grain weight per earhead (g) and test weight (g) were significantly more under weed free treatment. Among the different herbicidal treatments, application of pendimethalin 750 g/ha PE *fb* 2,4-D (Na Salt) 0.5 kg/ha at 30 DAS PoE was significantly superior over other chemical weed management treatments but it was at par with pendimethalin 750 g/ha PE *fb* 2,4-D (Dimethyl amine) 0.5 kg/ ha at 30 DAS PoE. The grain and straw yield (kg/ ha) of pearl millet was found to be significantly higher (2.9 and 5.3 t/ha, respectively) in treatment of weed free. Among the different chemical treatments, spraying of pendimethalin 750 g/ha PE *fb* 2,4-D (Na Salt) 0.5 kg/ha at 25-30 DAS PoE which recorded significantly maximum grain and straw yield (2.7and 5.1t/ha, respectively) as compared to other treatments of weed control and it was found at par with application of pendimethalin 750 g/ha PE *fb* 2,4-D (Dimethyl amine) 0.5 kg/ha at 30 DAS PoE (2.5 and 4.1 t/ha, respectively). Among the herbicidal treatments tried in the experiment, application of pre-emergence herbicide followed by post-emergence herbicide treatment was found significantly better than application of post-emergence herbicide only in respect of grain and straw yield of pearl millet may probably be due to better weed management resulting in improvement in all growth and sink parameters which contributed higher yield owing to favourable condition in absorbing soil moisture, nutrient content and sunlight penetration during crop growing period. From the economic point of view application of pre-emergence spray of pendimethalin 750 g/ha followed by post-emergence herbicide 2,4-D (Na Salt) 0.5 kg/ha at 30 DAS PoE and pre-emergence spray of pendimethalin 750 g/ha followed by post-emergence herbicide 2,4-D (Dimethyl amine) 0.5 kg/ha at 30 DAS PoE could be economical viable treatments based on B:C ratio.

Integrated weed management in Grain Amaranth

Ashok N. Chaudhary* and Jigar Desai
Center for Crop improvement, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Dist: Banaskantha, Gujarat 385506, India
**Email: drashok_agro@sdau.edu.in*

Grain amaranth (*Amaranthus hypochondriacus* L.) is an under exploited tropical novel crop with a high nutritive value. Among three pseudo-cereals (Buck wheat, Quinoa and Grain amaranth) grain amaranth is the most important belongs to the family Amaranthaceae and genus Amaranthus. The main virtue of the seed lies in the high protein content coupled with easily digestible carbohydrate component. .A field experiment to determine the yield and quality of grain amaranth (*Amaranthus hypochondriacus* L.) influenced by integrated weed management was carried out during the *Rabi* season of 2020-21 at the Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar.The treatments comprised of ten methods of weed management *viz*., Pendimethalin 400 g/ha (PE), Pendimethalin 400 g/ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Oxadiargyl 50 g/ha (PE), Oxadiargyl 50 g/ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Oxadiargyl 50 g/ha (PoE) at 3 WAS, Oxyflurofen 50 g/ha (PE), Oxyflurofen 50 g/ha (PE) and inter culturing *fb* hand weeding at 4 WAS, Inter culturing *fb* hand weeding at 3 WAS, Weed free and Weedy check were taken in Randomized Block Design with three replication. Grain amaranth variety GA 6 was grown with 45 cm spacing between the rows. The crop was fertilized with 60 kg nitrogen and 40 kg phosphorus per ha. The experimental field's topography was fairly uniform and levelled. The soil of experimental field was loamy sand in texture with low in organic carbon and available nitrogen (138 kg/ha), medium in available phosphorus (43 kg/ha) and high in available potassium (281 kg/ha). The results indicated that the highest values of growth attributes, such as plant height at harvest, and yield attributes, like the length of inflorescence, were observed under the weed-free treatment, which was comparable to the treatment with oxyfluorfen at 50 g/ha (pre-emergence) combined with interculture followed by hand weeding at 4 weeks after sowing (WAS). The highest grain yield per plant and overall grain yield were significantly greater under the weed-free treatment compared to all other treatments. Among the integrated weed management treatments, oxyfluorfen at 50 g/ha (pre-emergence) combined with interculture followed by hand weeding at 4 WAS resulted in significantly higher grain yield per plant and overall grain yield compared to other treatments. The highest straw yield was also recorded under the weed-free treatment, which was on par with the oxyfluorfen and interculture followed by hand weeding at 4 WAS treatment. The maximum net return was achieved under the weed-free treatment, closely followed by the oxyfluorfen and interculture followed by hand weeding at 4 WAS treatment. Meanwhile, the highest benefit-cost ratio was obtained by the oxyfluorfen and interculture followed by hand weeding at 4 WAS treatment, which was closely followed by the weed-free treatment.

Herbicides performance on chia in the arid climate of western Rajasthan

Anuj Kumar[1]*, J.P. Tetarwal[2], M.C. Jain[2] and Hitesh Genan[2]
[1,2] *Department of Agronomy, Agriculture University, Kota, Rajasthan 324001, India*
[2]*Department of Agronomy, Agricultural Research Station, Ummedganj, Kota, Rajasthan 324001, India*
**Email: anujjakhar561@gmail.com*

Chia (*Salvia hispanica* L.) is a medicinal and dietary plant species belongs to Lamiaceae family native from Mexico and Guatemala. Its product is a dry indehiscent fruit which is commonly called seed. Chia has a high nutritional value to the seed composition. The composition depends on the effect of the agroclimatic conditions *viz*., temperature and relative humidity where the plants were grown. Chia seeds contain 16-26 per cent protein, 31-34 per cent fat, 37-45 per cent carbohydrates and 23-35 per cent total dietary fibre. Chia is a source of minerals (calcium, phosphorous, potassium and magnesium), vitamins (thiamine, riboflavin, niacin, folic acid ascorbic acid and vitamin A) and antioxidant compounds. Chia crop is gaining popularity in this era as consumption of its seeds provides enormous health benefits. Its seeds regarded as powerhouse of ù-3 fatty acids and a vital source of bioactive and polyphenolic compounds. which can help prevent inflammation, increase cognitive performance and minimize the level of cholesterol in the human body. Chia seeds are cultivated on a small scale in their ancestral homelands. The largest production centre is located in Mexico. The cultivation of chia in India has been initiated in small pockets in Madhya Pradesh, Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Rajasthan, Haryana and Himachal Pradesh. A field experiment was conducted at research farm of Agricultural Research Station, Mandor, Agriculture University, Jodhpur during *Rabi* season of 2021-22 to find out efficacy of different herbicides on chia (*Salvia hispanica* L.) under western Rajasthan. The treatments comprised of herbicides namely bentazon 48% SL 500 g/ha and 750 g/ha (30 DAS PoE), fluazifop-p-butyl 11.1% SL 100 g/ha and 200 g/ha (30 DAS PoE), sulfentrazone 39.6% SC 50 g/ha and 75 g/ha (PE), pendimethalin 38.7% CS 200 g/ha and 400 g/ha (PE), weed free and weedy check were laid out in randomized block design with three replications. It was found that application of bentazon 48% SL 750 g/ha recorded significantly lower density of total weeds, total dry weight of weeds and maximum weed control efficiency at 30, 60, 90 and at harvest. It also recorded significantly higher seed yield (495 kg/ha), straw yield (197 kg/ha), biomass yield (755 kg/ha) and harvest index (65.56). Among pre-emergence herbicides, sulfentrazone 39.6% SC 75 g/ha and pendimethalin 38.7% CS 400 g/ha were found statistically equally effective in controlling weeds in chia.

Poster 182

Response of fennel (*Foeniculum vulgare* Mill.) to weed control measures and nutrient management

Pooja Kumari Meena* and R.C. Bairwa

**Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313 001, India*

Swami Keshwanand Rajasthan Agriculture University, Bikaner, Rajasthan 334006, India

**Email: pkmpoojakumarimeena@gmail.com*

A field experiment was conducted to study the “Response of Fennel [Foeniculum vulgare Mill.] to Weed Control Measures and Nutrient Management” during Rabi, 2021-22 at Instructional farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The soil of the experimental field was loamy sand in texture, alkaline in reaction (pH 8.5), low in organic carbon (0.18%), low in available nitrogen (121.4 kg/ha), medium in available phosphorus (19.08 kg/ha) and low in available potassium (191.42 kg/ha). The treatments comprising 16 combinations having four nutrient management treatments (control (no fertilizer applied), 75% RDF, 100% RDF and 125% RDF) and four weed control measures (weed free , pendimethalin 0.75 kg/ha (PE), Oxyfluorfen 50 g/ha (PoE at 25 DAS) and weedy check)were replicated thrice in FRBD. The results revealed that among the herbicidal treatments pendimethalin 0.75 kg/ha (PE) reduced in number of weeds and weed dry matter accumulation significantly over weedy check and also higher reduction as compare to oxyflurfen 50 g/ha (PoE at 25 DAS). Highest weed control efficiency (100%) and lowest weed index (0%) recorded by keeping the fennel crop weed free throughout the season and herbicidal treatment pendimethalin 0.75 kg/ha (PE) showed next best treatment. The weed free treatment significantly increased crop growth parameters, yield parameters and N, P and K content in seed and straw as well as their uptake followed by pendimethalin 0.75 kg/ha (PE) over weedy check. The significantly higher seed yield (1313 kg/ha), straw yield (3282 kg/ha) biological yields (4595 kg/ha) and net return (76783 Rs/ha) were obtained with weed free treatment however, highest B: C ratio secured by the application of pendimethalin 0.75 kg/ha (PE). Results further indicated that 125% RDF recorded the highest number of weeds and weed dry matter accumulation and control recorded lowest weeds and weed dry matter accumulation. This treatment was superiority in improving the growth and yield parameters and maximum seed yield (1131 kg/ha), straw yield (2838 kg/ha), biological yield (3978 kg/ha) and harvest index (28.61%) were obtained with application of 100 % RDF. It also improved the nutrient concentration in seed and straw and their uptake by crop and recorded the highest nutrient use efficiency which was closed to 125% RDF and significantly higher over remaining treatments. Significant improvement in net returns (68712 Rs/ha) and B: C ratio (2.78) was also obtained under this treatment.

Weed management: Evaluating crop-weed dynamics in cereal legume-based cropping systems under a natural farming paradigm

Bharat Bhushan Rana[1], M.C. Rana[1], G.D. Sharma[1], Tarun Sharma[1]*, Garima Chauhan[1], Akashdeep Singh[1] and Anubhav Thakur[2]

[1]*Department of Agronomy, Chaudhary Sarwan Kumar HPKV, Palampur, Himachal Pradesh 176 062, India*

[2]*Dr Yashwant Singh Parmar University of Horticulture and Forestry, Solan, Himachal Pradesh 173230, India*

**Email: tarunagronomos@gmail.com*

A field experiment was conducted at Research Farm, Department of Agronomy, CSKHPKV, Palampur during *Rabi* 2019. The soil at the experimental field was silty clay lam in texture with acidic soil reaction and having low available nitrogen, potassium whereas available phosphorus was medium in status. During cropping season maximum temperature ranged between 26.1 to 31.3°C (15th and 16th meteorological week, respectively). The minimum temperature ranged between 1.5 to 16.5°C (5th and 16th meteorological week, respectively). The total amount of rainfall received during the crop season was 638 mm with highest (107.8 mm) in the 11th meteorological week. The relative humidity (81%) was highest in the 3rd meteorological week of 2020 during the entire 2019-20 *Rabi* season. The natural farming inputs applied during the field investigation were *Beejamrita* (1 kg10^{-1} kg of seed), *Jeewamrita* (1st drenching 5% and subsequent 10%), *Ghanajiwamrita* (250 kg/ha) and mulching (10 t/ha). The field experiment consisted of nine cropping systems involving combination of cereals and legumes *i.e.,* C_1 - maize – wheat, C_2 - 'blackgram-wheat + gram', C_3 - 'soybean -wheat + lentil', C_4 - 'cow pea - wheat + sarson', C_5 - 'okra - wheat + pea', C_6 - 'maize + blackgram – gram', C_7 - 'maize + soybean – lentil', C_8 - 'maize + cow pea – sarson', C_9 - 'maize + okra – peas'. The crop varieties for the crops in the cropping system were HPW 368 for wheat, *Him-Chana* 1 for gram, HPLO-1 for Lentil, PB-89 for Pea and *Sheetal* for Sarson. The seed rates applied for wheat, gram, lentil, pea and sarson was 100, 45, 30, 75 and 6 kg ha^{-1} whereas the spacing adopted was 22.5, 25, 25, 45 x 10 and 30 cm, respectively. During the present investigation, it was revealed that intercropping systems exerted smothering effect over weeds and kept their dry matter considerably lower, however, the sole crops reported substantially higher weed dry matter in comparison to intercrops. The correlation studies and principal component analysis were carried out for field data. Results of the analysis revealed that wheat equivalent yield was negatively affected with weed competition after 60, 120 days after sowing and at harvest. No significant correlation was observed for wheat equivalent yield with soil biology attributes such as soil organic carbon, urease and dehydrogenase activity, microbial biomass carbon and nitrogen, microbial count *i.e.,* bacterial, fungi and actinomycetes count. Soil enzymatic activity *i.e.,* dehydrogenase activity was found to be significant positively correlated with microbial count *i.e.,* bacterial, fungi, actinomycetes count, microbial biomass nitrogen and soil urease activity. Bacterial count was found to be considerably correlated and improved with significant increase in microbial biomass nitrogen. No significant correlation was there for wheat equivalent yield and soil fertility attributes such as soil available nitrogen, phosphorus and potassium. Soil available nitrogen was considerably related with soil available phosphorus and potassium; however, a negative significant correlation was there between soil available nitrogen soil bulk densities. The principal component analysis for the data revealed that two principal components were able to explain >70% of variability in the wheat equivalent yield.

Biological weed control

Vikram Jat* and Prakash Navait
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: xlr8vikram@gmail.com*

Weeds are undesirable plants which affect crop production, both quality and quantity and other resource utilization and income generation activities of the humans by interfering the cultivation of land, water and other resources. Weeds have been existing on the earth ever since the man started domesticating and cultivating plants around 10,000 B.C. Weeds are the most underestimated crop pests in agriculture although they can cause higher reduction in crop yields than other pests and diseases. Hence proper weed management strategies need to be adopted that are efficient in use and sustainable in nature. In recent years it has been realized globally that the extensive and reckless use of chemical herbicides has negative aftermath in relation to human health and environment. The main problems encountered consist of shift in the weed flora, development of herbicide resistance and accumulation of persistent herbicide chemicals in groundwater. Here is where biological control comes to help. Biological control of weeds can be defined as the control of weeds by employing other living organisms or biological entities to a population lower than what naturally occurs in the absence of employed organism. Thus the biological control of weed simply means controlling weeds below their economic threshold level using another organism such as parasites, predators, pathogens, herbivores and botanical agents as applicable under specific conditions. The two approaches used in biological weed control are classical approach and augmentative approach. The classical approach involves the release of bio-agents (insect, fungi, nematodes, fish and other biological systems) just for once in the belief that it will readily adapt to the prevailing climate and multiply enough to keep pace with the multiplication rate of weed in question. Examples of successful biological controls are control of *Eichhornia crassipes* (water hyacinth) using *Neochetina eichhorniae* (hyacinth weevil), *Lantana camara* (lantana weed) in India has been effectively controlled by a moth *Crossidosema lantana*, *Zygrogamma bicolorata* (Mexican beetle) feeds on *Parthenium hysterophorus* (congress grass). The augmentative approach (or the bio-herbicide approach) involves control of weed which pursue *in vitro* augmentation of the pathogen inoculum and its culturing in artificial medium in the laboratory in the belief that the target weed may fall susceptible to it when applied in a large concentration over its existing population. Some popular examples include Collego, a wettable powder containing fungal spores of *colletotrichum gloesporiodes sub sp. Aeschynomone* controls *Aeschynomone sp.* (Joint vetch), and Bipolaris, a suspension of fungal spores of *Bipolaris sorghicola* controls *Sorghum halepense* (Johnson grass). The bio-herbicide philosophy differs from the classical bio-control philosophy referred to earlier. The development of bio-herbicides is of great interest to industrialists as it involves every season requirement of the product for the field use. In variance with it, the classical biological control has to the private, profit-oriented organization; it must depend solely on public sector support.

