

## **Proceedings of 3<sup>rd</sup> International Weed Conference**

**(20-23 December, 2022)**

**Venue:** Anand Agricultural University, Anand, Gujarat, India

**Theme:** *“Weed problems and management challenges: Future perspectives”*

To tackle the enormous losses caused by weeds in different ecosystems, and to discuss the future weed management strategies, the Indian Society of Weed Science, Indian Council of Agricultural Research - Directorate of Weed Research, Jabalpur and Anand Agricultural University (AAU), Anand, Gujarat jointly organized the 3<sup>rd</sup> International Weed Conference at AAU Campus during December 20-23, 2022. Around 500 delegates from across the country and the globe participated in the conference.

Following sub-themes were focused during the conference.

- Weed biology and ecology
- Integrated weed management in major crops and cropping systems
- Integrated weed management in non-cropped areas and aquatic environment
- Herbicide resistance
- Weeds under global climate change
- New ways to deal with weeds i.e. new technologies
- Weed utilization
- Weeds and biodiversity
- Herbicides and environment
- Weed science education

### **INAUGURAL SESSION**

The inaugural session of the conference was held on December 20, 2022. It was chaired by Dr. K.B. Kathiria, Vice Chancellor, Anand Agricultural University. Dr. Himanshu Pathak, Secretary, DARE, Government of India and Director General, ICAR, graced the inaugural session as the Chief Guest. Dr S.K Chaudhari, DDG (NRM), ICAR, Dr Samunder Singh, President, International Weed Science Society, USA and Prof. Yoshiharu FUJII, Tokyo University of Agriculture and Technology, Tokyo, Japan also graced the inaugural session as the Guests of Honour. Dr. JS Mishra, Secretary, Indian Society of Weed Science (ISWS) and Director, Directorate of Weed Research (DWR), Jabalpur welcomed the delegates. Dr. Sushil Kumar, President of ISWS also addressed the audience during the session.

In the inaugural programme, the Chief Guest highlighted the importance of weeds in crops and cropping system and the impact of climate change on weed dynamics. There is a need to incorporate traditional knowledge and wisdom in developing modern tools and techniques in weed management. More public and private collaboration is required in weed science research, he added. Further, Dr. S.K. Chaudhari highlighted the impact of weeds on crop production, losing yield loss of around 11 billion US\$, issues of herbicide resistance, pesticide residues, weed flora shift in organic, and natural farming and conservation agriculture. Dr. K.B. Kathiria, Vice Chancellor, highlighted the issues related to weed science, introduction of genetically modified crops their advantages and limitations. He also highlighted the recent development on genome editing, bioherbicide and nano-herbicide development. Dr. MK Jhala, Director of Research presented the salient research achievements in weed management of the AAU and emphasized on weed management in organic farming. During the session, many weed scientists were also awarded for their outstanding contributions. Three publications on weed

management were also released on the occasion. The session ended with vote of thanks proposed by Dr. YM Shukla, Dean, College of Agriculture.



**Release of publications:** A book '*Technological glimpses on weeds and their management*' (Eds. J.S. Mishra, Sushilkumar and A.N. Rao), published by Indian Society of Weed Science was released by the Chief guest and dignitaries. On this occasion, Proceedings of 3<sup>rd</sup> International Weed Conference entitled "*Weed problems and management challenges: Future perspectives*".



**Awards and Fellowships:** Dr. J.S. Mishra, Organizing Secretary, announced the names of awardees in various category of awards. In glittering inaugural function, the following scientists were honoured for their outstanding contributions to weed science.

<b>Life Time Achievement Award</b>	Dr. T.V. Ramachandra Prasad, Bengaluru (2020-2021)
<b>ISWS Gold Medal</b>	Dr. Mahesh K. Upadhyaya Canada (2020) Dr. A.S. Rao Hyderabad (2021) Dr. S.S. Punia Hisar (2021)
<b>ISWS Special Recognition Award</b>	Dr. Dr. O.S. Kandasamy, Coimbatore (2020-2021) Dr. Megh Singh, USA (2020-2021)
<b>ISWS Fellow</b>	Dr. Virender Kumar, Philippines (2020) Dr. P.K. Mukherjee, Jabalpur (2020) Dr. Ramanjit Kaur, New Delhi (2020) Dr. Pratap Singh, Kota (2021) Dr. P. Saravanane, Karaikal (2021) Dr. V.J. Patel, Anand (2021) Dr. Rakesh Kumar, Patna (2021)
<b>ISWS Recognition Award</b>	Dr. P.J. Suresh (2020-2021) Dr. Sunil Kumar (2020-2021)
<b>ISWS Young Scientist Award</b>	Er. C.R. Chethan Jabalpur (2020-2021) Dr. Todar Mal Poonia Hisar (2020-2021)
<b>ISWS Best Ph.D. Thesis Award</b>	Dr. Satya Prakash Kumar Bhopal (2020-2021) Dr. Writuparna Dutta Kolkata (2020-2021)
<b>ISWS Best Book Award</b>	Prof. Mahesh K. Upadhyaya Canada (2021) <i>"Global Plant Invasions"</i>
<b>IJWS Best Paper Award</b>	Nitish Tiwari, Shrikant Chitale and Tapas Choudhary, "Long-term weed management effect on weed dynamics, weed shift and productivity of direct-seeded rice-chickpea cropping system". <i>Indian Journal of Weed Science</i> <b>52</b> (2): 107–115, 2020; DOI: 10.5958/0974-8164.2020.00020.9 C. Durga and S. Anitha, "Effect of conservation agriculture practices on weed management in okra under rice- okra-green manure cropping system". <i>Indian Journal of Weed Science</i> <b>53</b> (2): 164–168, 2021; DOI: 10.5958/0974-8164.2021.00030.7
<b>ISWS Student Travel Grant Award</b>	Mr. Arockia Infant Paul R. TNAU, Coimbatore Mr. Badal Verma JNKVV, Jabalpur Mr. Deepak Kumar Jaiswal Visva-Bharati, Sriniketan Mr. Deepak Loura CCH HAU, Hisar Mr. Harendra Kumar IGKV, Raipur



	Mr. Manisankar G. Visva Bharti, Sriniketan Mr. Narendra Kumar RVSKV, Gwalior Mr. Sunil Kumar IARI, New Delhi Mr. Sushil Kumar CCH HAU, Hisar Ms. Harshdeep Kaur PAU, Ludhiana Ms. Justina Michael SRMIST, Chennai Ms. Manisha Dhurve IGKV, Raipur Ms. Narmadha R. TNAU, Coimbatore Ms. Pooja Maurya CSIR-CIMAP Lucknow Ms. Priyanka Devi CCH HAU, Hisar Ms. Suman Dhayal MPUAT, Udaipur Ms. Sunita Meher IGKV, Raipur Ms. Sonali Singh RVSKV, Gwalior Ms. Alpna Kumhare RVSKV, Gwalior
<b>Best poster awards</b>	11 best poster awards were also distributed



## PLENARY SESSIONS

### Plenary session 1. (20-12-2022):

**Chairman:** Dr. K.B. Kathiria, Vice Chancellor, AAU, Anand

**Co-chairman:** Dr. C.R. Chinnamuthu, Former, Director (Crop Management), TNAU, Coimbatore

**Rapporteurs:** Dr. P. Murali Arthanari, Professor, TNAU and Dr. V.K. Choudhary, Senior Scientist, DWR

In this session one key note address and two plenary lectures were delivered. The Key note was delivered by **Dr. Trilochan Mohapatra**, former Secretary, DARE and Director General of ICAR, New Delhi on “*Ensuring Food Security at Global Level: Role of Weed Science*”. He highlighted the problems in agriculture in general and weed management in particular. He stressed to develop scientific solutions for real weed problems and needs intensive research in basic science. He emphasized more on weed population dynamics in changing climate-analysis in time and space, nutrient and weed interactions, weed competitiveness and invasiveness, and breeding crops for competitiveness to biotic stresses, mechanism of herbicide tolerance in weeds. There is need to understand gene sequences in weeds. The genetic manipulation such as RNAi technology has to be introduced to develop herbicide resistance in crops. He advised to explore possibilities of using plant genome editing, nanotechnologies, microbial and bioherbicide products, robotics and drones, which are still in their research infancy, which will add a new tools in the weed management programme. Dr Mohapatra also suggested to work on one health in sustainable manner to support ecosystem services.