Poster 185

Understanding the ecosystem of *Parthenium hysterophorus* and biology of *Zygogramma bicolorata* for effective management of Invasive weed

Archana Anokhe*[1] and Mogili Ramaiah[2]

[1]*ICAR- Directorate of weed Research, Janalpur, Madhya Pradesh 482004, India*

[2]*ICAR- Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: anokhearchana12@gmail.com*

Parthenium hysterophorus (Family: Asteraceae), is also well known as gajar ghas, safed topi, chatak chandni and is native to Central America. It is one of the most problematic alien invasive weeds in the tropical and subtropical world and is popularly known as Gajar ghas due to its appearance like a carrot plant. Its strong allelopathic, potential prolific seed production and phenotypic plasticity in growth enable this species to invade a wide range of habitats in areas where natural ecosystems are disturbed to varying scales by anthropogenic activities. After the noticeable occurrence of the *Parthenium* in Pune (Maharashtra) in 1956, it has spread like wildfire throughout India. At present, it has invaded about 35 million hectares of land in India. It is a nuisance on roadsides and railway tracks, vacant lands, wastelands, industrial areas, on the sides of open drainage systems and irrigation canals besides invading crops. In general, *Parthenium* is a poisonous, pernicious, problematic aggressive weed posing a serious threat to biodiversity, human beings and livestock. *Parthenium* is partly responsible for allergic eczematous dermatitis, allergic rhinitis, fever, and asthma in urban populations of humans. Besides ill-effects, it also causes several other problems like blockage of common pathways and reduces the aesthetic value of parks, gardens and residential colonies. *Parthenium* also infests field crops, orchards, plantations and forest. It severely reduces the crop productivity besides loss to biodiversity and environment. Biocontrol management is sustainable management strategies to manage this weeds. It well documented that Mexican beetle, *Zygogramma bicolorata* effectively controls parthenium. Life cycle of *Z. bicolorata* was observed. It having six stages including egg and adult stages as well as lays 500-800 eggs. Another Semilooper has been also reported which causes damage to the parthenium by scraping. These larvae have been lab-reared in a semisynthetic diet prepared in the lab and sent for identification. Furthermore, it has been observed that three predatory bugs, *Eocanthecona furcellata* (family: Asopinae), *Perillus bioculatus* (family: Asopinae) & one unidentified bug *has* been reported to predate on *Zygogramma bicolorata* grub which reduces feeding efficiency of beetle. Parthenium is also been found as a potential alternate host of mealy bugs which spread very quickly with the help of ants associated with parthenium plants. It has also been reported that Parthenium also serves as a host of plant viruses. All these factors are responsible for making these weeds obnoxious. This study will provide insight to explore more possibilities of parthenium managements.

The role of biological control in managing parasitic weed control

Amisha Besarwal

Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan 313802, India

Email: amishabesarwal@gmail.com

Parasitic weeds, such as *Striga*, *Orobanch*e, and *Cuscuta*, severely reduce crop productivity worldwide by attaching to host plants and siphoning off nutrients, leading to substantial agricultural losses. Managing these parasitic weeds remains a significant challenge, especially for smallholder farmers in developing regions. Biological control is emerging as an environmentally sustainable and economically viable solution compared to chemical herbicides, which can be costly, harmful to the environment, and ineffective in the long term due to weed resistance. Biological control involves using natural enemies of parasitic weeds, such as fungi, bacteria, viruses, and insects, to suppress weed growth. Fungal species like *Fusarium oxysporum* have shown potential in controlling *Striga* populations by infecting its seeds and preventing germination. Similarly, bacterial species such as *Pseudomonas* and *Bacillus* produce allelopathic compounds that inhibit the growth of parasitic weed seeds. Recent studies have also explored endophytic microorganisms and mycorrhizal fungi for their ability to enhance plant resistance to parasitic weeds. Insect biocontrol agents like *Phytomyza orobanchia*, which specifically targets *Orobanche* seeds, have demonstrated success in reducing infestations in certain crops. Despite these advancements, the efficacy of biological control can be influenced by various factors, including environmental conditions, the specificity of the biocontrol agent to the parasitic weed, and the integration of biocontrol with other management practices such as crop rotation and the use of resistant crop varieties. Integrating biological control agents into sustainable agricultural practices is essential to developing long-term, effective solutions for parasitic weed management, minimizing reliance on chemical interventions, and promoting ecological balance. While biological control presents a promising solution to managing parasitic weeds, further research is required to develop integrated management strategies that combine biological control with agronomic practices and the use of resistant crop varieties. Such integrated approaches are likely to be more effective, economical, and sustainable in the long term.

Untangling bioagents to control weeds

Jyoti Kushawah*[1] and Mrinali Gajbhiye[2]

[1]*Department of Entomology, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[2]*Department of Agronomy, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

**Email: jkushwah7717566@gmail.com*

Excessive use of herbicide has negative impact on environment. They affect soil microorganisms which on the other side reduces soil fertility. Besides this it also reduces the population of natural enemies of weeds. In recent years, use of agrochemicals is increased that led to serious health issues and environment problems. Therefore, there is a need to spare biological control agents as a potential alternative to reduce the excessive use of herbicide. In current scenario, climate change has led to shift the weed flora and insects as well. Correspondingly, over use of herbicide has not only affect the environment but also the economic threat to farmers. Thus, biological control methos like use of insects and soil microorganisms *viz*. bacteria and fungi their extract could be a sustainable approach towards weed control. Bioherbicides on the other hand could be used as an inoculum in the form of liquid spray or solid granules. The approach can improve soil quality thereby enhancing growth and yield of crop. Weeds act as source of energy for numerous phytophagous insects. Insect that feeds on weeds lowers its density thereby reducing competitions between crop and weed so the competition for light, space, moisture and nutrients. This amplifies crop yield. Phytophagous insects like sesiid moth, Carmentha haematica (Utera), attacks only snakeweeds, Glutierrezia and Grindelia spp. Likewise, some insect feeds on the weeds and weed parts that can control its population and can also reduce its growth as some insect species are defoliators, flower feeders, root and shoot, stem spoiler and, seed and fruit feeders like larvae of the noctuid can completely destroy *Striga* angustifolia (Witch weed). Some biocontrol agents like *Zygogramma bicolorata* reduce the vegetative and reproductive growth of *Parthenium hysterophorus* weed, Lantana seed fly, Agromyza lantanae feed fruit and seed of Lantana plant, other bioagent insects are Froggatt, Lace bug, Teleonemia scrupulosa (Stal), Lantana flower-cluster moth, Epinotia lantana (Busck), Lantana Plume moth, Water hyacinth, *Eichhornia crassipes* (Mart.) fed by Neochetina eichhorniae Warner (the water hyacinth weevil) , Dactylopius indicus Green and Cactus moths, *Alternanthera philoxeroides* (Mart.) feed on Opuntia spp The alligator weed flea beetle, Agasicles hygrophila Selman, *Striga* hermonthica, Benth. is attacked by weevils, Smicronyx spp., From the study it can be concluded that insects can be involved to control the weeds by designing in the way to bring down the weed density below the economic threshold level. Hence, bio agents readily adapted to climate could help to overcome the weed density thereby, enhancing yield in a sustainable approach.

Poster 188

Valuable weeds: Harnessing their potential for sustainable practice

Jagjeet Panthi*, Shivani Thakur, Prem Prakash Parihar, Sakshi Mundra and Kusum Sharma
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: jagjeetpanthi694@gmail.com*

As the studies shown that weeds are the costliest category of pest. Weed causes 45% loss in crops. They cause different proportion of yield loss depending upon the type of weed, crop or climatic conditions. Significant economic losses due to reduced crop yield and increase in cost of production and land degradation, loss of ecosystem and biodiversity loss. But as weeds are also a part of nature and nothing in the nature is useless weeds also plays a beneficial role in environment. They provide multipurpose benefits to humans. Weeds are natures way of covering soil that has become exposed by fire, flood and landslides. The exposed soil surface is a risk of erosion by rain or wind, especially if root system have also been removed or disruptured. Pioneer plants that we call weeds are those species that can rapidly cover bare soil. Weeds protect soil from erosion, replenish organic matter and recycle soluble nutrients, feed and restore life, restore biodiversity, provide habitat for insects and animals. To combat climate change, we must shift from fossil fuels to renewable energy. This study looks at using three common plants (Canadian goldenrod, mugwort wormwood, common tansy) as affordable biofuels for homes without access to gas or external heating. Many of them have ethnopharma-ceutical and ethnomedical properties (dandelion), ethnobotanical (dandelion, traxacium and lambus quarter). In total, 33 plant species from 32 genera and 20 families were identified for use in treating about 36 different ailments or therapeutic indications, such as headaches, toothaches, and eye inflammation. Although many consider dandelions to be pesky weeds, they are actually a rich source of vitamins A, B complex, C, and D, along with minerals like iron, potassium, and zinc. Ethno-medical uses are most beneficial for weeds. Dandelion: Treats digestion, liver issues, and skin problems with its roots and leaves. Stinging Nettle: Relieves arthritis, allergies, and respiratory issues with its leaves and stems. Plantain: Soothes wounds, skin conditions, and respiratory issues with its leaves. Wild Chamomile: Calms anxiety, insomnia, and digestive issues with its flowers. Purslane: Reduces inflammation, fever, and skin conditions with its leaves and stems. Ethnobotanical uses include. Nutritious Leafy Green: Dandelion, Stinging Nettle, and Purslane in salads. Protein-Rich Seeds: Harvest Dandelion and Purslane seeds for a tasty snack or added nutrition. Soothing Herbal Infusions: Unwind with calming teas made from Wild Chamomile and Plantain. Biopesticide use of weeds. Stinging Nettle: Deters insects and repels pests. Wild Chamomile: Fights fungal infections and kills insects. Dandelion: Suppresses weeds and controls insect populations. Purslane: Repels insects and prevents fungal growth. Certain weeds offer valuable benefits in agriculture, including Food and Fodder Lamb's quarters. (*Chenopodium album*): edible raw, prevents erosion, and deters leaf miners. Dandelion (Taraxacum officinale): companion plant for tomatoes and grains, attracts honeybees. Burdock (Arctium lappa): edible roots, stalks, and young leaves. Flatweed (Hypochaeris radicata): edible leaves, roasted roots Ground Cover and Erosion Control:Lamb's quarters. Wild vetch (Vicia spp.): nitrogen fixer, ground cover, harbors beneficial beetles. Sustainable Weed Management. This approach minimizes weeds' negative impact on crops while leveraging their benefits.

Evaluation of lemongrass and *Lantana camara* extracts for organic weed control: phytotoxicity, efficiency, and metabolite characterization

Meryani M. Lotha*[1], P. Janaki[2] and R. Krishnan[2]

[1]*Department of Soil Science and Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India*

[2]*Nammazhvar Organic Farming Research Centre, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India*

**Email: kakamery79@gmail.com*

Researching natural herbicides is essential for safer, eco- friendly weed control, as it helps reduce chemical residues and herbicide resistance. Natural herbicides support organic farming, protect biodiversity, and other cost- effective, sustaiable alternatives. Hence this study aimed to extract botanical herbicides from Cymbopogon citratus (Lemongrass) and Lantana camara (Unnichedi/Ghaneri/Raimuniya) using cow urine and water in ratios of 1:10 and 1:20, respectively, and fermenting them for 1, 5, and 15 days. A field experiment with cotton crops was conducted to test weed control efficiency. The botanical extracts were applied at concentrations of 25%, 50%, and 75% in microplots (1m2) as early post-emergence (EoPE). Each plot had a weed population of approximately 100 weeds/m2, dominated by *Trianthema portulacastrum*, followed by Echinochloa crus-galli, Corchorus spp., and Cynodon spp. Phytotoxicity observations were recorded on the 5th and 7th days. Results showed that Lemongrass extracted with cow urine (1:10 ratio, 10-day fermentation, 75% concentration) affected 10% of weeds, while water extraction (1:20 ratio, 1- day fermentation, 75% concentration) affected 4% of weeds. The extracts were characterized using GC-MS to identify the volatile metabolites responsible for phytotoxicity. Phenol was found to be the predominant compound in Lemongrass extract, while Oxime-, methoxy-phenyl was present at higher intensity (8.59) in Lantana camara extract. The pH of the Lemongrass cow urine extract (7.51), water extract (7.05) and Lantana camara cow urine extract (7.05) was all neutral. The research suggests that Lemongrass has potential for weed control due to its phenol content, but it is not effective on its own. Further studies are needed to combine Lemongrass extracts with botanical adjuvants to enhance their weed control efficacy.

Poster 190

Unveiling the potential of using fungal pathogens for enhancing the insect biological control program of *Parthenium hysterophorus* L.

Durga Ray[1], Gyanendra Pratap Singh[2], Harshit Vishwakarma[1], Sushilkumar[2] and Puja Ray [3]

[1]*Department of Botany & Microbiology, St. Aloysius College, Jabalpur, Madhya Pradesh 482004, India*

[2]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

[3]*Multitrophic Interactions and Biocontrol Research Laboratory, Department of Life Sciences, Presidency University, 86/1 College Street, Kolkata, West Bengal 700073, India*

**Email: ray.durga@gmail.com*

Parthenium hysterophorus L., an annual, herbaceous plant of neotropical origin has emerged as one of the worst invasive weeds in many tropical and subtropical countries. It causes serious health hazards to human and other animals other than causing negative impacts on agricultural productivity, ecosystem diversity and its functioning. Efforts to control parthenium has been attempted by various methods, however, no single management option would be adequate to manage a noxious invasive weed like parthenium. Hence, there is a dire need to integrate various management options with an emphasis on biological control. An attempt was made to assess the occurrence of fungal pathogens of this weed. The plants with diseased symptoms were collected by periodical surveys from various parthenium-infested sites. Special care was taken to record the time, locality and place of collection. The diseased plant specimens were collected and stored in paper bags and brought to the laboratory where isolation of pathogens was attempted. All the emergent fungi were isolated and pure cultures were obtained. The isolates like *Penicillium, Aspergillus, Trichoderma, etc*, which were easily identified and seem to be invaluable were excluded from further consideration after their initial isolation. The fungal isolates were maintained on PDA slants and secured for further studies. Out of the forty fungi isolated some of the probable potential ones were *Alternaria* sps., *Fusarium* spp., *Dreshslera* sp., *Macrophoma* sp. and *Curvularia* sp causing more than 90% damage to parthenium under laboratory conditions. Although most of these isolates appeared severely damaging under controlled conditions their inability to serve as stand-alone replacements for chemical herbicides, has probably deterred their earlier commercialization efforts. The fungi were evaluated for their efficacy against parthenium, their potential for commercialization (performance under field conditions, specificity and host range, ease of inoculum production), and their compatibility with insect biocontrol agents of the weed, *Zygogramma bicolorata* (Chrysomelidae) was also evaluated under laboratory conditions. Our studies brought into light some interesting effects that the fungi and the insect had on each other including negative and positive impact on each other and the target plant. Fungi *Curvularia lunata* caused disease on the parthenium stand and could kill about 70% plants in about 60 days however the fungi in the presence of beetle feeding showed enhanced damage to parthenium under greenhouse and field conditions causing about 100% damage to the parthenium stand within 15 days of application. The beetles took about 30 days to defoliate the stand. With more studies, these agents may be used in combination with each other thus complementing each other for integrated biocontrol of the noxious weed parthenium.

Poster 191

Biological weed management for reduce the environmental threats

Kusum Sharma*, Shivani Thakur, Sakshi Mundra, Jagjeet Panthi and Prem Prakash Parihar
Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: sharmakusum8466@gmail.com*

Weeds generally limit the productivity of the lands and hence affect crop development and yield. The biological control of weeds is intimately connected with basic ecological problems, and its interest goes far beyond practical considerations. Exotic plants in new ecosystems where they may be of no economic importance and where their original biological enemies may be absent become weeds, difficult to manage by crop farmers. A successful biological weed control involves using living organisms, such as insects, nematodes, bacteria, or fungi, to reduce weed populations. Biological control of weeds has been conducted since 1902, resulting in over 500 biological control agents being intentionally released against nearly 200 weed species in over 90 countries. These countries have intentionally released over 80 biological control agents to help manage over 30 of their most invasive weeds. In addition, there have been very few (<1%) unpredicted, sustained non-target impacts on native or economic plants by weed biological control agents. There are numerous opportunities to introduce highly specific and very effective biological control agents from countries where they are being utilized successfully into other countries where the target weed is problematic to help manage these species. Successful weed control through the use of biological agents has a background of more than a couple of centuries. The biological approach as an integral part of integrated and sustainable weed control approaches has an increasing importance and consideration due to increasing environmental and anthropogenic problems. Classical biological weed control is the approach most frequently employed, provided an overall success rate of about 30%, has a positive cost-to-benefit ratio, and is ecologically rewarding. Biological control of weeds should be considered as one of the available options in all weed situations. Bioherbicides are a biological method in weed control and an eco-friendly alternative to chemical herbicides that use biological agents to disrupt the growth, metabolism, and photosynthesis of weed plant extracts. Allelochemicals and some microbes are utilized as bioherbicides to control weed populations. Bioherbicides that are thought to be safer and 'greener' have drawn attention, as scientific reports provide increasing evidence of their efficacy. However, their commercial presence in comparison to conventional herbicides is relatively new. Therefore, rigorous testing and validation is necessary to evaluate their efficacy and reliability for weed control. This review explores the impact of bioherbicides, particularly plant-based, on weed physiology and the factors that influence their efficacy as well as the limitations of their use. The inundative strategy attempts to overwhelm a weed infestation with massive numbers of a biotic agent in order to attain weed control in the year of release. In contrast to classical biological control, inundation involves timing of agent release to coincide with weed susceptibility to the agent and formulation of the agent to provide rapid attack of the weed host. Since most bioherbicides have been developed using selected plant pathogenic fungi that cause such diseases on weeds as anthracnose and rust, the term mycoherbicide is often used in reference to these fungal preparations

Biological weed control

Renuka Bhakher* and Arvind Verma
Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: bhakherrenuka@gmail.com*

Biological control (bio-control) involves the introduction of natural enemies (insects, mites and pathogens) of a target weed that will reduce the density of the weed to a level that is acceptable and that will maintain the weed density at that level. There are many reasons for using biological control in weed science such as loss of many common herbicides due to problems such as tight regulations or evolution of herbicide resistance in weeds; changing understanding in weed control such as targeting only unwanted species, conserving environmentally sensitive or prone to degradation areas, avoiding contamination due to chemicals; and inclination to healthier and sustainable cropping systems. Integrated Pest Management (IPM) strategies that combine biological control with cultural and mechanical practices are essential for maximizing effectiveness and sustainability. Biological controlling weeds can also be accomplished through livestock grazing. With rangelands and pastures, where animals may graze on certain plant species selectively, targeted grazing can be an efficient way to control some weed populations. An agricultural system that is more comprehensive benefits from the integration of weed control and animal husbandry in this strategy. In addition, some herbicides are capable of destroying weeds that are harmless to crops, resulting in a potential decrease in biodiversity on farms. Biological weed control offers a promising avenue for sustainable agriculture, enhancing biodiversity while providing effective management of weed populations. By integrating biological methods into traditional practices, farmers can foster healthier ecosystems and contribute to long-term agricultural sustainability. Biological control utilizes natural living organism, such as insects, herbivorous fish, other animals, disease organisms and competitive plants to limit their growth. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. This method is not useful to control all types of weeds. Introduced wends are best targets for biological control. Biological control is least harmful to the environment, have no residual effect, relatively cheaper, having comparatively long-lasting effect, harmless to non-targeted plants, very effective in control of weeds in non-cropped areas. Besides this some of the fish, snails and other animals convert weed vegetation into seafood. Landowners continue to spend millions of dollars to purchase and apply herbicides, when an integrated approach, which includes biological control, can reduce management costs and enhance control. The challenge, therefore, is to educate all stakeholders, including communities, in the safety and cost-effectiveness of weed biological control. There are numerous opportunities to introduce highly specific and very effective biological control agents from countries where they are being utilized successfully, into other countries where the target weed is problematic to help manage these species.

Ecological approaches to weed control

Vishakha Sharma*, Pawan Ahari and Rajendra Choudhary

Department of Agronomy, Rajasthan College of agriculture, Udaipur, Rajasthan 313802, India

**Email: vs9898354@gmail.com*

Biological control means, Utilization of natural living organism, such as insects, herbivorous fish, other animals, disease organisms and competitive plants to limit weed growth. In biological control method, it is not possible to eradicate weeds but weed population can be reduced. This method is not useful to control all types of weeds. Introduced weeds are best targets for biological control. The control *Opuntia* spp. (prickly pear) in Australia and lantana in Hawai with certain insect bioagents are two spectacular examples of early period biological control of weeds (Evans, 2002). Plants get water and nutrients through root. On the surface of root, some biological control agents attach, in doing so stunt plant growth. Bacteria and fungi use as biological control agent released toxins infecting and hampering water transport system that results in retardation of root and leaf growth. Beneficial insects and nematodes directly feed on weed root causing injury that leads to easy penetration of bacteria and fungi. Thakur et al. (1992) also recommended 3 indigenous insects as" potential bio-control agents for *Lantana viz* a flower feeder *Asphondylia lantanae* flower and leaf defoliator *Hypena laceratalis*, and a borer of ripe fruits, *Homona micaceana*. Therefore, 3 insects were imported among which only one, Mexican beetle (*Zygogramma bicolorata*). caused severe impact in suppressing of partheniun in and around Bangalore (Jayanth 1987, 1993). Some mycoherbicides like Divine and Collego have been registered for use as herbicides in other countries. The former is a liquid formulation of *Phytophthora palmivora* .Nowadays, environmental issues about the degradation of chemical herbicide through various industrial and agricultural processes arise and the need to protect it for future generation becomes more viral topic. For weed control, broad spectrum chemical herbicides are used discriminately resulting in reduction of natural enemies, further it caused outbreak of weed due to development of resistant varieties against chemical herbicide. However, biological control of weed is environmental friendly and has been systematically encouraged to bring down the use of toxic chemicals.

Utilization of weeds as substrates for cultivating edible mushrooms

Shubham Prakash Gupta and Jeetendra Kumar Rao*

Mycology and Natural Pesticide Laboratory, Department of Botany, Post Graduate College, Ghazipur, Uttar Pradesh 233001, India

**Email: rao.jeetendrakumar@yahoo.in*

In eastern Uttar Pradesh, weeds are generally treated as a waste, whereas in mushroom cultivation, it can be utilized in a positive manner by using weeds as a substrate. Due to mushrooms nutritional, medicinal, and delicious taste, the demand for mushrooms is increasing across the world. Considering the health benefits of edible mushrooms, they are also being used as a vegetable. Growing affordable, high-quality edible mushrooms in such a setting is a significant challenge to mushroom researchers and cultivators. Agricultural by-products are being used on a large scale for mushroom cultivation, although the use of weeds as a substrate is still largely underexplored. The objective of this study is to investigate the potential of weeds as a substrate for some edible mushrooms. Some weeds were selected on the basis of availability. Weeds were harvested by hand to avoid any physical damage; special care was taken to ensure that the weeds did not contain any pesticides or contaminants. Weeds were collected and cleaned with the help of a brush, and after that, they were washed with tap water. Weeds were properly cut to uniform size to preserve consistency, and sterilization was carried out using appropriate methods. Different ratios of weeds plus traditional substrate were prepared, and many edible mushrooms were cultivated on it. The mushrooms growth performances were regularly monitored and noted. Proper standard conditions for cultivation were maintained. By noting and analysing these data, a comparative study of the effect of the different substrates on edible mushrooms was also done. Results showed that different combinations of weeds and traditional substrates influenced the growth performance and yield of different edible mushrooms. Some edible mushrooms performed exceptionally well than other edible mushrooms on the mixed substrate of weeds and conventional substrates. The performance of Agaricus bisporus was good only on conventional substrates, but on mixed substrates there was a negative impact on the growth of Agaricus bisporus. The findings also demonstrate that a mixture of weeds with traditional substrates can be used to cultivate a variety of edible mushrooms. By utilizing weeds, not only proper management of weeds can be done but also the production cost of edible mushrooms can be significantly reduced. Using invasive species will not only improve soil health, but this practice will also contribute to biodiversity. The findings of this work here may open the door to more investigations on various unconventional substrates, especially different weeds, combinations of unconventional substrates with conventional substrates, and their potential to raise mushroom yields and innovating a variety of cultivating techniques. Future research could examine consumer acceptance of edible mushrooms grown on weed substrates; for this, a survey-based study can be conducted among consumers. A wider range of weed species can also be utilized, which will help in doing a more detailed analysis.

Significant importance of weeds

P.N. Mhaskar* and N.V. Mhaskar
Terna College, Navi Mumbai, Nerul, Maharashtra 400706, India
**Email: namdev_mhaskar@rediffmail.com*

Weeds, the plants out of their proper place, have been known to cause many damages and losses to crops and some are also known to cause health hazards. Weeds are plants that are undesirable in a given circumstance and might be unsafe, hazardous or monetarily unfavorable and to cause wellbeing risks. Disregarding every one of the troubles brought about by weeds, they can offer a few helpful properties. Some of the expected advantages of weeds are recorded and highlighted in this abstract. Some of the weeds *viz*., *Amaranthus* spp., *Digeria arvensis*, *Potulaca* spp., *Lactuca*, *Chinopodium* spp., *Cassia tora*, *Celosia argentina, Aeschynomene grandiflora etc*. are used as vegetables in human food. Many weeds are used as fodder for milch animals and other domesticated animals. Weeds benefit to microorganisms as weeds die and decay, their roots break down, feed microorganisms and insects, and make pathways and tunnels for worms. After that they release essential nutrients into the soil. They also store nitrogen and carbon dioxide in the ground, hence weeds are helpful in improving soil health. Many weed species have sturdy and massive taproots, so they pull up nutrients and moisture from deeper levels of the soil and provide nutrients to other crops. While some of the leguminous weeds have high nitrogen contents which are very helpful for improving soil fertility in long run. Some weeds add the organic matter to the soil and use as excellent green manure for rice fields. Weeds are creating cleaner air and removing greenhouse gasses from the atmosphere, mitigating the climate crisis. Weeds are essential to pollinators' as a fundamental food source especially bees and other including bats, beetles, butterflies, moths, wasps, and small mammals. Weeds and specially grasses are good soil binders with its dense root system in the fallow land and prevent soil erosion. Many places people use Prosopis juliflora which is a tree weed as fire wood. Weeds are perhaps the oldest medicines Some weeds are making extraction of medicines *viz*., *Leucas aspera, Eclipta erecta, Celosia argentina, Commelina benghalensis*, *Launea procumbens etc*, Other economic uses of weeds like production of fragrance, extraction of aroma oils, reclamation of soils, use as fencing purpose, making mats and screens, use as green mulch, trap crops, landscaping and beautification *etc*. Thus considering the importance and beneficial properties of weeds in human life as well as other purposes compels one to rethink about weeds in spite of invasive and unsafe.

Weeds: Nature's silent eco-warriors

Ved Prajapati* and Manish Kumar
Department of Agronomy, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313001, India
**Email: vedprhmt99@gmail.com*

Weeds are often seen as harmful to farming. In spite of many difficulties caused by weeds, they can offer some beneficial properties, particularly when occurring at low densities. Weeds play an important role in natural ecosystems. Weeds promote biodiversity, improve soil quality and aid in maintaining ecosystem functions. They also improve soil fertility by extracting nutrients from deeper layer of soil and returning them to the surface when they decompose. Some weeds, like grasses and mustard plants, can remove harmful metals from contaminated areas like old mines. The Khimp plant, which grows in dry climates, is used as animal fodder. Weeds like *Chenopodium album*, *Amaranthus viridis* and *Portulaca* spp. form good leafy vegetables. Whereas Cichorium intybus roots are used for adding flavour to coffee powder. Certain weeds have medicinal value, such as *Withania somnifera* as aphrodisiac, Abelmoschus moschatus as heart tonic and Phyllanthus amarus for jaundice treatment. Weeds can also be used in crop breeding programs to introduce traits such as resistance to pests and environmental stress, for instance, Saccharum spontaneum has been widely exploited for developing the present noble canes for North India. Ipomoea carnea a weed found in tropical wetlands, can also be used for energy generation. Problematic weeds like Lantana camara, Datura stramonium and Ricinus communis contain chemicals that make them useful as natural pesticides/biopesticides. Recently, weed incorporation into the soil has been found to result in greatly reduced root-knot nematode population. Some promising weeds in this respect are Crotolaria, Parthenium, Calotropis and Eichhornia spp. Some weeds produce allelochemicals that can act as natural herbicides or facilitate the development of synthetic herbicides. Weed biomass is used to make products like silage, fodder, compost, vermicompost, biogas production, paper and pulp. Arundo donax is used to treat runoff water from fields and mining areas. Weeds are also used for making high-quality vermicompost in a short time. Some common weeds such as *Parthenium hysterophorus*, *Datura alba* and *Cassia fistula* are known in traditional medicine for treating animal illnesses. Weeds also provide food and shelter for animals, including pollinators, herbivores and helpful predatory insects, which increases biodiversity. They offer essential ecosystem services like filtering water, controlling erosion and storing carbon through carbon sequestration. Weeds can even indicate the health of the soil by showing the signs of nutrient deficiencies or contamination. Although weeds are often seen as pests in farming, they are crucial for maintaining healthy ecosystems. This shows the importance of managing weeds in such a way that balances their ecological benefits with agricultural needs.

Comprehensive weed risk assessment and quarantine strategies for weed management

Smriti Singh* and Krishna Shankar Tripathi
Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India
**Email: smritisingh20010821@gmail.com*

Weeds, especially the introduced ones account for 40% of economic losses to agriculture and also cause damage to natural resources. It is necessary to evaluate the risk before permitting the admission of many of these species since they have the potential to become weeds in the environment or in agriculture. Due to these significant losses, there is an increasing need to develop tools which can identify plants that are likely to cause menaces. Weed risk assessment (WRA) is such a tool used by regulatory bodies to make decisions about plant imports, manage invasive species of plants and protect the ecosystem. It aims to assess the likelihood of a plant species establishing, spreading and causing harm. It analyses various factors such as plant's ecology, biology and potential pathways for introduction. In order to estimate the risk of introduced weeds, three general approaches have been used that are quantitative statistical models, semi-quantitative scoring, and qualitative expert judgment. This strategy would deal with both "sleeper weeds" that are already established in an area and problems posed by recent introductions. Weed risk assessment and subsequent adaptation thereof and provides protocols for, the identification of assessor (who will carry out screening), definition of risk assessment area, the criteria for selection of species for screening and then a priori categorization of species into invasive or non-invasive. It is necessary to compute thresholds by which high risk and medium risk non-native species can be distinguished. WRA of various weeds are provided in plant quarantine order, 2003 issued under Destructive Insect and Pest act (1914) of India. Weed species that are studied in present are already in quarantine weed list. On this basis, present studies evaluated weed showing high, intermediate and low risk. As export and import of plant commodities have increased in recent era, there is distinct possibility of moving of weed species, insect pests and diseases from their native habitation to new location. For preventing this plant quarantine order (2003) was harmonized with International Plant Protection Convention (IPPC) and internationally accepted standard and the tenets of SPS agreement of World trade organization (WTO). Many weeds like *Parthenium hysterophorus*, *Phalaris minor*, *Eichhornia crassipes*, *Lantana camera, Hydrilla verticillata, Sorghum halepense*, *etc*. are some exotic weeds and have caused extensive damage before the PQ order. Enforcement of the quarantine measures is supported by legal enactments, called quarantine laws. Effective implementation of quarantine is highly emphasized for manage of exotic weeds and pests which in turn helps in maintaining the productivity of crops. Proper integration of Weed risk assessment and quarantine strategies will result in effective weed management with predictive models, risk matrices, protocols and control methods on regional and global scale.