The first plenary lecture was delivered by **Dr. Yoshiharu FUJII**, Tokyo University of Agriculture and Technology, Japan on “*Allelopathy utilization for weed control: Challenges and perspectives*”. He narrated the importance of allelopathy concept in weed management. He has explained in detail about the screening of allelopathic plants specific bioassay methods such as ‘Sandwich method, Plant Box method and Dish pack methods’. He has evaluated 4000 plants and cover crops having allelopathic principles and selected for further utilization. Effective allelochemicals working in the field have been screened and identified by a new method named “Total activity”. Based on this method more than 20 chemicals were identified and some new chemicals were patented. He also informed that, *Mucuna pruriens* – Velvet Bean and Vetch – *Vicia villosa* traditional cover plants showed allelopathic activity which are useful for weed management in organic farming.



**Dr. Prasanta C. Bhowmik**, University of Massachusetts, USA delivered plenary lecture on “*Bioavailability of allelochemicals in soil environment under climate change: Challenges and perspectives*”. He indicated the influence of climate change on current agricultural systems. He mentioned that the Allelopathy was recognized as a one of the tool for managing weeds over the years. He stressed on importance of addition of crop residues which will help to suppress the selective weeds through the exudate of allelochemicals. For example the *Brassica nigra*, *Avena fatua*, *Fagopyrum esculentum*, *Secale cereale*, *Sorghum bicolor*, *Triticum aestivum* and other cover crops release the allelochemicals such as DIBOA, DIBOA-glycoside, dhurrin, isoflavonoids, isothiocyanate, juglone, momilactone, scopoletin and sorgoleone etc., He stressed that, future allelopathic research should be focused on identification of promising allelochemicals, persistence and availability of allelochemicals in soil environment. Further, bioavailability of allelochemicals under field condition with changing climate scenario must be understood further to utilize the allelochemicals to manage weeds.



## **Plenary Session 2: (21-12-2022 F/N)**

**Chair:** Dr. N.T. Yaduraju

**Co-Chair:** Dr. T.K. Das

**Rapporteurs:** Dr. P. K. Mukherjee and Dr. Malay K Bhowmick

**Dr. Shoumo Mitra** delivered his plenary lecture on “Current herbicide development scenario: Need to launch reduced risk herbicides”. He highlighted the Corteva R&D efforts in coming out with green solutions in the form of reduced risk compounds and green chemistry innovations for meeting up the farmers’ needs and consumers’ preferences while protecting the environmental and natural resources. According to him, Corteva R&D efforts are also involved in improving the environmental and toxicological profile of older herbicides. He discussed on development of new molecules like florpiauxifen-benzyl and halauxifen-methyl for weed management in rice and wheat, respectively. Recently, Corteva is introducing a novel choline salt formulation of 2,4-D as Colex-D that provides robust weed control in fallow areas, besides ensuring its reduced drift, near zero volatility, proven compatibility and ultra-low odour properties, which would make the growers to use the herbicide with confidence.



Dr. Das remarked that herbicide resistance as one of the frontier research areas in the field of weed science since the incidence cases and management challenges of multiple-resistant weed populations are increasing worldwide. The Session Chair Dr. Yaduraju emphasized on adopting smarter options for durable weed management toward ensuring food security and improving farm income.

### **Plenary session 3: (21.12.2022 A/N)**

**Chair:** Dr. RK Ghosh

**Rapporteurs:** Dr Mukesh Kumar and Dr. P. Saravanane

**Dr. Bhagirath Singh Chauhan**, Professor, UQ, Gatton presented a plenary talk on “*Weed biology: an important science to develop effective weed management strategies*”. Indian population expected to reach 1.5 billions by 2030. Several biotic and abiotic factors affect crop growth. Among this, weeds is the most important one. Weeds cause 30% yield loss and >US\$ 10 billion in 10 crops. Management of weeds by manual weeding is difficult and hence, herbicides are widely used. But, problem of herbicide resistance is the major problem. He quoted the example of 1<sup>st</sup> case of Herbicide resistance weed *Phalaris minor* in 1995 in India. To develop innovative, economical and sustainable IWM, good knowledge of weed biology is essential.



While highlighting the need of stale seed bed techniques, he said that light is required for breaking the dormancy of weed seeds. Information on temperature to understand the weed spread in different regions. Weed seeds which have hard seed coat require seed scarification. Weed seeds present on surface germinate earlier than buried seeds. Surface seeds decay faster eg. *Hibiscus tridactylites*. He indicated the 2 factors may decide the herbicide application. a). Determines amount of weeds present b) their timing of appearance. Predicting the timings can strengthen IWM program. Phenology is critical to understand the weed growth, biomass and level of potential competition. Weeds have ability to adjust to the environment. He concluded that weed biology studies do not create new management products but they provide a concept for weed management that can be successfully used in making informed decisions. There was good interaction between the delegates. In particular, Dr JS Mishra, Director, DWR indicated that most weeds are coming in a group which makes the weed biology study most complex. Plenary speaker suggested to prioritize and study one or two weeds.

### **Plenary Session 4: (22.12.2022 F/N)**

**Chair:** Dr. Prashant Bhowmick

**Co-Chair:** Dr. Muthu Bagavathiannan

**Rapporteurs:** Dr. M.K. Singh and Dr. Himanshu Mahawar

In this technical session two plenary lectures were presented by Dr. N. T. Yaduraju and Dr. Samunder Singh.

**Dr. Yaduraju**, former Director, ICAR-DWR delivered lecture on “*Non-GM HT rice is now in India: The way forward*”. Dr. Yaduraju discussed the success of Bt cotton in India and highlighted the challenges in development of genetically modified (GM) herbicide resistant crop (HRC). Thereafter, suggested the option for development of non-GM HRC that can be achieved through different processes, like, conventional mutation breeding, etc. This non-GM HRC was already developed in several crop worldwide and recently, scientist in India also developed non-GM rice crop tolerant to imazethapyr. Moreover, this technology has no opposition from wider scientific fraternity. This non-GM based crop has wider implication for weedy rice management in DSR and difficult-to-control weed, like striga. However, he has clarified the challenges of non-GM rice crop, like chances of gene flow and development of HR-weedy rice. He also suggested the stewardship programme for adoption of this variety and insist that Directorate of Weed Research should take the responsibility of development of detail stewardship programme for adoption of herbicide tolerance rice in India.