The effect of flumioxazin 50% SC on wasteland soil chemical and microbiological parameters

Shabnam Thakur*, Suresh Kumar and Shivali Rana
Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh 176062, India
**Email: shabnamthakur399@gmail.com*

In the agricultural production system weeds are major constraints to cropped as well as non-cropped lands. In India wide range of area is enclosed under non-cropped land, which is badly infested with perennial as well as annual monocot and dicot weeds. In Himachal Pradesh, this category of land occupies most of the geographical area (about 80%) due to typical physiography of the state. Weeds under non-cropped situation not only reduce the value of lands, but also deteriorate the aesthetic look and cause many problems for the movement of human beings as well as animals. Weeds are persistent, prolific and effectively compete with beneficial plants and thus adversely affect crop production and human welfare. Though herbicides play a crucial role in weed control and enhancing food production, their potential harm to humans, soil health, and the environment is cause for concern. Herbicides influence not only weeds, but also soil chemical and microbiological qualities. These non-target impacts may impair the performance of critical soil activities and endanger the overall ecological system by (a) altering their biosynthetic mechanism, (b) regulating protein synthesis, (c) disrupting cellular membranes, and (d) influencing plant growth regulators. Herbicides are not part of the soil component pools and are likely to impact the catalytic efficiency and behavior of soil enzymes, both of which contribute to the overall biological activity of the soil-plant ecosystem in different states. The interaction between herbicides and soil microorganisms may have practical implications since it may limit microbial activities that contribute to soil fertility. Therefore the present study was conducted during *kharif* 2021 to determine the influence of flumioxazin 50% SC on the chemical and biological properties of wasteland soil after herbicide application. Nine weed control treatments, *viz*. flumioxazin 150 g/ha, 200 g/ha, 250 g/ha, 300 g/ha, 500 g/ha, oxyfluorfen 1000 g/ha, weed free check, glyphosate 4000 g/ha and untreated control were evaluated in randomized block design with three replications. Soil of the experimental site was silty clay loam in texture, acidic in reaction, low in available nitrogen and medium in available phosphorus and potassium. *Synedrella nodiflora, Ageratum conyzoides* and *Parthenium hysterophorus* were the dominant weeds, each constituting 14.58percent of the total weed population, respectively. *Cynodon dactylon*, *Cyperus* sp., *Erigeron canadensis* and *Centella asiatica* constituted 12.50, 10.41, 12.50 and 11.46 per cent of total weed population, respectively. The other weed species included *Trifolium repens, Phyllanthus niruri, Polygonum alatum, Hypoestes phyllostachya, Digitaria sanguinalis* and *Commelina benghalensis* constituted 9.37 percent of the total weed flora. Results of the study revealed that available nitrogen, phosphorus and potassium were not significantly influenced by all weed control treatments. The microbial studies revealed that there was no adverse affect of herbicides on count of fungi and actinomycetes. However, weed control treatments brought about significant influence on count of bacteria. All the doses of flumioxazin, behaving statistically similar with glyphosate 4000 g/ha, resulted in higher count of bacteria as compare to other treatments. As a result, flumioxazin can be used to achieve superior weed control in non-cropped areas.

Adsorption-desorption dynamics of glyphosate in wheat straw biochar enriched biomixtures

Garima Sethi[1,2], Renu Saini[1,2], Tirthankar Banerjee[1], Sudama Ram Sahu[1,2] and Neera Singh[1]*

[1]*Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

[2]*The Graduate School, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: garima.sethi267@gmail.com*

This study aims to evaluate the adsorption-desorption behaviour of glyphosate in rice straw-compost biomixtures. To improve pesticide retention and bio-purification effectiveness, 1% and 5% wheat straw biochar (WBC) was added to the rice straw-compost (BM) biomixture, and the adsorption of glyphosate in these biomixtures was assessed. The kinetics study revealed that the pseudo-second-order model best explained the time-dependent adsorption of glyphosate. The percent adsorption of glyphosate in BM, WBCBM (1%) and WBCBM (5%) biomixtures ranged from 42.90-67.16, 46.67-76.82 and 53.48-82.04%, respectively. The adsorption coefficients for glyphosate in BM, WBCBM (1%), and WBCBM (5%) were 26.74, 38.16, and 51.97, with the Freundlich isotherm providing the best fit among the Langmuir, the Freundlich and the Temkin models. The results from desorption experiments suggested that glyphosate's adsorption was irreversible and dependent on the initial concentration of glyphosate. This research proposes that wheat straw biochar mixed with rice straw-compost increased the sorption capacity and can be effectively employed in bio-purification systems for glyphosate removal.

Development of an extraction method for novel triketone and pyrazolone herbicide from various matrices by using response surface methodology and genetic algorithm models

Atanu Sarkar[1], Neethu Narayanan[1], Tirthankar Banerjee[1], Tapas Kumar Das[2] and Suman Gupta[1*]

[1] *Division of Agricultural Chemicals, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

[2] *Division of Agronomy, ICAR-Indian Agricultural Research Institute, New Delhi 110012, India*

**Email: drsumangupta2002@yahoo.com*

Weed infestation is a major problem in crop production. Economic loss of our crops caused by weed infestation is much more than the loss occurred by other phytopathogenic pests like insects, fungi, bacteria, etc. That's why the use of herbicides has become foremost important to protect the crop from weeds. In this aspect, there are some novel herbicides of the triketone (tembotrion, mesotrione) and pyrazolone (topramezone, pyroxasulfone) group that are now extensively applied in maize crops to control weeds, viz. *Eleusine indica, Digitaria sanguinalis, Dactyloctenium aegyptium, Echinocloa spp., Chloris barbata, Digera arvensis, Amaranthus viridis, Physalis minima, Alternanthera sessilis, Convolvulus arvensis, Celotia argentea,* etc. These novel herbicides are selective for maize and effectively control weeds in the field. But the problem is that because of injudicious use of herbicides, it can cause residual toxic effects on subsequent crops, resistance development and also may cause toxic effects on non-target organisms. In this regard, there should be a monitoring technique for pesticide residues and their environmental behavior. That's why we developed an extraction method for these triketone (tembotrion, mesotrione) and pyrazolone (topramezone, pyroxasulfone) groups of herbicides from soil, water, and plant matrices (maize and wheat). We tried various extraction and clean-up methods, including QuEChERS, modified QuEChERS, liquid-liquid partitioning (LLP), and SPE (HLB cartridge). Finally, we developed a miniaturized LLP method for extraction and clean-up of herbicide(s). The method was developed by using topramezone, and then recovery % of tembotrione, mesotrione, and pyroxasulfone were also investigated. We used the response surface methodology (RSM) and the genetic algorithm model to develop and optimize the method conditions. Final analysis was done in an LC-MS/MS instrument, and the limit of detection (LOD) of the analytical method was 1 ppb (at 3:1 signal-to-noise ratio). The overall recovery% of all the above-mentioned herbicides were found to be 85% to 97%. The method was repeatable as well as reproducible, with a relative standard deviation (RSD) of d" 10%. As a result, the developed method is valid and efficient for monitoring the residual content of these novel triketone and pyrazolone groups of herbicides in soil, water, and plant systems (maize and wheat).

Poster 201

Effect of crop residue management and weed management practices on yield attributes, yield and economics of timely sown wheat

Ankur Tripathi*[1], Manoj Kumar Tripathi[2], Hariom Mishra[3], Shweta Gupta[4], Anchal Singh[5] and Shivam Kaushik[1]

[1,3]Department of Agronomy, Acharya Narendra Dev University of Agriculture and Technology, Ayodhya, Uttar Pradesh 224229, India

[2]ICAR- Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh 226002, India

[4]Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh 208002, India

[5]Department of Agronomy, Banda University of Agriculture and Technology, Banda, Uttar Pradesh 210001, India

**Email: hariommishra171@gmail.com*

The field experiment was conducted during two successive *Rabi* (winter) seasons of 2021-22 and 2022-23 at the Agronomy Research Farm of Acharya Narendra Deva University of Agriculture; Technology, Kumarganj, Ayodhya (U.P.). Twenty treatment combinations comprised of four crop residue management, viz. conventional tillage without residue, conventional tillage with residue (3.0 t/ha rice residue), zero tillage without residue, zero tillage with residue (3.0 t/ha rice residue) and 5 weed management practices, *viz*. Triallate 50% EC PE 1250 g/ha, Triallate 50% EC PE 2500 g/ha, clodinafop-propargyl 15% + metsulfuron-methyl 1% WP PoE (60 + 4 g/ha), hand weeding at 20 and 40 DAS and weedy check in wheat were tested in split-plot design with 3 replications, keeping crop residue management in main plots and weed management practices in subplots. Zero tillage with residue (3.0 t/ha) proved to be more effective in controlling weeds than conventional tillage with residue, zero tillage without residue and conventional without residue. Zero tillage with residue (3.0 t/ha) recorded better yield attributes and highest yield of timely sown wheat crop. Hand weeding at 20 and 40 DAS recorded maximum improvement in yield attributes and yield of timely sown wheat crop being on par with post emergence application of clodinafop-propargyl 15% + metsulfuron-methyl 1% (60 + 4 g/ha) at 30 DAS. The highest total cost of cultivation for wheat occurred under the treatment combination of conventional tillage with residue + hand weeding at 20 and 40 DAS during both the years. The lowest total cost of cultivation was recorded in conventional tillage without residue + weedy check while highest net return was recorded in treatment combination of (zero tillage with residue + post-emergence application of clodinafop-propargyl 15%+ metsulfuron-methyl 1% (60 + 4 g/ha) followed by (conventional tillage with residue +post-emergence application of clodinafop-propargyl 15%+ metsulfuron-methyl 1% (60 + 4 g/ha) during both years. Lowest net return was found in treatment combination (zero tillage without residue + weedy check) during 2021-22 whereas, in 2022-23 it was found in (conventional tillage without residue + weedy check). Highest gross return was recorded with treatment combination of (zero tillage with residue + post-emergence application of clodinafop-propargyl 15% + metsulfuron-methyl 1% (60 + 4 g/ha) followed by (conventional tillage with residue + post-emergence application of clodinafop-propargyl 15%+ metsulfuron-methyl 1% (60 + 4 g/ha) during 2021-22, whereas, in 2022-23 it was found in zero tillage with residue + hand weeding at 20 and 40 DAS) followed by (zero tillage with residue + post emergence application of clodinafop-propargyl 15%+ metsulfuron-methyl 1% (60 + 4 g/ha).

Herbicide behaviour in soil and water

Indar Raj Naga*[1], Rameshwar Choudhary[2] and Renu Jayant[3]

[1]*Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[2]*Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab 141004, India*

[3]*Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

**Email: indrarajnaga0@gmail.com*

Herbicides are pivotal for controlling weeds in both agricultural and non-agricultural contexts. However, their environmental behavior is complex and influenced by numerous factors. A comprehensive understanding of herbicide fate, including retention, transport, and transformation, is critical for effective management and minimizing ecological impacts. This chapter underscores the importance of investigating herbicide behavior under real-world conditions, particularly in relation to physical, chemical, and biological soil amendments. These amendments can significantly impact the efficacy of residual herbicides applied pre-emergence. Detailed insights into herbicide behavior facilitate the optimization of application rates tailored to soil types and climatic conditions, a fundamental aspect of precision agriculture. Research on herbicide interactions with the environment has seen substantial expansion, especially over the past three decades. This field is inherently interdisciplinary, integrating agricultural, environmental, and biological sciences with technology, physics, chemistry, and biomedicine. To date, over 35,000 publications have explored herbicide behavior in environmental contexts, and this research trend is expected to continue its upward trajectory in the future.

Poster 203

Computational design and screening of fragment-based molecules for acetyl-coa carboxylase inhibition in a *Phalaris minor* herbicide development

Bikash Kumar Rajak* and Priyanka Rani

Department of Bioinformatics, School of Earth, Biological and Environmental Sciences, Central University of South Bihar Gaya, Bihar 824236, India

**Email: bkrbikash0@gmail.com*

Acetyl-CoA carboxylase (ACCase: EC 6.4.1.2), is an essential biotin-containing enzyme for fatty acid synthesis and elongation in plants. A homomeric form of ACCase protein can be found in all Graminae families, making it the ideal target for herbicides to exert selective activity against weeds that infest agricultural fields. One such example is *Phalaris minor* infestation in wheat (*Triticum aestivum*) crop fields. The uncontrolled growth of *P. minor* in the wheat crop has remained a problem, which has led to a massive reduction in wheat grain production. The most effective way till date to control *P. minor* infestation in agricultural fields is the use of herbicides. However, regular misuse of herbicides has caused rapid development of *P. minor* resistant biotypes. It has compelled agro-scientists to analyse the action of herbicide on *P. minor*, for the development of new potential herbicide-like molecules. The traditional herbicide discovery process is cost-prohibitive and time-consuming, making the herbicide discovery process inefficient. However, current advancements in computational techniques are efficient in exploring genomics, transcriptomics and proteomics. These insights into the structural details of catalytic sites of herbicide action in weeds provide valuable guidance for the discovery, development and designing of novel herbicide-like molecules. For the discovery of ACCase-inhibiting herbicide-like molecules small molecule databases (ZINC, CHEMBL and DrugBank) have been screened based on 35% structural similarity with known ACCase-inhibiting herbicide. The retrieved molecules are then put through the 'High Throughput Virtual Screening (HTVS)' workflow, followed by their filtration through physicochemical criteria of known ACCase-inhibiting herbicides. The known ACCase-inhibiting herbicides and screened herbicide-like molecules are then used to generate fragments, that are later used in the generation fragment-based library of new herbicide-like molecules. The unique feature of the generated library is that all the molecules possess herbicide-like characteristics, specifically aligned with the physicochemical properties of ACCase-inhibiting herbicides. The library is again screened based on the threshold binding affinity of known ACCase-inhibiting herbicides (-8.5kCal/mol), which are later validated for their interaction stability through Molecular Dynamics (MD) simulation for 100ns. Finally, four promising true positive molecules with potential ACCase-inhibiting herbicide-like properties are identified and optimised, after analysing simulated trajectories. The next step to ensure the activity of the in-silico validated molecules would be the evaluation of designed molecules through in-vitro laboratory-controlled testing of molecules on *P. minor* plantlets.

Poster 204

Comparative efficacy evaluation of glyphosate formulations for weed control in tea under the conditions of North Western Himalayas

Garima Chauhan*, Suresh Kumar, Sandeep Manuja, G.D. Sharma, Tarun Sharma, Akashdeep Singh and Bharat Bhushan Rana

Department of Agronomy, Chaudhary Sarwan Kumar HPKV, Palampur, Himachal Pradesh 176062, India

**Email: garimac2010@gmail.com*

A present field experiment was conducted in farmer's field (Tanda, Palampur) from 2020 to 2021 to evaluate glyphosate formulations *i.e.*, glyphosate potassium salt 46% SL and glyphosate IPA salt 41% SL for weed control in tea. The soil at the experimental site was acidic in reaction, silty clay loam texture and medium status for soil available nitrogen, phosphorus and potassium. The mean weekly weather parameters, such as maximum and minimum temperature, relative humidity, sunshine hours, and rainfall, recorded at the meteorological observatory of the Department of Agronomy, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, for the experimental season, *i.e.* 25th May, 2020 to 4th October, 2020. The data revealed that the total rainfall received during the experiment period was 1560.8 mm. The mean maximum temperature for the experimental period varied from 26.0 to 28.9 0 C and the minimum temperature ranged from 13.2 to 20.0 0 C. The mean sunshine hours for the experimental period remained between 2.0 to 10.0. The experimental site was continuously under tea cultivation as orchard. Field experiment consisted of ten treatments *i.e.*, glyphosate IPA salt 41% SL 2000, 4000 and 8000 ml/ha, glyphosate potassium salt 46% SL 1440, 2880 and 5760 ml/ha, paraquat di chloride 24% SL 2000 ml/ha, glyphosate 41% 4000 ml/ha, glufosinate ammonium 13.5% 3333 ml/ha and weedy check which were replicated thrice in a completely randomized block design. The gross plot size for the experimental plot was 16 m^2 (4 x 4 m). The results of the experiment revealed that application of glyphosate IPA salt 8000 ml/ha and glyphosate potassium salt 5760 ml/ha resulted in considerably higher weed control efficiency, significant lower total weed dry weight at different observational stages such as 30, 45, 60, 75 and 90 days after spray. Tea bush height and girth at 30, 45, 60, 75 and 90 days after spray were also recorded to be considerably improved under with the spray of glyphosate IPA salt 8000 ml/ha and glyphosate potassium salt 5760 ml/ha. Similarly, green leaf yield and made tea yield were recorded to be substantially higher with the application of glyphosate IPA salt 8000 ml/ha and glyphosate potassium salt 5760 ml/ha. Therefore, based on the present investigation it was concluded that application of glyphosate IPA salt 8000 ml/ha and glyphosate potassium salt 5760 ml/ha can be recommended for considerably better weed control and tea yield under the conditions of North-western Himalayas.

Novel approach for weed seed bank management in garden land ecosystem

S. Vignesh*, P. Murali Arthanari and S. Vellaikumar
Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India
**Email: vigneshagri119@gmail.com*

The weed seed bank is widely considered as the major source of weed infestation in arable land. Despite advances in above ground weed control decreases the production of new seeds. Weed infestations continue to be generated from a portion of seed bank that persists as result of dormancy and resistance to decay. Identifying the presence of such weed seeds in soil before their emergence will be useful for forewarning, and to develop new management strategies in future. Therefore, the study was conducted to quantify the weed seeds in garden land soil before their emergence through *in-situ* electrochemical detection by identifying the specific compounds in weed seed exudates released d uring imbibition process of germimation using GCMS. The laboratory experiment was carried out at the Department of Agronomy, Tamil Nadu Agricultural University. The matured weed seeds of *Trianthema portulacastrum* and *Parthenium hysterophorus* were collected from the respective weeds and germination test were conducted in petriplates with germination paper and in pot with soil to know their germination percentage. The germination percentage of 16% and 4 per cent were obtained respectively in *Trianthema portulacastrum*. Whereas in *Parthenium hysterophorus* it was 14.7% and 46.7% respectively. Seed exudates were collected by soaking the weed seeds in water for 48 hours. After 48 hours the weed seed exudates were collected by filteration and processed further for identifying the specific compounds present in the exudate through GCMS analysis. Compounds with highest peak percentage identified in *Trianthema portulacastrum* were terpenoids like 9,19-Cyclolanost-25-ene-3,24-diol, Betulin, 9,19-Cyclolanostan-3-ol, 24-methylene-, (3.beta.), and sterol lipids like .gamma.-Sitosterol. Whereas, in *Parthenium hysterophorus* Card-20(22)-enolide, 3,5,14,19-tetrahydroxy-, (3.beta.,5.beta.), Cholesta-3,5-dien-7-one, 2-Butenedioic acid (E)-, bis(2-ethylhexyl) ester, n-pentadecanol were found. Which belongs to the class terpenoids, sterols, fatty acids and fatty alcohol. In this preliminary investigation these compounds were identified in water exractable seed exudates of *Trianthema portulacastrum* and *Parthenium hysterophorus*, the further studies on weed seed exudates in soil media will make a way for developing sensor and identification of weed seeds in the soil.

Harnessing the potential benefits of aquatic weed plants through phytoremediation of wastewater and their biomass utilisation

Biswabhusan Ghosh* and Sunil Kumar Verma
Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India
**Email: imbiswa453@gmail.com*

Clean water is an inevitable necessity in human life apart from food and shelter. Surface and underground water are the major sources of clean water. However, with the rapid growth in population and increasing industrial development in India, many water sources have become polluted. Hence, wastewater must be adequately treated prior to discharge into the environment. Some conventional methods such as reverse osmosis, adsorption, ion exchange, deionization, chemical precipitation *etc*. are used to remove organic and inorganic contaminants. These conventional treatment technologies to remove the pollutants from wastewater are usually costly, time-consuming, environmentally destructive, and mostly inefficient. Phytoremediation is a cost-effective green emerging technology with long-lasting applicability. The selection of plant species is the most significant aspect for successful phytoremediation. Phytoremediation technique is a branch of bioremediation that employs the application of plants for the remediation of wastewater. Aquatic plants have the capacity to absorb excess contaminants such as organic and inorganic, heavy metals, and pharmaceutical pollutants present in agricultural, domestic and industrial wastewater. Water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), water fern (*Salvinia molesta*) and Duck weed (*Lemna minor*) along with some other aquatic plants are prominent metal accumulator plants for the remediation of heavy-metal polluted water. The aquatic plants have been widely used for the treatment of agricultural, domestic and industrial wastewater. The wide application of these plants is due to their availability, resilience in a toxic environment, bioaccumulation potentials, invasive mechanism and biomass potentials. The application of aquatic plants in phytoremediation like other conventional physical and chemical techniques does not require any post-filtration and can be effectively used to treat a large volume of polluted water and soil. The phytoremediation potential of the aquatic plant can be further enhanced by the application of innovative approaches in phytoremediation.

Measurement of allelopathic capacity of eucalyptus and it's derivatives on germination of obligate root-parasitic weed, broomrape

Raman Manoharlal* and G.V.S. Saiprasad
ITC Life Science and Technology Centre (LSTC), Bengaluru, Karnataka 560058, India
**Email: ramanpdf04@gmail.com*

In the present study, an assessment of allelopathic impact of *Eucalyptus camaldulensis* (Ec) and its various derivatives was made on and holo-parasitic weed, nodding broomrape (*Orobanche cernua*; Oc). For the same, an optimized *in vitro* Oc germination assays were evaluated as functional read-out under different experimental setup, to determine the allelopathic capacity of Ec sapling, its leaf-litter extract, Ec plantation-soil, distilled *Eucalyptus* oil and purified eucalyptol. Our results demonstrated a considerable and significant negative allelopathic impact of all aforesaid test-reagents on Oc seed germination. This report, to the best of our understanding, represents the first instance wherein the allelopathic effects of Ec and/ it's derivatives on Oc seed germination have been documented. From the application perspective, these findings have the potential to be expanded to develop the innovative '*Green*' approaches for managing the underground root parasitic-weed infestation in a diverse range of agriculturally-significant crops.

Weed management tools under the aquatic ecosystem

Prem Prakash Parihar*, Shivani Thakur, Kusum Sharma, Sakshi Mundra and Jagjeet Panthi
Jawaharlal Nehru Krishi Vishwavidayala, Jabalpur Madhya Pradesh 482004, India
**Email: pariharprem2001@gmail.com*

Aquatic weeds are found in different zones in aquatic ecosystem and inhabitants of water environment and also interfere with the growth of other plants. Climatic and water conditions are the main determinant factors for the growth and expansion of aquatic weeds. Many different aquatic plants can be found in, on, and around fish culture ponds. These plants range from microscopic organisms known as plankton algae which drift suspended in the water, to larger plants rooted in the pond bottom. aquatic weeds are seen as a global threat to the aquatic ecosystem and it is merely impossible to eliminate them completely with the application of available costly and energy intensive control measures. Hence, it is more preferable to utilize them as a bioenergy feedstock, keeping in mind their biological and physical attributes and the vital need of renewable energy alternative that can be produced with minimal land use change. Once introduced into an aquatic ecosystem, invasive plants known as “aquatic weeds” can seriously harm the environment and the economy. They can have detrimental effects on the environment and the economy because to their rapid growth rate, diverse ways of dissemination, and worldwide spread. All bodies of water utilised for agriculture, recreation, and hydropower production are negatively impacted by them. Furthermore, they pose a threat to aquatic biodiversity by displacing native wildlife and vegetation, altering habitats permanently. Their rapid growth lowers the water’s oxygen content, which fosters anoxic conditions that support methanogenesis and cause global warming. once water bodies are infested, integrated measures are recommended to manage the weed. There are various alternatives like Biological, mechanical and chemical methods are used for the management and control of aquatic weeds. Mechanical Techniques such as Harvesting: Using machine harvesters or manual tools, physically chopping and pulling weeds. Although labour-intensive, it is effective in suppressing emergent and floating weeds. Dredging is the process of removing sediments from water bodies’ bottoms in order to get rid of weed roots and nutrient-rich sediments that promote the growth of weeds. Physical barriers or mats can be erected to block sunlight and stop the growth of weeds. Biological control agents involve the introduction of naturally occurring predators that consume weeds, including fish, fungi, or insects. Herbicides are useful, but they must be applied properly to protect non-target species and the purity of the water. Chemicals created especially to stop the growth of algae are called algaecides. The use of herbicide has the disadvantages of being in water as residue but using of herbicide is easy quicker and usually cheaper as compared to the other mechanical method. Aquatic weeds (emergent, floating and submerged) interference with static and flow water system approximately 75% of the total area is infested with water hyacinth. Integrated Weed Management (IWM) is a combination of methods tailored to the specific water body and type of aquatic weed. For example, mechanical harvesting can be combined with herbicide applications for more effective results. There are many challenges and consideration regarding aquatic weed management such as impact on the environment: making sure that techniques don’t damage non-target species or water quality. Regulatory compliance refers to using herbicides and other management techniques in accordance with municipal, state, or federal regulations. Dredging and mechanical harvesting are two examples of pricey techniques that may require repeated use. Selecting the best approach relies on various aspects such as the kind of aquatic weed, the size of the body of water, and the surrounding.

Assessing the impact of *Lantana camara* removal on the regeneration of native plant diversity in Chhattisgarh forests

Rathod Digvijaysinh*[1], Neelu Singh[1], Himanshu Mahawar[2], Nikita Rai[1] and Shashank Gupta[1]

[1]*ICFRE-Tropical Forest Research Institute, Jabalpur, Madhya Pradesh 482021, India*

[2]*ICAR-Directorate of Weed Research, Jabalpur, Madhya Pradesh 482004, India*

**Email: rathodd@icfre.org*

The invasive alien species *Lantana camara* has invaded the major and sub-forest types in Chhattisgarh. Due to its invasion, the natural native biodiversity is affected and it severely affects the natural regeneration of commercially important species native to that area. The aim of study was to measure the impact of Lantana camara removal on regeneration of native forest species in different density invaded area. The present study was conducted in the Bastar Forest Division of Chhattisgarh state. The quadrat sampling method was used for understorey vegetation survey in eradicated and non-eradicated area. The permanent sample plots of 1 ha were established on site and vegetation data was collected from this plot by randomly layout the five sample plots of 10 × 10m size on both eradicated and non-eradicated area. The results revealed that in high-density area, a total of 31 species and higher number of seedling (2740 individual/ha) and sapling (940 individual/ha) in eradicated area were recorded as compared to seedling (2440 individual/ha) and sapling (680 individual/ha) density in the non-eradicated area. In medium-density area, a total of 31 species and higher number of seedling (5820 individual/ha) and sapling (1100 individual/ha) were recorded in eradicated area compared to seedling (840 individual/ha) and sapling (820 individual/ha) in the non-eradicated area. In low-density area, a total of 22 species and lower number of seedlings (3160 individual/ha) and saplings (860 individual/ha) were recorded in eradicated area compared to seedling (3660 individual/ha) and sapling (880 individual/ha) in the non-eradicated area. Good regeneration was observed in the *Diospyros melaoxylon, Shorea robusta, Azadirachta indica, Terminalia tomentosa* and *Wrightia tinctoria*. It is concluded that eradication of *Lantana camara* from forest invaded area is increasing the density of seedlings and saplings on forest floor, which may be useful to improving the tree stock density and composition of forest through boost up the regeneration of native species. This study will be helpful in development of suitable restoration model for eradication of invasive alien species. Further, it will be helpful in the development of silvicultural based control measures of invasive alien species through understanding tree species and invasive alien species interaction.

Anatomical divergence in *Cyperus*: A comparative study of two species

K. Srimathi* and C.R. Chinnamuthu

Department of Agronomy, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India

**Email: srimathiraj95@gmail.com*

Cyperus rotundus and *Cyperus difformis*, both members of the Cyperaceae family, are notorious weeds in agricultural ecosystems. Despite their differing morphological and anatomical characteristics, they belong to the same genus and family. This study aimed to anatomically characterize the leaves and stems of both species to identify diagnostic features and explore potential relationships between them. Standard anatomical methods were employed to examine epidermal and cross sections of leaves and stems. The transverse sections revealed significant diagnostic traits. Notably, *C. difformis* leaves lack kranz tissue and minor vascular bundles, which are present in *C. rotundus* leaves. Kranz tissue, a key feature in Cyperus species, allows for the spatial dissociation of photosynthetic enzymes, such as phosphoenolpyruvate-carboxylase and Ribulose-1,5-bisphosphate carboxylase. Both *C. rotundus* and *C. difformis* are classified as hypostomatous, exhibiting a greater concentration of stomata exclusively on the lower leaf surface. Leaves have epidermal cells on their upper surface. Stomatal density varied widely with *C. difformis* had the highest mean value (19 No. /mm2) whereas in *C. rotundus* with the lowest mean value (6 No. /mm2). Both species feature a major vascular bundle at the center of the leaf, encircled by a bundle sheath. Both species have single-layered epidermal cells and bulliform cells, with *C. rotundus* having more bulliform cells. The presence of air cavities in the transverse section of *C. difformis* stems suggests an adaptation to submerged growth conditions. Additionally, *C. difformis* exhibited higher stomatal density and shorter interveinal distances compared to *C. rotundus*. The findings indicate that leaf anatomical characteristics, such as the presence of kranz tissue and interveinal distance, are reliable indicators for distinguishing species within the Cyperus genus, which includes both C3 and C4 plants. Specifically, *C. difformis* is identified as a C3 species, while *C. rotundus* is a C4 species. These anatomical differences provide insights into their ecological adaptations and potential management strategies in agricultural settings.

Effect of weed management practices on soil health

Alka Pandey

Department of Agronomy, Banda University of Agriculture and Technology,
Banda, Uttar Pradesh 210001, India
Email: alkap6600@gmail.com

Soil health play an important role in crop production. Weeds are the major biological constraint of modern farming practices. Weed management is an ever-present challenge to crop production. Weeds have the potential to grab resources that would otherwise provide nourishment to growing crops. Because of these potential negative impacts, more attention has been devoted to developing management strategies aimed at reducing weed populations, usually through mechanical disturbance or chemical. The direct and indirect effects of weed management on soil quality can range from negative to positive. Direct effect alters diversity of soil biota and quality while, the indirect effects of weed management occur through changes in weed abundance and species composition. Based on soil sample collected from treated and untreated sites under conditions of Bundelkhand region, some marked variations in soil quality has observed. Collected soils analyzed to understand the effect of weed management practices and available soil moisture on soil organic matter and dehydrogenase activity, an indicator of soil quality. Mechanical management of weeds significantly reduced the organic carbon content when compared with soil collected from manual weeded plots. Mechanical manipulation of soil for weed management prior to sowing by using several tillage implements influenced soil organic carbon content markedly. In comparison to use of mould board plough for tillage more soil organic carbon content observed under tilled soil by using cultivator or country plough. Observed range of SoC was 0.36 to 0.37%. Under modern farming practices mostly weeds are managed by using herbicides. The use of herbicides is more likely to reduce the organisms present in the soil and affect the quality of the soil. Organic carbon content in soil sample collected from herbicide treated and untreated soil does not notice variable up to the level of significance. Might be due to faster degradation of applied herbicides in soil. Although higher SoC observed under soil collected from untreated sites. Weeds in vegetable and some other crops also managed by using organic mulches. Which facilitates to protect soil from erosion and reduced weed problem. Besides this, mulches help in keeping soil moist for longer period resulted more microbial activity as well as higher soil organic carbon content. Dehydrogenase activity of observed soil sample was in the range of 173.1 to 189.3 µg of TPF per g/hr. Thus, various weed management methods had variable effects on the soil quality parameters. Herbicides when used at the prescribed doses also remain safe for microbial activity.