**Dr. Samunder Singh**, President, International Weed Science Society delivered his talk on ‘*Do we see the end of chemical weed control soon?*’. He emphasized on weed management to save nutrient depletion from the soil. He further discussed the status of herbicide usage in India, total number of herbicide developed worldwide with different mode of action. He also discussed the major challenges for herbicide research, like, development of herbicide resistant weeds in India and increasing cost of herbicide development. He also suggested various agronomical intervention to manage herbicide resistant weeds, like, sterile pollen techniques, crop rotation and diversification, straw management, time and method of herbicide application, herbicide mixtures, adequate herbicide application technology, and irrigation management. He also suggested the rapid detection method of herbicide resistant weeds which helpful in selection of appropriate herbicide. Additionally, he also suggested other means to tackle weeds, like, use of microbial formulation alone and in combination with herbicide, P-450 inhibitors, nano-herbicide, mechanical weeding, precision spraying, electrocution of weeds, microwave for weed management and phenotyping. At last he suggested the future of weed management, like, growing of crops in hydroponics, vertical farming, use of Crisper/CAS 9, bioherbicide and RNAi technology.



### **Plenary Session 5: (22.12.2022 A/N)**

**Chair:** Dr. Yoshiharu FUJII

**Co-Chair:** Dr. Pratap Singh

**Rapporteur:** Dr. MT Sanjay

The plenary lecture (Mahesh K Upadhyay Award Lecture) on “*Current Status of Biological Control of Weeds and Future Perspectives*” was delivered virtually by **Dr Martin Hill**, Centre for biological control, Department of Zoology and Entomology, Rhodes University, South Africa. Biological weed control is becoming popular because of human and environmental health issues as well as sustainability of food production system all around the world. Until 2018, there have been 1555 international releases of 468 biological control agent species, used against 175 species of target weeds in plant families, in 90 countries. There is greater need of promotion of biological weed control in resource poor countries and it can be well integrated in IWM program. In one of the socioeconomic studies, it has been found that nearly 1 billion dollar could be saved by uses of biological weed control. Biological weed control also helps in ecosystem recovery. However, proper risk assessment is required before release in new bio-agent in an ecosystem.



## **TECHNICAL SESSIONS**

### **Technical Session 1: New ways to deal with weeds, i.e. new technologies**

**Chair:** Dr. B. S. Chauhan

**Rapporteurs:** Dr. Fayaz Ahmed Bahar & Todar Mal Poonia

In this session two lead lectures were delivered by Dr. Muthu Bagavathiannan and Dr. Aviraj Datta respectively in addition to one invited oral lecture and eight oral presentations out of ten scheduled oral presentations with following recommendations:

**Dr. Muthu Bagavathiannan** talked about “*Application of Digital Technologies for weed detection and precision management*”. He discussed on site-specific weed management as an effective strategy for improving management outcomes, enhancing resource use efficiency and achieving long term sustainability. Weed recognition and identification can be accomplished through machine learning by field image collection through synthetic image generation (artificial image), deep



learning (CNN based models), 3D modeling of weed features and generation adversarial networks (GAN) aided with their management by drone based herbicide applications. The use of precision technologies is expected to facilitate effective management of resistant weeds through smart diversification of strategies.

**Dr. Aviraj Datta** in his lecture on “*Monitoring water hyacinth for weed detection using remote sensing technologies: Challenges and future development*” proposed aerobic composting as an alternative approach for management of aquatic weed like water hyacinth with location specific multi-model approach having wider geographical applications and preferred community engagement and women SHGs. Use of allelochemicals/botanicals can be explored for effective weed management in organic agriculture and needs focused research efforts and approach for lowering down the usage of inorganic herbicides and maintaining the microbial biodiversity in soil (**Dr. Doddaga Subramanyam**). Bio-synthesis of silver nano-particles using plant extracts having allelopathic potential is rapid, cost effective and eco-friendly. Allelopathy based biosynthesized AgNPs using *P. hysterophorus* at 1% showed better allelopathic/bio-herbicidal property for the management of water hyacinth (**Dr. V. S. Susha**). Promotion of sensor based weeding equipments/implements can serve as an effective technique/intervention for increasing weeding efficiency, energy and cost saving besides decreased plant damage (**Dr. C. R. Chetan**). With the help of mechatronics, four bar linkage (FBL) mechanism and fuzzy logic algorithm, crop sensing triggers the electronic control to laterally shift the rotor from intra row crop line. System robotic concepts derived for inter and intra row weeding that is automated and tractor operated using fuzzy logic have been developed (**Dr. Satya P. Kumar**). A high clearance, self-propelled machine with a spraying and weed attachment could do intra-chemical weeding and the mechanical weeder could do inter-mechanical weeding in tall field crops (**Dr. Ajay K. Roul**). In India, where majority of the farmers’ practice small scale farming, huge robotics cannot be implemented and are not affordable as well. Therefore small scale robots will be of high use as they will ease a farmer’s work and save time, manpower and money (**Mrs. Justin Michael**). Knowledge based tools are urgently needed to maximize long term sustainable weed control and economic benefits. Decision Support System (DSS) can help farmers and practitioners develop effective weed management programs and evaluate for themselves the benefits of adopting and penalties for not adopting best management practices. A simulation model (WEED:- Weed Ecological and Economic Decision Support) is being developed to support weed management decision making, targeting driver broadleaf and grassy weeds with wide geographical applications (**Porushotam Gyawali**). Nano-herbicides indicating comparative stability in different agro-ecological systems can be promoted for curtailing herbicide pollution in environment and addressing the biosafety concerns. Commercial dose of atrazine can be reduced by the use of laboratory synthesized nano-atrazine (**Dr. Nitin N. Gudadhe**). Natural metabolites produced from the plant species having allelopathic potential is one of the promising alternative strategies for achieving sustainable and integrated weed control. Nano formulation/Nano-emulsion has a potential scope for developing nano-herbicide that works well against noxious weeds by integrating allelopathy and nanotechnology (**Dr. N. Swathika**).

## **Technical session 2: Weed management in cereals-based cropping systems**

**Chair:** Dr. Virender Kumar

**Rapporteurs:** Dibakar Roy and Dr. Ramphool Puniya

During this session all the 18 presentations were made including two lead lectures.

**Dr. T.K. Das** delivered lecture on “*Weed management in conservation agriculture: Challenges and perspective*”. Dr. Das reported that CA adoption for longer run reduces weed pressure in terms total weed density but increases weed diversity and weed shift in Rice and Maize based cropping systems. CA system results in weed shifting towards perennials weeds but annual grassy weed like *Phalaris minor* is reduced considerably. Beside this the infestation of *Cyperus*



*esculentus* increased tremendously in different CA based systems after 8 years. The *Euphorbia microphylla* after wheat harvest also became dominant in CA based rice-wheat system. For the management of perennial weeds in long term CA based systems there is need to develop IWM programme and use of broad spectrum or non-selective herbicide during off-season.