Manipulating the soil microbiome to create unfavourable conditions for weed growth

Lakey Radha*[1], Ram Narayan Meena[1], P. Halesha[1], Ambikesh Tripathi[1], Sanju Choudhary[1], Kareti Harika[1] and Nishtha Sharnagat[2]

[1]*Department of Agronomy, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*

[2]*Department of Farm Engineering, Banaras Hindu University, Varanasi, Uttar Pradesh 221005, India*

**Email: radhalakey@gmail.com*

Managing weeds in agricultural fields is key to food security globally. Most agricultural weeds are early successional plant species and, as such, are particularly apt to establish and thrive well in disturbed habitats like those created on agricultural land. Weed management strategies, like tillage and herbicide treatments, to control weeds generally alter soil structure going alongside with changes in the microbial community. Weed and crop plants compete for light, nutrition and water, but may differently interact with soil microorganisms. The development of new sequencing technologies for analysing soil microbiomes has opened up the possibility for in depth analysis of the interaction between 'undesired' plants and crop plants under different management systems. Variety of microorganisms such as rhizobacteria, pathogenic soil-borne fungi, and arbuscular mycorrhizal fungi, all of which have a direct or indirect impact on weeds and their competitive ability. In some cases, specific microbes have a detrimental effect on the weeds and can be exploited as biological control agents. The ubiquitous mycorrhizal fungi are beneficial symbionts that can impart a competitive advantage to their plant hosts, particularly if mycorrhizal dependency is exhibited in weeds as opposed to crops. It may be possible to exploit various soil microbes by directly or indirectly reducing weed competition and tipping the competitive advantage in favour of the crop. Implementing the full range of ecological weed management practices (rotation, allelopathy, weed seed bank reductions, seed predators) in conjunction with soil building practices is even more critical for farmers who wish to reduce herbicide use or in organic production systems where herbicides cannot be used. Management-induced differences in soil microbiota can further affect crop-weed competition. However, soil biotic legacy effects differed between crop/weed mixtures and their respective monocultures, suggesting context-dependency in crop/weed responses to management-induced differences in soil pathogens, plant growth promoting rhizobacteria and/or mycorrhizal fungi. The management legacy effects on soil microbiota have the potential to increase crop competitiveness and mitigate the negative effects of weed competition. Developing management tools that modify the soil environment of weeds can be an effective alternative method, to the use of microbial natural products for weed control is the use of ecological management strategies, that enhance microbiome function to suppress weeds. Soil resource modification can be a useful method to alter microbial community structure and function resulting in microbial immobilization of soil nitrogen and weed growth suppression. Designing functional synthetic microbial communities may be the way forward to more consistently suppress root parasitic weeds and microbes with complementary modes of action that act together or synergistically, and preferably at different stages of the parasite's life cycle. Microbiome-based strategies hold promise for developing and integrating novel and sustainable strategies for weed control. It benefits crop production and reduce chemical inputs is a viable strategy and should be pursued.

Poster 213

Assessing the risk of weed invasion by superasterids in the motahaldu haldwani block, Uttarakhand

Manisha Pandey*, S.P. Joshi and Sachin Sharma
Eco-Taxonomy Research Laboratory, Department of Botany, D.A.V. (P.G.) College, Dehradun, Uttarakhand, 248001, India
**Email: manishapandey614@gmail.com*

The global proliferation of invasive plant species is causing havoc in ecological and agricultural ecosystems. Early warning and avoiding high-risk introductions are critical for minimising losses and increasing gains. Weed risk assessment can help identify efficient weed management techniques on Indian public lands also, aiding policymakers in managing plant invasions, developing human capital, and raising public awareness. Future technologies could address agricultural industry concerns. The Weed Risk Assessment method has been a successful prediction project for forecasting naturalisations of weed species in Motahaldu, Haldwani Block, Uttarakhand. From April 2022 to January 2023, 30 field site (agricultural and non-agricultural) surveys were conducted to gain knowledge of the availability and geographic distribution of the various ruderals and agrestal weed flora expanding in the focus area and to generate a generalised weed risk score of weeds from Superasterids. The APG-IV classification system was graded by utilising the risk-based Assessment score method to forecast the weed hazards of various weeds in the block. The research looked at 17 weed species in the Superasterids Grade of the APG-IV classification system. The study discovered that 53% of the reported weed species were of low rank, 35% were of medium rank, and 12% were of high-risk rank status. In our investigation, we discovered that *Alternanthera philoxeroides* (Mart.) Griseb. had the highest weed risk score (25) while Mirabilis jalapa L. and Opuntia elatior Mill. had the lowest weed risk score (1.08). A study found that 75% of the weed species were herbs. Ruderal weeds (41%) were the most common, followed by Agrestal weeds (41%) and (18%) in both categories. In terms of the origin of weed species, most weeds were from Tropical America (62%), and the minimum was from Tropical Africa (6%). we recorded that there were 2 weed species in the high and zero weed species in extreme risk rank statuses, while there were 6 weed species in the high-risk rank and 3 weed species in the extreme risk rank statuses. There was one weed species in unscored status in the compendium, and in our analysis, we found no species in unscored status. The study finds that the aforementioned approach may be used to determine the risk rank status of the concerned weed species in the climatic and various habitats. The revealed data will supply the future aspect of the problematic weed species, and we will be able to check them. The research will also aid in the optimal use of weedicides and concentrations for certain weed species in various agricultural settings.

Herbicide-nutrient interactions and soil nutrient dynamics under diverse nutrient management practices

Yerra Pavani*, P. Janaki, P. Murali Arthanari, D. Jagadeeswaran, A. Ramalakshmi and A. Sankari

Department of Soil Science & Agricultural Chemistry, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu 641003, India

**Email: paavaneyerra11@gmail.com*

This study explores the intricate interactions between commonly used herbicides (glyphosate, pendimethalin, and metribuzin) and soil nutrients, focusing on their impact on nutrient availability. Laboratory was conducted using a Factorial Completely Randomized Design (FCRD), with two factors: four fertilizer nutrient application (NFA) practices as factor 1, and seven herbicide treatments as factor 2. The nutrient management practices included soil test-based NPK alone, NPK with micronutrients, NPK with FYM (farmyard manure), and farmers' practice. The herbicide treatments consisted of combinations of glyphosate (at two doses), pendimethalin, and metribuzin. Treatments were replicated three times, and nutrient practices were applied based on soil test crop response techniques. Fertilizers used to supply NPK were urea, superphosphate, and potassium chloride, while FYM was applied according to treatment plans. In the incubation study, soil test-based NPK+FYM treatments consistently increased organic carbon content over time, whereas NPK alone resulted in lower organic carbon levels. No significant interaction effects between nutrient practices and herbicides were observed for nitrogen availability in the soil. However, the NPK+FYM treatment significantly increased nitrogen levels throughout the study. Phosphorus availability varied with time and herbicide treatment. Initially, no significant differences were noted among herbicide treatments, with the control showing higher phosphorus levels from 15-45 days. After 60 days, significant differences were observed in glyphosate treatments. The NPK+FYM treatment showed significantly higher phosphorus availability from day 45 onwards, while NPK alone, NPK+MN, and farmers' practices remained consistent throughout the study. Potassium content showed no significant variation among herbicide treatments initially, but after 45 days, NPK+FYM recorded significantly higher potassium levels. Calcium and magnesium levels showed no significant differences across nutrient and herbicide treatments throughout the study. Sulfur availability was unaffected by treatments at the beginning, but after 60 days, NPK treatments showed a significant increase. Micronutrient levels (iron, copper, manganese, and zinc) varied with nutrient management, with NPK+MN and NPK+FYM showing higher iron levels compared to NPK alone and farmers' practice. Boron levels varied among nutrient treatments but not with herbicide treatments, with NPK+MN and farmers' practice showing higher levels compared to NPK+FYM and NPK alone. Among the nutrient management practices, the combination of soil test-based NPK with FYM and inorganic fertilizers mitigated negative interactions with herbicides more effectively than other practices. The study also revealed that sequential application of glyphosate, especially in combination with NPK+micronutrients, significantly reduced micronutrient and phosphorus availability in the soil. This negative effect was moderated by the addition of organic sources like FYM. Therefore, when applying multiple herbicides in sequence, it is crucial to include organic sources in the nutrient management plan to counteract adverse effects and reduce herbicide residue persistence in the soil.

Parthenium hysterophorus – survey and current status in Bilaspur district of Chhattisgarh

Arun Tripathi

Indira Gandhi Krishi Vishwavidyalaya, Krishi Vigyan Kendra, Bilaspur, Chhattisgarh 174029, India

Email: aruntripathi847@gmail.com

In agriculture, weeds cause huge reductions in crop yields, increase cost of cultivation, reduce input use efficiency, interfere with agricultural operations, impair quality, act as alternate hosts for several insect pests, diseases and nematodes, compete with crop plants for various inputs/resources like water, space, nutrients, sunlight *etc*. Parthenium (*Parthenium hysterophorus*), commonly known as Carrot grass has taken the most dreaded position among various weeds and posing a great threat to major cereal, pulses and oilseed crops in Chhattisgarh plains. It is considered as an exotic, poisonous, allergic and aggressive weed creating serious challenge to environment and biodiversity. Parthenium as a weed has tremendous potential for biomass production both under cropped fallow, non-cropped area and cropped field situations. This is a herbaceous, erect, annual plant belonging to the family Asteraceae. A study was conducted to understand the distribution of Parthenium in different villages and crops of district Bilaspur during *Rabi* season of 2023-24. It was undertaken in the adopted and contact villages of Krishi Vigyan Kendra, Bilaspur during *Rabi* 2023-24. The crops selected were wheat, mustard, lathyrus, chickpea and linseed in villages Risda, Bhainsajhar, Hindadih, Darrighat, Pondi, Ranigaon, Dhuma, Hirri and Nagoi. Wheat, mustard, chick pea were in irrigated condition, however linseed was under partially irrigated and lathyrus under rainfed condition. Maximum Parthenium infestation was recorded in wheat followed by mustard and chick pea. Minimum infestation was observed in lathyrus under rainfed utera condition. This reveals that seed bank of Parthenium is increasing very rapidly under irrigated and well supplemented crop by different manures and fertilizers. The other prominent weed species observed in the farmers' fields included *Chenopodium album*, *Medicago denticulata, Vicia sativa*, *Phalaris minor*, *Avena ludoviciana* and *Lathyrus afaca etc*. The relative weed density, relative frequency and relative dominance were computed and Importance Value Index (IVI) was derived. Based on IVI values, *P. hysterophorus* (65.3), *C. album* (46.3), *M. denticulata* (38.6) have been the dominant weed species. The study revealed that there is a serious problem of troublesome weed *Parthenium hysterophorus* in cropped fields particularly under irrigated condition which needs to be managed otherwise this exotic weed will pose a great menace to most of the *Rabi* crops in Bilaspur district of Chhattisgarh.

Plant-microbiome interactions in weed control

Renu Jayant*[1], Indar Raj Naga[2] and Rameshwar Choudhary[3]

[1]*Department of Agronomy, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[2]*Department of Soil Science and Agricultural Chemistry, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh 482004, India*

[3]*Department of Soil Science, Punjab Agricultural University, Ludhiana, Punjab 141004, India*

**Email: renujayant24@gmail.com*

The soil microbiome significantly influences the establishment of weeds and invasive plants by supporting their growth and health through microbial associations. Conventional weed management practices, such as tillage and herbicide applications, disrupt soil structure and alter the microbial community composition. Once a weed population is established, these plants form intimate relationships with the soil microorganisms present. Weed seeds or vegetative structures overwinter in the soil and select their own microbiome early in the growing season before crop plants begin to grow. While both weed and crop plants compete for resources such as light, nutrients, and water, their interactions with soil microorganisms may differ. Advances in sequencing technologies now allow for a comprehensive analysis of the soil microbiome interactions with both undesired plants and crops under various management systems. Such research enhances our understanding of the roles of microorganisms in crop productivity, plant health, weed establishment, and weed control. This knowledge provides opportunities to explore novel biocontrol strategies based on soil and plant-associated microorganisms, offering potential for new methods to manage weeds and invasive plants in diverse land management contexts.

Restoring aquatic health: sustainable management of submerged weeds

P. Prameela*, Savitha Antony and S.G. Gowtham
Kerala Agricultural University, Thrissur, Kerala 680656, India
**Email: prameela.p@kau.in*

Aquatic weed infestations are escalating at an alarming rate, leading to multiple adverse effects, including the degradation of water quality, obstruction of water flow, reduced water storage capacity, and the creation of habitats for harmful vectors. Despite the availability of various management techniques, such as physical, mechanical, biological, and chemical methods, no registered herbicide effectively controls submerged aquatic macrophytes. Therefore, a study was conducted at the AICRP on Weed Management, College of Agriculture, Vellanikkara, Kerala Agricultural University, during 2022-23. The study aimed to assess the effectiveness of different liming materials against three prevalent submerged fresh water aquatic weeds - Cabomba furcata, Lymnophila heterophylla, and Hydrilla verticillata and to evaluate their effects on water and sediment quality. The experiment involved three phases of tank studies, complemented by field trials conducted in ponds and stagnant channels across four locations. Initial tank studies tested calcite, quicklime (CaO), and dolomite at varying concentrations (50, 100, 200, 400, and 600 mg/L), but these doses proved ineffective. Subsequent trials increased concentrations to 0.8–1.4 g/L, where only quicklime showed effectiveness at 1.0 g/L and above. The third phase focused solely on quicklime at higher concentrations (2, 4, 6, 8, and 10 g/L), confirming its efficacy at these levels. Field trials in lined irrigation channels tested doses of 2, 4, and 6 g/L, where the 6 g/L dose achieved complete weed control. Chlorophyll degradation and phytotoxicity were significant from 7 days post-quick lime application, with more than 50% reduction in chlorophyll content by 14 days at higher doses). In cabomba and hydrilla, the decrease in chlorophyll content was 85% while limnophila showed 75% reduction by 21 days. Water quality parameters such as pH, electrical conductivity (EC), carbonates, bicarbonates, alkalinity, total hardness, and calcium levels were positively correlated with increasing quicklime doses, but generally returned to acceptable levels within 30 days of liming. At 30 days after liming, nutrient content in both water and sediment parameters showed a negative correlation with the increasing dose of quicklime. Sediment quality parameters like pH, EC, organic carbon, and calcium content were positively correlated with increasing dose of quicklime. The study concludes that quicklime can be a highly effective, eco-friendly alternative for managing submerged aquatic weeds. The effects on water and sediment quality were transient, with parameters normalizing within 30 days, and no adverse impact on aquatic fauna was observed. The findings suggest that CaO application holds promise for broader use in water bodies, but further validation in diverse settings is required for comprehensive management strategies. This technology works well in small to medium-sized water bodies with neutral pH; for every one square meter of infested surface area, it is recommended to apply 900 grams of CaO. In ponds, where infestation is in localized patches, application can be restricted to infested area.