**Dr. Uday Pratap Singh** on “*Can Conservation Agriculture helps in Sustainable Weed Management*”? Dr. Singh highlighted that weed problems in CA can be managed by proper sowing of crops by machines, residue management, cleaning of harvesting machines to check entry of weed seeds from outside the farms and use of herbicides. Less weed infestation was observed in happy seeder sown wheat and it gives more yield especially under terminal stress conditions. **Dr. M L Kewat** presented salient findings on effectiveness of carfentrazone ethyl for controlling broad leaf weeds in wheat and its carryover effect in soybean. **Dr. Simerjeet Kaur, Dr. Kiran Yadav, Dr. B Sandhya Rani, Dr. Prabu Kumar Ganeshkaran, Dr. Muni Pratap Sahu and Dr. S Manimaran** presented various aspects of irrigation, nutrient and weed management practices on maize growth and crop productivity. In spring maize, significantly lower weed density and biomass were observed under sub-surface drip irrigation along with straw mulch than the atrazine treated furrow irrigated. In sub-surface drip irrigation along with straw mulch pre-emergence herbicide can be avoided. For effective weed management, IWM i.e. atrazine 1 kg/ha fb hand weeding or sequential application of atrazine 1 kg/ha fb topramezone 25.2 g/ha/ tembotrione 120 g/ha at 15-20 DAS or tank mix application of atrazine 0.5 kg/ha + topramezone 25.2 g/ha/ tembotrione 120 g/ha at 15-20 DAS. Mr Prem Kumar presented about a new herbicide formulation i.e., Mateno Duo TM, a new herbicide combination made with aclonifen + diflufenican can be used as Pre Emergence or early post-emergence found very effective against all type of weeds including resistant *P. minor* in wheat under medium to heavy soils. Dr. Dasari Sreekanth delivered reported that draught stress reduces herbicide efficacy under climate change scenarios. For better herbicidal actions, good soil moisture is a prime factor. **Dr. Sonaka Ghosh** delivered her research findings on weed interference under CA in maize-wheat-green gram cropping system and reported weed shift under CA situation. **Mr. Ayan Sarkar** presented effectiveness of herbicide mixtures and nano urea on wheat yield. He reported that in sole nano urea fertilization wheat yield was lower compared to prilled urea fertilized plots, although prevalence of weeds were less under nano urea supplemented plots. **Mr Swapnil Deshmukh** reported that for *rabi* sorghum application of atrazine 0.5 kg/ha+ pendimethalin 0.5 kg/ha found very effective for weed control. **Dr. Ramanpreer Kaur and Mr Deepak Loura**, presented about various weed management practices like herbicide and crop residue utilization on weed behaviour in wheat. **Mr. Ansul Sharma** presented about CA effect of weed behaviour, crop yield and soil health in pigeon pea-wheat-mung bean cropping system.

### **Technical session 3: Weed management in oilseeds and vegetable crops**

**Chair:** Dr. T.V. Ramachandra Prasad

**Rapporteurs:** Dr. Rakesh Kumar and Dr. Deepak Pawar

**Dr. D. D. Patel** presented the lead lecture on “*Weed management in vegetable crops: Problems and perspectives*”. He emphasized that most of the vegetables are slow growing during the initial stage of development, making them more vulnerable to weed competition. He also suggested adopting a systematic approach to maintain the weed population below the economic threshold level by adopting all available means of weed management without any harmful effect on the environment, besides, considerably reduced the weed seed bank.

**Dr. J. A. Hosmath** presented the oral lecture on “*Post-emergence application of imazethapyr on soybean and its residual toxicity effect on performance of succeeding crops in transitional tract of Dharwad, Karnataka*”. Imazethapyr 100 g/ha as an early post-emergence application (EPoE) proved effective against weeds in soybean (Cv. JS-335) ecosystem without any phytotoxic effect on soybean. However, on succeeding crops like wheat and sorghum, imazethapyr exerted mild residual toxicity with lower germination percentage.

**Dr. R. Dash** presented the oral lecture on “*Integrated weed management in Indian mustard*”. He reported that application of pendimethalin 0.75 kg/ha PE fb straw mulch 5t/ha recorded the lowest weed density, weed biomass, highest weed control efficiency of 89.62%, and lowest weed index, with the highest mustard grain yield and stover yields. **Dr. Y.S. Parameswari** presented the oral lecture on the “*Effect of different weed management*



*practices on yield and economics of mustard*". She reported that significantly higher yield attributes (number of silique/plant and number of seeds/pod), yield, gross and net returns, higher nutrient uptake by the crop and lower nutrient removal by the weeds were recorded with inter-cultivation and hand weeding at 15 and 30 DAS and it was comparable with oxadiargyl 0.09 kg/ha PE fb inter-cultivation at 30 DAS. **T. Selvakumar** presented the oral lecture on "*Evaluation of chemical cum mechanical weed management – A way to reduce chemical usage in sunflower*". He suggested controlling weeds effectively and economically in sunflower application of pendimethalin (38.7 CS) 1.0 kg/ha as pre-emergence at seed row (After irrigation) + power weeder at 15 and 30 DAS. **Dr. Sanjeevraddi G. Reddi** presented an oral lecture on "*Bio-efficacy of different herbicides on weeds and their impact on fresh fruit bunch (FFB) yield of oil palm*". He reported that in oil palm, new herbicide indaziflam 500 SC 62.5 or 125 g/ha as pre-emergence or indaziflam in combination with glyphosate or glufosinate ammonium as post-emergence was effective up to 90-120 DAS as revealed by low weed count and weed dry weight. **Dr. Ramanjit Kaur** presented an oral lecture on "*Effect of different weed management options in vegetable pea*". She reported that sequential application of pendimethalin 750 g/ha PE, fb mulch, fb quizalofop-p-ethyl 50 g/ha PoE resulted in a lower weed density, increased crop growth, and increased pod yield.

#### **Technical Session-4: Herbicide residues, monitoring, mitigation and effect on non-target organisms in weed management**

**Chairman:** Dr. Samunder Singh

**Rapporteurs:** Dr. Yogita Gharde & Dr. Mini Abraham

**Dr. Shobha Sondhia**, presented her lead lecture on "*Herbicide residues in soil, water and plants: Mitigation challenges and the future perspectives*". She highlighted that: Atrazine, 2, 4-D and diuron have chronic effect on marine species and coral ecosystem. One of the problems with herbicide residue studies is that maximum residue limits (MRLs) are not harmonized internationally. Big challenge for herbicide industries is to develop new herbicide with new and multiple sites of action. **Dr. P Janaki** presented her work on 'Determination of ready-mix herbicides residue in soybean cultivated tropical inceptisol'. She highlighted that ready mix combination of fomesafen 12% and quizalofop ethyl 3% SC were investigated for their persistence in soybean cultivated tropical inceptisol. Residues of fomesafen 12% and quizalofop ethyl 3% SC at 1250 ml/ha and 2500 ml/ha were not detected in the soybean seed, oil, de-oil cake and field soil samples at the time of harvest irrespective of their applied dose. In case of fomesafen, dissipation occurs more rapidly under warmer climate than cold weather conditions. The detection limit of fomesafen and quizalofop ethyl was found to be 0.005 and 0.01 mg/kg which is well below the standard MRL for soybean. **Dr. P Sudhakar** presented his work on '*Impact of post-emergence herbicides on soil micro flora in transplanted rice*'. He mentioned that microbial count decreased initially and regain at 60<sup>th</sup> days after application. Actinobacteria were less affected as compared to bacteria and fungi. Actinobacteria are reported relatively resistant to herbicides and get affected at high concentration. At recommended dose, flucetosulfuron, azimsulfuron and bispyribac Na were found to be safe for soil microbial communities. **Dr. Kaushik D. Parmar** presented work on '*Residues and persistence of pendimethalin in chickpea*'. They found that the pre-plant incorporation of pendimethalin in chickpea at 677.25 and 1354.45 g/ha resulted in residues of pendimethalin in chickpea at below determination level of 0.05 mg/kg at either dose in all samples. The dry pod and soil collected at harvest too did not reveal any residues of pendimethalin in both the dosages. **Dr. Dibakar Roy** presented work on '*Effect of herbicide on soil biochemical properties under varying level of crop, nutrient and herbicide dose in wheat under vertisols of Central India*'. They found that the presence of crop and nutrient management reduces the negative effect of herbicide even at double dose of herbicides. However, he was suggested to use maximum of 4X dose for such type of studies. **Dr. Nitesh S. Litoriya** presented '*Residue status of diclosulam in soybean*'. They investigated the residue status of diclosulam 84% WG in soybean and found that no residue was found at harvest at X and 2X doses of herbicide. The residues were found below determination level of 0.05 mg/kg in leaves, dry pods, oil and soil. **Ms. Annu Kumari** talked about the '*Cereal rye residue effects on the germination of troublesome weeds in the Southern United States*'. They found that *Ipomoea purpurea* was least responsive to increasing biomass, and palmer was the most responsive one due



to small seed sizes. Germination and growth rate of *Digitaria sanguinalis* L. and *Senna obtusifolia* L. have influenced with different levels of biomass residue. However, the findings are required to confirm with field level study. **Dr. Navjot Singh Brar** presented their work on ‘*Weed dynamics and atrazine residue in green fodder and silage of spring maize grown under different cropping systems in north-west India*. They found that in maize-oat-spring maize and maize-toria-spring maize cropping systems, atrazine residue to the tune of 0.01 mg/kg was observed in green fodder samples of spring maize at 60 DAS. However, atrazine residue was below the detection limit (<0.01 mg/kg) in maize-gobhi sarson-spring maize cropping system. **Dr. N.R. Chauhan** talked on ‘*Residue status of pre-emergence application of pendimethalin in cumin and soil of Bhal region of middle Gujarat*’. They found the residue of pendimethalin at below detectable level (i.e. 0.05 µg/g) after 25, 30, 35 DAA in cumin plant. It was also found at below detectable level in cumin seed and clay soil at harvest stage.

### **Technical session 5: Non-chemical weed management including biological control**

**Chair:** Dr. M.K. Upadhyaya

**Rapporteurs:** Dr. Chethan C R and Dr. Rishi Raj.

**Dr R.K. Ghosh** presented the lead lecture on “*Botanical herbicides for eco-friendly weed management and sustainability smallholder farming*”. He highlighted the problems of present day agriculture, banned herbicides from the government and other problems. To cope up the above said situations he suggested to adopt the eco-friendly weed management such as reducing weed seeds under soil prior to crop planting, application of botanical/ natural herbicides, and mechanical weeding. He used raw extract, methanol extract and aquom extract for field trials. He mentioned that, farmers can easily prepare the botanical herbicides at home and need not to depend on others. He also mentioned that by adopting the technology crop yield can be increased by 30-60%. **Dr R R Upasani** presented the invited oral lecture on “*Weed management in organic farming – A review*”. He informed the house that, rice cultivation under zero-tillage organic agriculture is not recommended as the weed control will become more problematic. However, wheat can be cultivated under zero-tillage organic agriculture. **Dr. S P Singh**, presented the oral presentation on “*Weed management under organic production system of rice-vegetable pea-sweetcorn cropping system*”. Grassy weeds were significantly controlled under sesbania (green manuring) fb transplanted rice. In direct-seeded rice (without stale seed bed) and sesbania (green manuring) – transplanted rice recorded the lowest weed density of grasses and sedges respectively. The highest grain yield of rice i.e. 3.1 t/ha and vegetable pea 8.4 t/ha were achieved under stale bed-direct seeded rice along with sesbania, whereas all the establishment system attained similar sweet corn cob yield of 7.6 t/ha except transplanted rice. **Dr. Bhimireddy Padmaja** presented the oral lecture on “*Mulch based weed management strategies in organic baby corn –Cabbage cropping system*”. Cropping system productivity, net returns and B-C ratio was highest in the combination of live mulching with *dhaincha* up to 30 DAS in baby corn and ground nut shell mulching 2 t/ha in cabbage followed by poly film mulch ore rice straw mulch + inter row HW at 30 DAS/T in both the crops. Crop residues like rice straw can be utilized for weed control instead of burning. **Dr. Asha Chavan** presented the oral lecture on “*Weed management in soybean-gram sequence in organic production under irrigated condition*”. Application of stale seed bed with reduced spacing and mulching with 2 tonne of wheat straw along with one hand weeding at 25 DAS recorded higher SEY of 5.89 t/ha and gross monetary returns of Rs. 18,19,000/ha of soybean-gram cropping system. Soybean + sunhemp incorporation at -40 DAS in kharif and gram + Safflower in *rabi* season recorded higher net monetary returns and B-C ratio of soybean-gram cropping system followed by application of stale seed bed with reduced spacing and 2 tonne of wheat straw along with one hand weeding at 2 DAS. **Dr. P.S. Maliwade** presented the oral lecture on the topic “*Evaluation of phyto-extracts for weed management in sweetcorn under organic production*. He reported that, inter-cultivation at 20 and 40 DAS fb one hand weeding at 20 DAS was effective in controlling the weeds and gives higher economical benefits in sweet



corn. The directed spray of *Parthenium hysteroporus* 30% leaf extract at 20 DAS and one inter cultivation at 20 DAS fb hand weeding was best treatment among phyto-extracts spraying treatments. **Dr. Writuparna Datta** presented the oral lecture on “*The mycobiota associated with the weed water hyacinth in Kolkata, India*” with prominence on biological control of the macrophyte. She identified the different pathogens and tested the pathogenity trial hosting for host range including economic importance.

### **Technical session-6: Weed management in pulses and cash crops**

**Chair:** Dr LS Brar

**Rapporteur:** Dr Simerjeet Kaur and Dr Sheela Barla

Lead paper on “*Weed management in pulse crops: challenges and opportunities*” was presented by **Dr Narendra Kumar**. He emphasized on importance of pulses in the diet of vegetarian community. As pulses are mostly grown in rainfed areas, weeds are one of the major biotic stresses reducing the productivity of pulses. Currently weeds in pulses are managed by various cultural (cropping system, intercropping, allelopathy) and mechanical methods. He also highlighted the herbicide tolerant lines in chickpea.

**Dr Tej Pratap** presented on post-emergence herbicides for weed management in greengram. Fomesafen plus fluazifop butyl 25% w/v SL 312.5 g/ha as post-emergence in greengram proved effective for control of grass and broadleaf weeds. Six oral papers were presented by **Dr M L Mehriya, Dr Indubhushan Pandey, Dr Ananda N, Dr B S Gohil, Dr Rakesh Jaiswal, and Dr Rajvir Sharma** on weed management in greengram, pigeonpea, pigeonpea+greengram and Indian mustard.

- Propaquizafop 33.3 g/ha plus imazethapyr 50 g/ha as post-emergence in greengram, chlorimuron 9 g/ha plus fenoxaprop ethyl 70 g/ha as post-emergence in pigeonpea, pendimethalin 750 g/ha as pre-emergence followed by imazethapyr 75 g/ha as post-emergence in pigeonpea+greengram proved effective for control of grass and broadleaf weeds.
- Elias 20% CS (flurochloridone), new carotenoid biosynthesis inhibitor as pre-emergence proved effective for control of grass and broadleaf weeds in potato.
- Oxadiargyl 75 g/ha as pre-emergence proved effective for weed control in Indian mustard.

### **Technical session 7: Weed Management in the rice-based cropping system**

**Chair:** Dr. Udai Pratap Singh,

**Rapporteur:** Dr. Bhimireddy Padmaja, and Mr. Jamaludheen

The session commenced with the lead lecture by **Dr. Virender Kumar** from IRRI on “*Weed management in smallholder rice in Asia: Challenges and opportunities*”. He mentioned that weed management practices in rice in Asia are changing in response to rural drivers including emerging issues of labour and water scarcity, rising production costs, and climate change. Because of these drivers, farmers are shifting from the most dominant rice cultivation method of puddled transplanted rice (PTR) to direct-seeded rice (DSR), flooded to alternate wetting and drying (AWD) water management system, and from hand weeding to herbicide-based weed control. However, weed management is the biggest constraint in the wide-scale adoption of these new systems (DSR and AWD) and several weed-related challenges have emerged including risks of higher yield losses due to higher weed infestation, evolution of weedy rice which poses a serious threat to DSR sustainability, shifts in weed flora, increased dependence on herbicides resulting in the evolution of herbicide-resistant weeds and weed management become knowledge intensive.