Bionetwork of pernicious weed: Nutsedge

Tushar Patel* and Jimit Patel
College of Agronomy, Navsari Agricultural University, Bharuch, Gujarat 392012, India
**Email: tushagri.ank@gmail.com*

Knowledge of its biology, ecology are necessary to reduce the effect and spread of sedges. Hence, an investigation and campus-wide survey were done at College Farm, Navsari Agricultural University, Campus Bharuch. The phonological survey was conducted during the *Kharif* and *Rabi* seasons in order to determine the diversity, distribution, and degree of infestation of Cyperus spp. To learn about the biology of *Cyperus rotundus* L., including its growth, flowering, and tuberization pattern, a pot culture study was set up. Large plot approaches were also used to assess yield losses resulting from *Cyperus* spp. infestation in various crops. *Cyperus rotundus*, *Cyperus eragrostis, Cyperus iria*, and *Cyperus compressus* were the species that recorded during survey. Of them, *C. rotundus* and *C. eragrostis* are perennial and found mostly in arable and non-arable land, while *C. iria* and *C. compressus* are annual and found in marshy areas during *Kharif* season. Overall, mean composition of sedges, grasses, and BLWs was 45.18, 23.92 and 30.90 percent during *kharif*; in Rabi, it was 41.88, 21.13, and 36.99 percent. *C. rotundus* regenerated within two to three days after the nuts were planted, and after ten days, 91% of the plants regenerates. A substantial increase in height was seen up to 20 DAP (more than 60%), after which slight increments that reached 88.0 cm at 60 DAP. An increase in leaves was seen up to 30 DAP (10.9), and then declined with maturity as older leaves dropped. Weed flowered at eight leaves on average, and between 30 and 35 DAP was when 50% of the weed was seen to be flowering. At 60 DAP, plentiful tuberization was seen, with a mean of 22.1 tubers per planted nut and a range of 15 to 33 tubers/basal bud. Contrary to this, *C. rotundus* was sprout and develop; however, flowering and further development was not observed in shady condition. Overall, it has been shown that cereals are harder and more competitive than oilseed and pulse crops, both have very poor ability to compete with *Cyperus* spp. Soybean saw the highest losses, accounting for 33.5% of the total, followed by pigeon pea (28.2%), cotton (25.7%), blackgram (21.4%), greengram (21.1%), groundnut (21.1%), cowpea (20.9%), sorghum (11.3%), and sweet corn (8.4%).

Poster 219

Strategic weed management practices for high yields

Manish Kumar* Ved Prajapati and Rahul Tirpathi[2]
Department of Agronomy, Rajasthan College of Agriculture, MPUAT, Udaipur, Rajasthan 313001, India
[2]Department of Agronomy, CSA University of Agriculture & Technology Kanpur, Uttar Pradesh, India
**Email: manishdagla77@gmail.com*

Weed management is a critical issue in modern agriculture directly affecting crop productivity, economic viability and environmental health. Effective weed control is essential to ensure high yields and sustainable farming practices. However, conventional methods such as herbicide application and mechanical tillage, face growing challenges. Herbicide resistance is becoming increasingly widespread, leading to reduced efficacy of chemical controls. Moreover, while effective, mechanical tillage contributes to soil degradation, biodiversity loss and a decline in long-term soil fertility. These issues underscore the need for more sustainable and advanced weed management strategies. One of the most promising innovations in weed management is Site-Specific Weed Management (SSWM). This approach leverages advanced technologies, including unmanned aerial vehicles (UAVs) and hyperspectral imaging systems, to precisely identify and map weed infestations. By targeting only the affected areas, SSWM significantly reduces herbicide use by up to 70% without compromising crop yields. This not only cuts costs but also minimizes environmental impact making it a sustainable alternative to blanket herbicide applications. Robotics is another transformative development in this field. Automated weeders such as the Robovator are equipped with sophisticated image recognition systems that can distinguish crops from weeds. These machines enhance operational efficiency by reducing the time and labour required for manual weeding while ensuring minimal crop damage. Such technology offers a sustainable solution to labour shortages and rising costs in agriculture. Additional advancements like seed priming also play a vital role. Seed priming enhances the germination rate and early growth vigour of crops enabling them to outcompete weeds for resources. This technique is particularly effective under challenging environmental conditions, helping farmers maintain productivity even in stress-prone areas. Nanotechnology further revolutionizes weed control by introducing nano-herbicides. These advanced formulations encapsulate active ingredients in nanomaterials, allowing for targeted and sustained release. This reduces herbicide wastage, effectively controls herbicide-resistant weed species, and minimizes harmful environmental effects. Despite these advancements challenges persist. High costs and technical complexities associated with cutting-edge technologies limit their adoption, particularly in resource-constrained regions. Traditional methods like mulching and cover cropping although environmentally friendly, face issues such as high implementation costs and competition with crops. To address these limitations, integrating advanced technologies with existing weed management practices is crucial. Precision agriculture tools, robotics, nano-herbicides and seed priming should be part of a holistic approach to weed control. Policymakers, researchers and agricultural extension systems must work together to develop cost-effective solutions, create farmer-friendly technologies and implement supportive policies for widespread adoption. Sustainable weed management requires a paradigm shift from conventional methods to innovative, eco-friendly practices. These advancements promise to enhance agricultural resilience, improve food security and promote environmental sustainability, paving the way for a more sustainable future in agriculture.

PATRONS

Dr. Himanshu Pathak
Secretary, DARE & Director General
Indian Council of Agricultural Research
New Delhi

Prof. Sudhir K. Jain
Vice Chancellor
Banaras Hindu University
Varanasi

Convenor: Dr. J.S. Mishra, President, ISWS, Jabalpur

National Advisory Committee

Dr. Suresh Kumar Chaudhari, DDG, ICAR, New Delhi
Dr. K. Sammi Reddy, ICAR-NIASM, Baramati
Dr. S.K. Sharma, ADG (HRM), ICAR, New Delhi
Dr. Anil Kumar, ADG (TC), ICAR, New Delhi
Dr. R.K. Malik, Ex-President, ISWS, New Delhi
Dr. N.T. Yaduraju, Ex-President ISWS, Madurai
Dr. O.P. Yadav, Director, ICAR-CAZRI, Jodhpur
Dr. V.K. Singh, Director, ICAR-CRIDA, Hyderabad
Dr. N.G. Patil, Director, ICAR-NBSS&LUP, Nagpur
Dr. Anup Das, Director, ICAR-RCER, Patna
Dr. H. S. Ginwal, Director, TFRI, Jabalpur
Dr. M. Madhu, Director, ICAR-IISWC, Dehradun
Dr. Parveen Kumar, Director, ICAR-CCARI, Goa
Dr. R.K. Yadav, Director, ICAR-CSSRI, Karnal
Dr. Sunil Kumar, Director, ICAR-IIFSR, Modipuram
Dr. P.K. Ghosh, Director, ICAR-NIBSM, Raipur
Dr. Rajbir Singh, ADG (AAF & CC), ICAR, New Delhi
Dr. Velmurugan, ADG (S&WM), ICAR, New Delhi
Dr. Sudhanshu Singh, Director, IRRI SARC, India
Dr. L.S. Brar, Ex-President, ISWS, Ludhiana
Dr. Samunder Singh, President, IWSS, Hisar
Dr. V.K. Mishra, Director, ICAR-RCNEHR, Umiam
Dr. A. Arunachalam, Director, ICAR-CARI, Jhansi
Dr. A. Sarangi, Director, ICAR-IIWM, Bhubaneswar
Dr. G.P. Dixit, Director, ICAR-IIPR, Kanpur
Dr. K.G. Mandal, Director, ICAR-MGIFRI, Motihari
Dr. P.S. Brahmanand, Project Director, WTC, New Delhi
Dr. R. Viswanathan, Director, ICAR-IISR, Lucknow
Dr. S.P. Datta, Director, ICAR-IISS, Bhopal
Dr. T.K. Behera, Director, ICAR-IIVR, Varanasi

Overseas Advisory Committee

Prof. Robert L. Zimdahl, USA
Dr. Yoshiharu Fujii, KU, Japan
Dr. Prasanta C. Bhowmik, UMA, USA
Dr. Bhagirath S. Chauhan, UQ, Australia
Dr. Bharat Babu Shrestha, TU, Nepal
Dr. Jonathan Storkey, SAS RR, United Kingdom
Dr. Prashant Jha, Montana State University, USA
Dr. Nimal Chandrasena, Australia
Dr. Krishna Narasim Reddy, USDA, USA
Dr. Amit Jhala, UNL, USA
Dr. B. Muthukumar, TAMU, USA
Dr. Gulshan Mahajan, QAAFI, Australia
Dr. Mithila Jugulam, Kansas State University, USA
Dr. Virendra Kumar, IRRI, Philippines

National Steering Committee

Chairman: Dr. J.S. Mishra, President, ISWS, Jabalpur
Co-Chairman: Dr. Anil Dixit, Vice-President, ISWS, Raipur
Members:
Dr. R.K. Ghosh, BCKV, Nadia
Dr. B.P. Bhatt, NRM, ICAR, New Delhi
Dr. T.K. Das, ICAR-IARI, New Delhi
Dr. Mool Chand Singh, ICAR-NBPGR, New Delhi
Dr. R.S. Chhokar, ICAR-IIWBR, Karnal
Dr. M.S. Bhullar, PAU, Ludhiana
Dr. A.S. Tomar, Dhanuka Agritech Limited
Dr. Anil Kakkar, Sumitomo Chemicals
Dr. Sunil Kumar, Corteva Agriscience, Hyderabad
Dr. A.S. Rao, ANGRAU, Guntur
Dr. P.K. Singh, ICAR-DWR, Jabalpur
Dr. P. Murali Arthanari, TNAU, Coimbatore
Dr. Arvind Verma, MPUAT, Udaipur
Dr. Vimal J. Patel, AAU, Anand
Dr. K.N. Geetha, UAS, Hebbal, Bengaluru
Dr. Ajit Kumar, UPL India Pvt. Ltd.
Dr. Mayank Yadav, Bayer Crop Science, New Delhi

National Organizing Committees

Organizing Secretary: Dr. R.P. Dubey, ICAR-DWR, Jabalpur

Publication Committee

Chairman: Dr. Ashok Yadav, CCSHAU, Hisar
Co-Chairman: Dr. D. Subramanyam, ANGRAU, Tirupati
Convenor: Dr. Simerjeet Kaur, PAU, Ludhiana
Members:
Dr. Shobha Sondhia, ICAR-DWR, Jabalpur
Dr. K.A. Gopinath, ICAR-CRIDA, Hyderabad
Dr. C.M. Parihar, IARI, New Delhi
Dr. Puja Ray, Presidency University, Kolkata
Dr. Yogita Gharde, ICAR-DWR, Jabalpur
Dr. Narendra Kumar, ICAR-IIPR, Kanpur
Dr. P. Prameela, KAU, Thrissur
Dr. Malay K. Bhowmick, IRRI, Varanasi
Dr. Dibakar Ghosh, ICAR-IIWM, Bhubaneswar
Dr Todar Mal Poonia, CCSHAU, Hisar

Technical Programme Committee

Chairman: Dr. A.N. Rao, Hyderabad
Co-Chairman: Dr. S.P. Singh, GBPUAT, Pantnagar
Convenor: Dr. V.K. Choudhary, ICAR-DWR, Jabalpur
Members:
Dr. K.K. Barman, ICAR-DWR, Jabalpur
Dr. Ramprakash Tata, PJTSAU, Hyderabad
Dr. B.R. Bazaya, SKUAT, Jammu
Dr. A.P. Singh, NU, Medziphema
Dr. Rakesh Kumar, ICAR-RCER, Patna
Er. C.R. Chethan, ICAR-DWR, Jabalpur
Dr. I.C. Barua, AAU, Jorhat
Dr. M.L. Mehriya, ARS, AU, Jodhpur
Dr. Mukesh Kumar, RPCAU, Pusa
Dr. Rabiratna Dash, OUAT, Bhubaneswar
Dr. Amit Jha, JNKVV, Jabalpur
Dr. Deepak V. Pawar, ICAR-DWR, Jabalpur

Finance Committee

Chairman: Dr. Sushil Kumar, Chief Editor, IJWS, Jabalpur
Co-Chairman: Dr. V.K. Choudhary, ICAR-DWR, Jabalpur
Convenor: Dr. P.K. Mukherjee, ICAR-DWR, Jabalpur
Members:
Dr. Anand Jha, UPL India Pvt. Ltd.
Dr. Ch Sreedhar, TAGROS HOUSE
Dr. Purushottam Mishra, ADAMA India Pvt. Ltd.
Dr. Shekhar Varshney, Sumitomo Chemical India
Mr. Anirban Gangopadhyay, BASF India Pvt. Ltd.
Dr. Chakradhar Paul, PI Industries
Mr. Ranganatha MC, Indofil Industries Limited
Mr. Sunil Naganur, Syngenta India Ltd.

Local Organizing Committee

Chairman: Prof. S.V.S. Raju, Director, Institute of Agricultural Sciences, BHU, Varanasi
Convenor: Prof. Udai Pratap Singh, Head, Department of Agronomy, BHU, Varanasi
Co-Convenor: Prof. Ram Kumar Singh, Department of Agronomy, BHU, Varanasi
Local Organizing Secretary: Prof. Manoj K. Singh, Vice-President, ISWS, BHU, Varanasi
Local Joint Organizing Secretary: Dr. M.K. Singh, Department of Agronomy, BHU, Varanasi

Resource Mobilization Committee
Convenor: Prof. Ram Kumar Singh
Co-convenor: Prof. M. Raghuraman

Transport Committee
Convenor: Prof. Amlan Kumar Ghosh
Co-convenor: Dr. Nikhil Kumar Singh

Accommodation Committee
Convenor: Prof. Rakesh Singh
Co-convenor: Dr. Manoj Kumar Singh

Food and Refreshment Committee
Convenor: Prof. H.P. Singh
Co-convenor: Dr. Rajesh Kumar Singh

Farmers Co-ordination Committee
Convenor: Prof. Shree Ram Singh
Co-convenor: Dr. N. Raghuvansi

Registration Committee
Convenor: Prof. P. S. Badal
Co-convenor: Dr. Sudhir Kumar Rajpoot
Dr. Savita Devangan

Poster presentation Committee
Convenor: Prof. Pawan Kumar Singh
Co-convenor: Dr. S. K. Prasad

Technical Sessions Committee
Convenor: Prof. Satish Kumar Singh
Co-convenor: Dr. Pratik Sanodiya

Publication Committee
Convenor: Prof. Birinchi Kumar Sarma
Co-convenor: Dr. Ram Swaroop Meena

Press, Media, Videography & Photography Committee
Convenor: Prof. S.P. Singh
Co-convenor: Dr. Rajesh Singh

Stage management and Seating arrangement Committee
Convenor: Prof. Anil KumarSingh
Co-convenor: Dr. R.N. Meena

Cultural Program Committee
Convenor: Prof. Sangeeta Pandit
Co-convenor: Prof. J.K. Singh

Stall presentation Committee
Convenor: Prof. Chandra Bhushan
Co-convenor: Dr. S. K. Verma

Invitation Committee
Convenor: Dr. Rakesh Kumar Singh
Co-convenor: Dr. Nikhil Kumar Singh

Tour and Excursion Committee
Convenor: Dr. Rajesh Kumar Singh
Co-convenor: Dr. K. S. Shashidhar

INDIAN SOCIETY OF WEED SCIENCE

(Founded in 1968)

Regd. S. No. SOR/BLU/DR/518/08-09 |IJWS REGD. NO. MAG (5) PRB 249/82-83

EXECUTIVE COUNCIL (2023-24 to 2024-25)

President	Dr. J.S. Mishra, Jabalpur
Vice-President	Dr. Manoj Kumar Singh, Varanasi
	Dr. Anil Dixit, Raipur
Secretary	Dr. R.P. Dubey, Jabalpur
Joint Secretary	Dr. D. Subramanyam, Tirupati
	Dr. S.P. Singh, Pantnagar
Treasurer	Dr. P. K. Mukherjee, Jabalpur
Chief Editor:	Dr. Sushil Kumar, Jabalpur
Past Presidents	Drs. R.S. Choudhry, C. Thakur, V.S. Mani, K. Krishnamurthy, U.C. Upadhyay, H.S. Gill, S.K. Mukhopadhyay, S. Sankaran, G.B. Singh, V.M. Bhan, L.S. Brar, R.P. Singh, R.K. Malik, Jay G. Varshney T.V. Muniyappa, N.T. Yaduraju and V. Pratap Singh, Sushil Kumar.