**Dr. Pradeep Kumar** from BAYER CropScience Ltd. who spoke on the *Sustainability in the rice ecosystem with direct-seeded rice and the emerging opportunity of carbon farming*. He discussed the opportunities of carbon marketing through DSR. He highlighted the multiple benefits of DSR viz. saving in irrigation water, reduction in labour requirement, reduced greenhouse gas emission, less cost of cultivation, and positive effect on the performance of succeeding crops. He also discussed the “Sustainable Rice Project” launched by BAYER in 2020





in collaboration with national agricultural research and extension system (NARES) partners in India. The project aims to encourage rice farmers to switch from PTR to DSR and thereby strengthen the emerging voluntary market for carbon credits in India. **Dr. Atturi S Rao** presented on the different herbicide mixtures used in rice and emphasized the importance of herbicide mixture application to avoid quick development of resistance in weeds and herbicide mixtures also give broad spectrum weed control at a lower cost. **Dr. Manoj Kumar Singh** spoke on “*crop diversification and residue mulching for weed management in rice-wheat cropping system*” He accentuated that the weed management in conservation agriculture (CA) based rice-wheat system has to be customized depending on growing ecology, availability of herbicides, crop residue management, and appropriate uses of machines and labour. **Dr. Iswar Chandra Barua**, and **Dr. Malay K. Bhowmick**, presented their research works on managing the weeds with competitive varieties under upland direct-seeded rice. **Dr. Rakesh Kumar** presented on *weed competitive ability of rice cultivars influenced by different weed management practices under transplanted conditions* and indicated that growing high-yielding rice hybrids Arize 6129, Ariz Dhani, and cultivar Swarna Shreya with adequate weed management (pretilachlor at 0.60 kg/h PE fb bispyribac-sodium 30 g/ha PoE at 20 DAT fb one manual weeding at 25 DAT) is a better option to manage weeds and improve productivity of transplanted rice. **Dr. MT Sanjay** and **Dr. Kesipreddy Naganjali** shared their research results on the management of weeds using different combinations of herbicide treatments in DSR and semi-dry rice, respectively. **Dr. Ramprakash Tata** shared his findings on the changes/improvement in soil quality with ZT compared to CT in a rice-maize-sesbania cropping system under conservation agriculture. He highlighted that ZT improved soil aggregation, hydraulic conductivity, bulk density, and penetration resistance. Better aggregation and soil physical properties were observed with the retention of crop residues and adoption of zero-tillage. **Mr. Deepak Kumar Jaiswal** presented his research works on the management of complex weed flora of dry direct-seeded rice with sequential application of herbicides under CT and ZT.

### **Technical session 8: Herbicide resistance in weeds, herbicide tolerant crops and weed utilization**

**Chair:** Dr. Y.M. Shukla

**Rapporteurs:** Dr. Dasari Sreekanth and Dr. Sonaka Ghosh.

The session had total of three lead lectures, two invited oral lectures and six oral lectures.

**Dr Amit J Jhala** presented the lead lecture on “*Pollen-mediated gene flow and transfer of herbicide-resistant alleles from herbicide-resistant to susceptible weeds*”. He highlighted the evolution of herbicide resistant weeds. Interspecific hybridization studies within *Amaranthus* and *Ambrosia* species showed that herbicide resistance allele transfer is possible between species of the same genus but at relatively low levels. He specified that occurrence of herbicide-resistant weed populations and high genetic diversity is at least partly due to PMGF, particularly in dioecious species such as Palmer amaranth and water hemp compared with monoecious species such as common lambsquarters and horseweed. He mentioned that intra- and interspecific gene flow can occur and, even though at a low rate, and suggested that it can contribute to the rapid spread of herbicide resistance alleles. **Dr. C. Chinnusamy** presented the lead lecture on “*Pros and cons of herbicide tolerant crops in Indian agriculture*”. He gave the brief introduction about the role of biotechnology in producing herbicide tolerant crops. He mentioned that herbicide tolerant crops are strongly impacting weed management choices. He suggested that cultivation of herbicide tolerant crops will decrease the cost of effective weed management in the short to medium term. HTCs offer the farmers a powerful new tool that, if used wisely, can be incorporated into an integrated weed management strategy, to more economically and effectively manage weeds. He discussed about the glyphosate history, importance of EPSP gene transfer,



herbicide resistant weeds and their challenges. **Dr. Nagendra Prabhu** presented the lead lecture on “*People Participatory model for value addition and utilization of invasive aquatic weeds with special reference to water hyacinth*”. He briefed about the impact of water hyacinth on water bodies, mode of control measures of these aquatic weeds and utilization of these water hyacinth for mushroom cultivation, bricks making, manure and paintings etc. He also discussed about the preparation of plant biodegradable nursery pots and potting mixtures, paper and napkins making from the water hyacinth. **Dr P.J. Khankhane** presented an invited oral lecture on “*Performance of weedy plants in decentralized constructed wetland systems and their potential of post-harvest biomass utilization for bio-energy production*”. He highlighted about the status of STPs in India and discussed the performance of weeds grown in surface and sub-surface constructed wetlands developed for treatment of different types of waste waters including sewage, industrial, dairy and river water of India. He mentioned that the macrophyte based treatments, *Phragmites karka*, *Typha latifolia*, *Arundo donax*, *Vetiveria zizanioides*, *Canna indica* as emergent and *Eichhornia crassipes*, *Pistia stratiotes* as floating aquatic plants were largely used for water treatment in decentralized sub-surface and surface constructed wetlands. He mentioned about the management of post-harvest biomass after phytoremediation and utilization of *Typha* in biogas production. **Dr Deepak Pawar** presented the oral lecture on the topic “*Studies on the molecular basis of imazethapyr resistance in Commelina spp. and Echinochloa colona*”. He evaluated the selection pressure for *Echinochloa colona* and *Commelina communis* in soybean against imazethapyr” from 20 soybean growing districts of Madhya Pradesh. He also carried out the ALS enzyme bioassay from the imazethapyr resistant and susceptible biotypes of *Echinochloa colona* and *Commelina* spp. He reported that the ALS enzyme activity was not affected by applying different doses of imazethapyr in *Commelina* spp. and *Echinochloa colona*-resistant and susceptible biotypes. **Dr Todar Mal Poonia** presented the oral lecture on “*Management of resistant Phalaris minor in wheat in north-western Indo-Gangetic Plains of India*”. He discussed about the menace of herbicide resistant *P. minor* in rice-wheat cropping system. He reported that pyroxasulfone + pendimethalin (TM) fb mesosulfuron + iodosulfuron (RM) also resulted in higher WCE (> 90%) for both grassy and broad-leaved weeds. Metribuzin (350 g/ha) mixed with urea after first irrigation resulted in significantly lower weed biomass by grassy as well as broad-leaved weeds compared to weedy check without any crop phyto-toxicity. **Dr P Anandan** presented the oral lecture on “*Impact of various depths of rice transplanting and Salvinia molesta compost on rice*”. He mentioned that rice planting at 1 cm depth under SRI recorded significantly higher yield parameters viz., panicle/ m<sup>2</sup>, filled grains/panicle. **Ms. Kommireddy Poojitha** presented the oral lecture on “*Investigations on herbicide resistance in Echinochloa colona and their management strategies under direct-seeded rice*”. She mentioned that *Echinochloa colona*, has developed moderate level of resistance to pyrazosulfuron-ethyl and very low level of resistance to bispyribac- sodium at the recommended dose of application i.e., at 20 g/ha. She also reported that the pyrazosulfuron resistant population of *Echinochloa colona* have not shown any cross and multiple resistance to other herbicides. **Dr R.V. Akil Prasath** presented the oral lecture on “*Decontamination of heavy metal polluted environment utilizing a wide spread invasive taxa Prosopis juliflora in Southern India*”. He highlighted the importance of *Prosopis juliflora* bioremediation potential. The weed can be utilized in decontaminating the soil environment from heavy metal contaminations. **Dr Nagaraja Reddy** presented the oral lecture on “*Opportunities for enterprise developments in weed management in crops*”. He highlighted the medicinal properties of several weeds. He specially emphasized on start-ups opportunities in medicinal weeds like Kalmegh, Bringaraj, *Senna tora* and *Lepidium* etc.

### **Technical Session 9: An industry perspective on weed management strategies for sustainable agriculture**

**Chair:** Dr JS Mishra

**Rapporteur:** Partha Baruah & Sunil Kumar

The session was an interactive session with various pesticide industries.

### **Session 1: Drone Application Technology: A New Paradigm and Opportunity for Weed Management**

1. The house welcomed and appreciated the concerted efforts of Govt of India for developing SOPs for drone application technology for insecticides, fungicides and adhoc approval of 507 products to be used with drones for interim period of two years.
2. To include herbicides for using through drones initially with broad acreage crops like wheat, rice, sugarcane, cotton, soybean for interim approval on similar lines of insecticide and fungicides.
3. To address the challenges/issues related to use of herbicide through drones (e.g. spray drift, etc.) by involving all stakeholders (DWR, SAUs, crop protection industry, drone service providers and drone manufacturers, etc) and generating required data.

### **Session 2: Emerging Challenges with Herbicide Usage in India: Current Status and Future Prospects**

1. The scientific fraternity of ICAR- Directorate of Weed Research (DWR), Jabalpur, Indian Society of Weed Science, other organizations, SAUs, etc. should come forward and take lead in providing science-based review of various herbicide molecules, which have been in use in India for last many years without any untoward incidence so far. This will enable policy makers as well as regulatory authorities in taking pragmatic decisions before banning / prohibiting various herbicide molecules on flimsy grounds. The unscrupulous voices of various NGOs will also be quietened by science-based arguments of researchers and scientists of our country. House agreed for ensuring the fact of “science prevails” while advising the Govt on such issues.
2. The way, Indian Council of Medical Research (ICMR) has tackled the covid – 19 pandemic, Indian Council of Agricultural Research (ICAR) could also be instrumental in handling various challenges related to abrupt ban of pesticides with a robust review process based on scientific rationale. There are some good herbicide molecules e.g. Glyphosate, 2,4-D, Sulfosulfuron, etc., which have contributed tremendously in increasing farm productivity by reducing losses due to weeds. Any review of such herbicides should be based on scientific facts.
3. As stated before Hon’ble High Court of Delhi, the Government of India shall revisit the matter and take a conscious decision on continuing the use of Glyphosate including its derivatives in India. Directorate of Weed Research (DWR), Jabalpur and Indian Society of Weed Science may also like to advise the Government of India to continue the use of Glyphosate since its use through Pest Control Operators (PCOs) is difficult, as there is no infrastructure of such PCOs available in our country. As urged by Directorate of Weed Research, Jabalpur as well as Indian Society of Weed Science, industry has submitted registration dossiers for label expansion of Glyphosate on cotton and grape. On this matter, the CIB&RC may be advised to extend the use of Glyphosate in cotton and grape crops, which will help the farmers to use Glyphosate in normal Bt-cotton.
4. To devise mechanisms of Crop Grouping for selective and non-selective herbicides.
5. There is a need of training farmers on various types of application technologies for efficient use of herbicides. Different methods/techniques to combat weed management challenges are required. To have further research on herbicide development in oilseeds, pulses, vegetables etc.
6. Collaboration between ICAR, DWR, SAUs and industry is need of the hour for achieving the common goal of weed management and increasing farmers profitability.





## **Technical session 10: Weed biology, ecology and climate change**

**Chair:** Dr. C. Chinnusamy

**Rapporteurs:** Dr. B. R. Bazaya and Dr. Sheeja K Raj

During this session all the 14 presentations were made including two lead lectures and two invited lectures.

- For management of wild oat integrated approach like chemical with non-chemical methods such as crop rotation, seed rate, sowing time and allelopathy suppression are better options.
- Weeds are normally available gene pool and can be used as a source of genetic materials for traits like abiotic stress tolerance for the crop plants.
- *Panicum repens* has been major problem in Assam in non-cropped and cropped areas and further recommended that lower dose of Glyphosate 0.75 kg/ha in two splits along with 2% Jaggery found suitable for management of *Panicum*. However, deep tillage also other options for tackle *Panicum repens*.
- Most of weed seeds of *Physalis minima* germinates from 1-2 cm soil layer and seeds found more than 3 cm depth have undergone enforced dormancy.
- Under flooding as well as sprinkler irrigation system in direct seeded rice, pendimethalin 1000 g/ha(PE) *fb* bispyribac-sodium 25 g/ha+ ethoxysulfuron- ethyl 18 g/ha was found economically suitable for weed control in direct seeded rice.
- A survey of ecology and biology of nutsedge was conducted at Navsari Gujrat and observed that the yield reduction due to *Cyperus* in soybean 33.5 % followed by pigeon pea 28.2% and least was reported in sweet corn 8.4%.
- A study of soil weed seed bank under different cropping system was conducted at Ludhiana and reported that weed seeds and growth was higher in conservation agriculture than in conventional agriculture.
- For the management of *Cyperus* in turf grass, halosulfuron-methyl 3.3 g/10 L water found suitable.



## **Technical Session-11 “Weed management in cash crops and minor crops**

**Chairman:** Dr. A.S. Rao

**Rapporteurs:** Dr Amit Kuamr Jha and Dr. Veeresh Hatti

**Dr RP Dubey** presented the lead lecture on “*Weed management in millets: Challenges and perspectives*”, wherein he emphasised the importance of minor millets due to their hardiness under climate change scenario as well as their nutritional and health benefits. He briefed the challenges of millets cultivation, wherein weeds are the major threats in millets cultivation causing yield loss of 15-97%. He mainly emphasised the problem of *Striga* sp. in sorghum. He emphasised that under the labour scarce scenario, the adoption of integrated method of weed control including various preventive, cultural, mechanical and chemical methods is necessary.