COUNCILLORS

Andaman & Nicobar	Dr. T. Subramani, Port Blair	Andhra Pradesh	Dr. P. Munirathnam, Peddapuram
Arunachal Pradesh	Dr. N. Premaradhya, Pasighat	Assam	Dr. I.C. Barua, Jorhat
Bihar	Dr. Rakesh Kumar, Patna	Chhattisgarh	Dr. Adikant Pradhan, Raipur
Delhi	Dr. Subhash Babu, New Delhi	Goa	Dr. V. Paramesha, Old Goa
Gujarat	Dr. D.D. Chaudhari, Anand	Haryana	Dr. Ankur Chaudhary, Hisar
Himachal Pradesh	Dr. S.S. Rana, Palampur	Jammu & Kashmir	Dr. Fayaz Ahmed Bahar, Srinagar
Jharkhand	Dr. C.S. Singh, Ranchi	Karnataka	Dr. K.N. Geetha, Bangalore
Kerala	Dr. Savitha Antony, Thrissur	Ladakh	Dr. Vikas Gupta, Leh
Madhya Pradesh	Dr. Varsha Gupta, Gwalior	Maharashtra	Dr. Shoukat Pinjari, Palghar
Meghalaya	Dr. Amit Shahane, Umiam	Nagaland	Dr. Avanish P. Singh, Kohima
Orissa	Dr. Rabiratna Dash, Bhubaneswar	Pondicherry	Dr. P. Saravanane, Karaikal
Punjab	Dr. Pervinder Kaur, Ludhiana	Rajasthan	Dr. M.L. Mehriya, Jodhpur
Sikkim	Dr. Manoj Kumar, Gangtok	Tamil Nadu	Dr. G. Senthil Kumar, Coimbatore
Telangana	Dr. B Padmaja, Hyderabad	Tripura	Dr. Biman De, West Tripura
Uttar Pradesh	Dr. Dinesh Sah, Banda	Uttrakhand	Dr. Tej Pratap, Pantnagar
West Bengal	Dr. Dhiman Mukherjee, Jhargram		

EDITORIAL BOARD

Chief Editor: Dr. Sushil Kumar, Jabalpur

Associate Editors: Dr. Ashok Kumar Yadav and Dr. T.K. Das

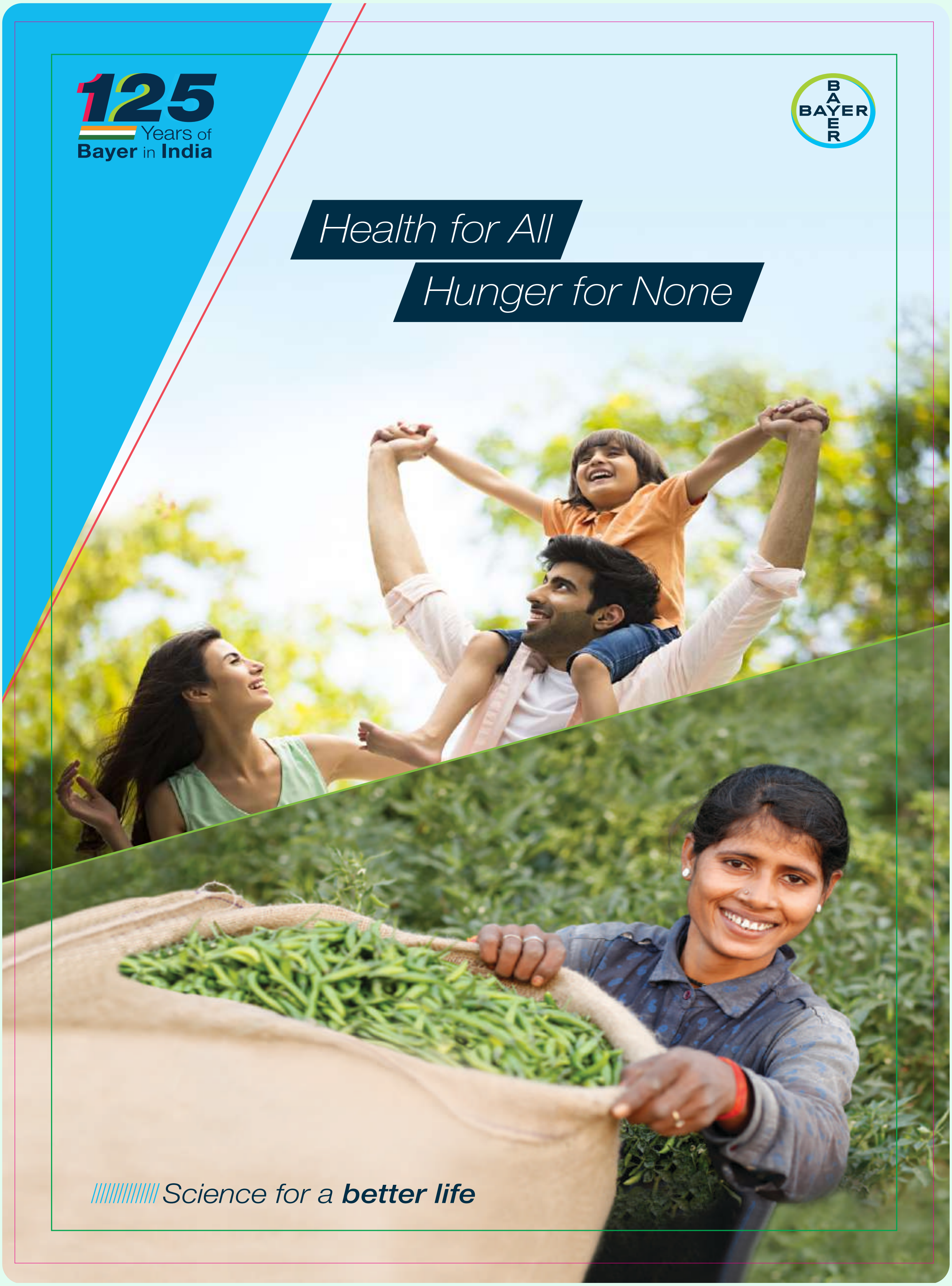
Indian editorial board members

Dr. Gulshan Mahajan	Dr. K.A. Gopinath	Dr. R.S. Chhokar	Dr. Mool Chand Singh
Dr. Mukesh Kumar	Dr. Narendra Kumar	Dr. Nimmy Jose	Dr. Shobha Sondhia
Dr. Simerjeet Kaur	Dr. Vimal J. Patel	Dr. C.M. Parihar	Dr. V.K. Choudhary
Dr. Malay K. Bhowmick	Dr. Mangal Deep Tuti	Dr. R. Veeraputhiran	Dr. Anil Duhan
Dr. Arunima Paliwal	Dr. C.M. Sunil	Dr. C.P. Nath	Dr. Dibakar Ghosh
Dr. M.K. Singh	Dr. Puja Ray	Dr. Sheela Barla	Dr. Veeresh Hatti

Overseas editorial board members

Dr. Amit Jhala	Dr. Bharat Babu Shrestha	Dr. Christos Damalas	Dr. Hafiz Haider Ali
Dr. Ho Le Thi	Dr. Mirza Hasanuzzaman	Dr. Mithila Jugulam	Dr. Prashant Jha
Dr. Singarayer Florentine	Dr. U.P.K. Epa		

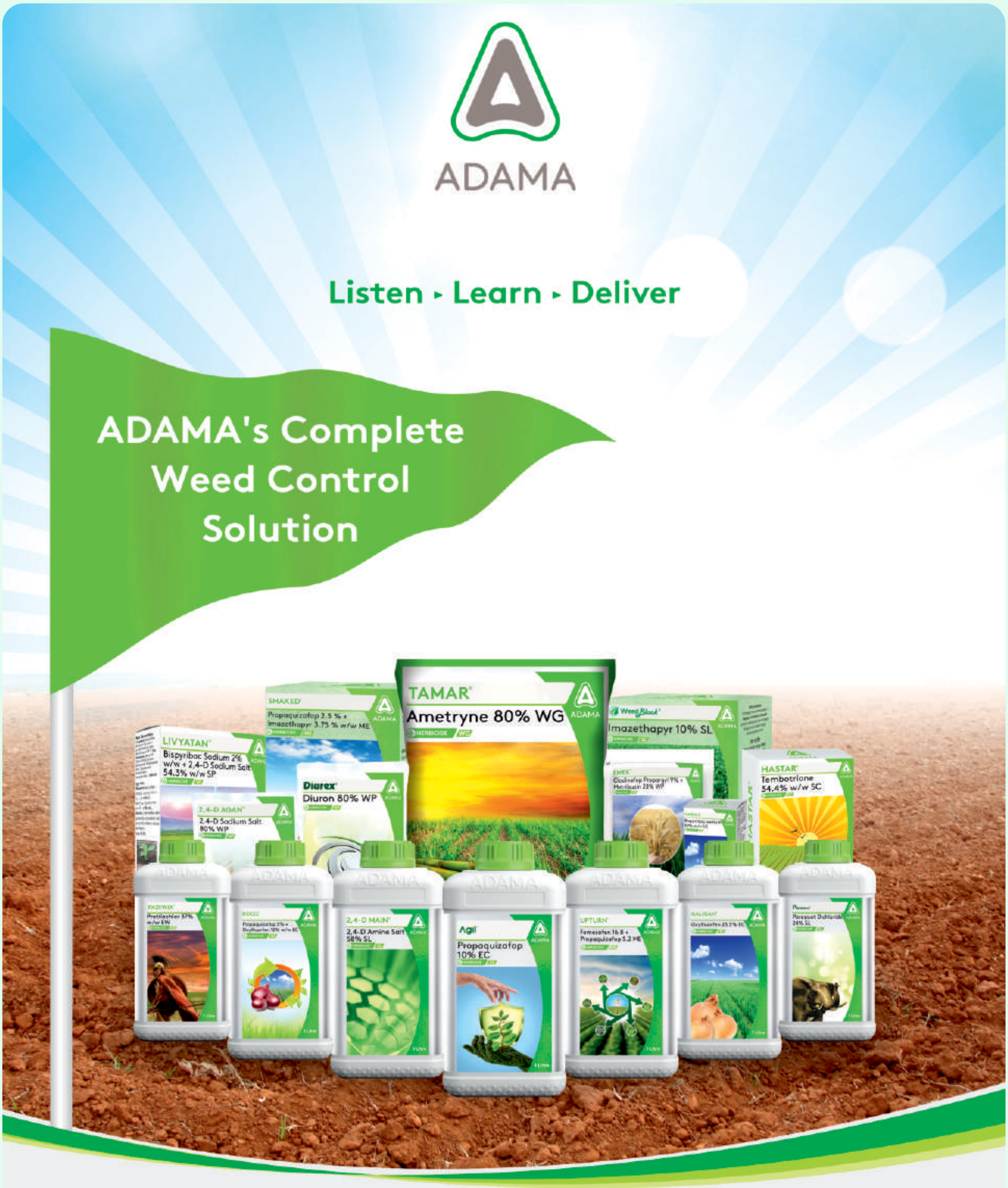
Office Manager: Gyanendra Pratap Singh, Jabalpur


125 Years of Bayer in India
BAYER
Health for All
Hunger for None
Science for a better life


ELEVATING GROWERS
TO THE NEXT LEVEL!!
Innovative Herbicide
Offerings from syngenta
Rifit Xtra
Baloric
syngenta
Rifit Plus
BYE
BYE
WEEDS
weedmanagement.in
Fusiflex
syngenta
Calaris Xtra
syngenta
Axial
syngenta
2 Litre
Movondo
syngenta

Beyond Imagination
CENTURION
Most effective on grassy weeds
Long Duration Control (3-5 leaf stage)
Combats Resistance
UPL
SWEEP POWER
Safest and Most Effective
SWEEP POWER
Quick action
Controls resistant weeds
Broad spectrum herbicide
nurture.farm
For more information please call 18001021199


Growth is mine.
Novixid™
Loyant™
Novlect™
Rinskor™ active
I want to build a business that future generations can be proud of
The Rinskor™ active program helps grow a better and more profitable crop with excellent broad-spectrum control even on resistant weeds, thus delivering a flexible and safe choice for users, consumers and bystanders.
Grow your profits, grow your business.
Learn more on corteva.com
CORTEVA™ agriscience
™ ® Trademarks of Corteva Agriscience and its affiliated companies. © 2024 Corteva.
www.corteva.in



ADAMA India Private Limited

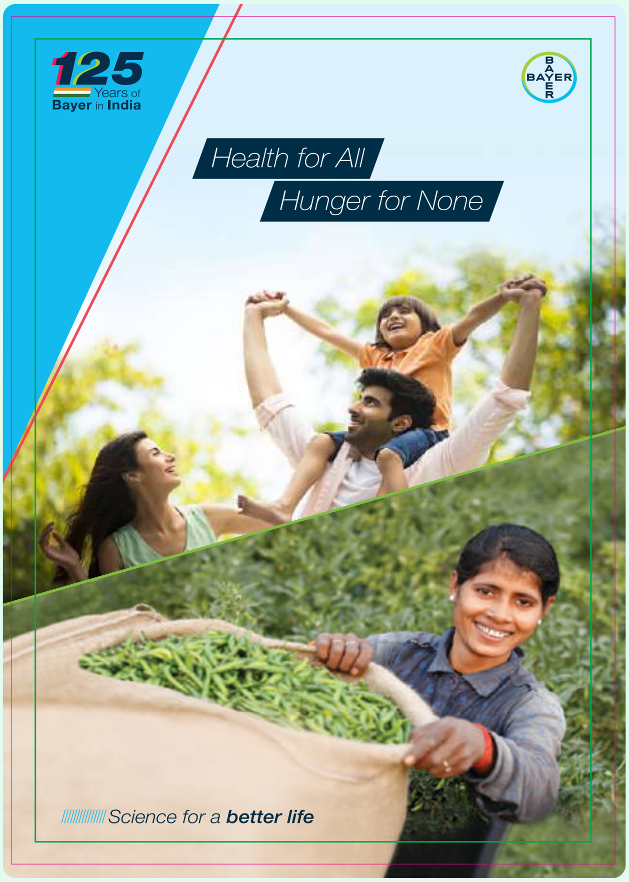
Plot No. DS-13, IKP Knowledge Park, Sy. No. 542/2, Genome Valley, Turkapally, Shameerpet, Hyderabad, Telangana-500101.
Tel.: +91 40 40361300 | Fax: +91 40 40361301 | Website: www.adama.com | Email: customercare-in@adama.com

FARMER SERVICE CENTRE NO. (TOLL FREE): 1800-103-4991


BASF
We create chemistry
HERBICIDE
INNOVATIONS FROM BASF
Pursuit
Odyssey
Tynzer
Valor 32
Stomp EC
Vesnit Complete
Facet
Basagran

dhanuka
इंडिया का प्रणाम
हर किसान के नाम
MYCORe
BIO FERTILIZER
CONIKA
CHEMPA
SEMPRA
LUSTRE
धानुका भारत के सभी किसानों को राष्ट्र निर्माण में
उनके अहम योगदान के लिए प्रणाम करता है
धानुका एग्रीटेक लिमिटेड
ग्लोबल गेटवे टॉवर्स, गुरु द्रोणाचार्य मेट्रो स्टेशन के पास, एमजी रोड,
गुरुग्राम – 122002, हरियाणा, दूरभाष: 91-124-434 5000,
ई–मेल: headoffice@dhanuka.com
Toll free no.: 1800-102-1022 | www.dhanuka.com | follow us on:


Transforming Villages.
Ensuring Prosperity.
Climate Action
Rural Infrastructure
Watershed Development
Farmer Collectives
Women Empowerment
Tribal Development
Financial Inclusion
NABARD
Development Bank of the Nation
www.nabard.org
/nabardonline



भाकृअनुप ICAR

BAYER

syngenta

UPL OpenAg

CORTEVA agriscience

ADAMA

BASF We create chemistry

IRRI

dhanuka

NABARD