**Dr SB Yogananda** presented his lead lecture on “Weed control efficacy of herbicide mixtures on major weed flora of cotton in Cauvery Command Area of Karnataka”. He indicated that the PoE application of glufosinate ammonium 12.8% + metolachlor 30% EW @ 4100 ml/ha was found most effective in control of all the grasses, broad leaved weeds and sedges and recorded significantly higher seed cotton yield and cost benefit ratio. **Dr Vrajdas Usadadia** presented the oral lecture on “Integrated weed management in Bt cotton”. Pre-emergence application of pendimethalin at 1.0 kg/ha + two hand weeding at 30 and 60 DAS in Bt cotton is more effective, efficient and economical management of weeds under irrigated conditions. **Dr Kamala Bai** presented in her oral lecture on “Evaluation of post-emergence herbicide in foxtail millet” and revealed that post-emergence spray of metsulfuron methyl (10 %) + chlorimuron ethyl (10%) WP-20 WP (2+2) 4 g/ha OR 2 4 D sodium salt 80WP 1000 g/ha recorded significantly highest marginal returns and were significantly superior over other herbicides evaluated in controlling the weeds in foxtail millet. **Dr Manoj Kumar Singh** presented the oral lecture on “Influence of herbicides and agri-horti systems on growth and yield of finger millet under semi-arid condition of eastern Uttar Pradesh”. He revealed that PRE application of isoproturon 0.75 kg/ha fb one hand weeding at 30 DAS gave higher growth, yield and economics of finger millet. **Dr. P. Thimmegowda** made his lecture on “Tank mix application of Halosulfuron-methyl and Metribuzin against major weed flora of Sugarcane in Cauvery Command Area of Karnataka”. Wherein, he concluded that PoE tank mix application of halosulfuron-methyl 75% WDG @ 90 g/ha + metribuzin 70% WP @ 1.5 kg/ha when the weeds are at 3-4 leaf stage found economically viable in control of weeds especially sedges in sugarcane. **Dr Sheela Barla** in her lecture on “Effect of herbicides on weed dynamics and yield of finger millet” inferred that PPI application of bensulfuron ethyl + pretilachlor 0.33 kg/ha + 1 inter-cultivation at 25 DAS recorded maximum seed yield, net return and B: C as compared to unweeded check. **Dr. Sourabah Munnoli** given the lecture on “Weed management in sugarcane through ready-mix post-emergence herbicides” and stated that PoE application of 2,4D Sodium salt 44 % +metribuzine 35 % + pyrazosulfuron ethyl 1.0 % @ 3.0 kg/ha OR PoE application of topramezone 10 g/l + atrazine 300 g/l @ 3.0 l/ha recorded significantly higher and on par yield and economic parameters. **Miss Gurleen Kaur** presented the lecture on “Effect of various weed control treatments on different weed species of Mentha under Punjab conditions” and highlighted that hand weeding or application of propaquizafop 10 EC is effective in reducing the and weed populations and dry matter in mentha. **Dr Rajendra Hasure** presented the lecture on “Evaluation of bio-efficacy of herbicide, Atrazine 50% WP against major weed species in sugarcane with its phytotoxicity effect on sugarcane and residual effect on the succeeding cowpea crop”. He reported that PRE atrazine 50% WP @ 2000 g/ha is the ideal dose for the effective management of all types of weeds in sugarcane crop and obtaining higher cane yield with safe to the succeeding cowpea crop. **Dr SM Patel** in his presentation on “Integrated weed management in coriander and residual effect of herbicides on succeeding green gram” reported that inter-culturing followed by hand weeding at 20 and 35 DAS OR PRE application of pendimethalin @ 1.00 Kg/ha followed by inter-culturing and hand weeding at 30 DAS can be followed for achieving higher yield in coriander crop. **Mrs Pokala Sravani** given her lecture on “Weed management in foxtail millet with pre-and post-emergence herbicides”. She said that ssignificantly higher number of panicles/m<sup>2</sup>, weight of the grains/panicle, grain and straw yield were recorded with two hand weeding at 20 and 40 DAS and it was closely followed by pre-emergence application of pretilachlor 500 g/ha fb inter-cultivation at 20 DAS. **Dr Suresh Kumar J** in his lecture on “Integrated weed management in taro” said that perforated ground cover mat/weed mat/nursery men mat @ 120 GSM is to be adopted to realize higher gross return, net return and cost benefit ratio in taro crop. **Miss Ruchika Choudhary** given the lecture on “Efficacy of different weed management practices on weed density and seed yield of dill”. She highlighted that either PRE oxadiargyl @ 75 g/ha followed by one hand weeding at 40 DAS, PRE oxadiargyl 100 g/ha or intercultivation fb hand weeding at 20 and 40 DAS resulted in superior seed yield and proved effective weed management practice for dill crop grown in sub-humid regions of Southern Rajasthan. **Dr. Roop nagar, UPL Ltd.** briefed about the new molecule TRISKELE, a ready mix combination of 2,4-D Na salt 44% + metrobusin 35% + pyrazosulfuron ethyl 1% for application at 3-5 leaf stage of weeds which provides broad spectrum weed control in sugarcane. **Dr K Nalini** presented her lecture on “Weed flora of cotton – A review”.

#### **Technical session 12: Weed threat to biodiversity in forest, wasteland and aquatic ecosystem and socio-economic implications**

**Chair:** Dr. C.T. Abraham

**Rapporteurs:** Dr. Tej Pratap & Dr. Navjot Brar

In this session 1 lead paper, 1 invited oral & 9 oral papers were presented. The following findings were emerge out.

- Post -emergence spray of butachlor 38.8 + penoxsulam 0.97 SE 0.82 kg/ha with adjuvant was controlled the *Salvinia molesta* in rice ecosystem of Kerala. Pyrazosulfuron ethyl 0.75 + pretilachlor 30 WG 0.62 kg/ha completely controlled this weed. Glufosinate ammonium 15 SL 0.30 kg/ha dissolving in 500 liter water/ha spray 15 days before transplanting of rice during the field preparation also controlled this weed successfully.
- Florpyrauxifen benzyl 17.5-20 g/ha dissolving in 500-liter water/ha apply after draining water from the field controlled *Eichhornia crassipes* in rice ecosystem of Kerala.
- Increasing CO<sub>2</sub> level increase the plant height, leaf area, leaf dry weight and total dry weight of *Parthenium hysterophorus*.
- Predicting the potential risk of little seed canary grass (*Phalaris minor*) in India under future climatic scenario, it was emerge out that in future this weed will shifted to coolest region due to increase in temperature.
- With control of *Lantana camara* diversity and total density of forest will be increase, pH increases from acidic to neutral and availability of nutrients also improved.
- It is also observed that organic carbon and microbial pollution was higher under *Lantana camara* infested soil.
- Metribuzin shows highest growth rate 30.72 % followed by diziron 21.74 %, 2,4-D recorded highest volume production and butachlor recorded highest volume in consumption.
- Club rust (*Scirpus grossus*) spread in fallow areas in wet lands and shows higher level of habitat tolerance and flourishes under wide range of field conditions.



### CLOSING CEREMONY

**Chief Guest:** Dr KB Kathiria, Vice Chancellor, AAU Anand

**Guest of Honour:** Dr. Satyanshu Kumar, Director, ICAR-DMAP, Anand

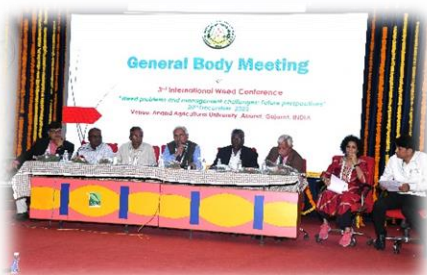
During this session, the salient recommendations of various sessions were presented by the rapporteurs. The Student Travel Grant (STG) certificates were given by the Chief guest and Guest of honour. The STG certificates to three foreign students sponsored by IWSS were given by Dr. Samunder Singh, President, IWSS. Dr. JS Mishra, the Organizing Secretary declared the results of the best posters and the certificates were distributed to the awardees by the Chief Guest. Dr Sushilkumar, the Convener of the Conference thanked the AAU authorities for their support, and the participants for their active participation and presentations. The Chief Guest congratulated the organizers and participants for the grand success of the Conference. He wished that the recommendations of the conference will be helpful for researchers, policy makers and other stakeholders in formulating the new research strategies in weed management. The Guest of honour appreciated the efforts of the ISWS for organizing such a mega event successfully. He also highlighted the medicinal importance of some weeds and possibility of active collaboration with weed science group. Dr. JS Mishra, the Organizing Secretary presented the formal vote of thanks.





## GENERAL BODY MEETING

The GB meeting of ISWS was held on 20-12-2022 at 6: 00PM in the main hall. The Secretary ISWS presented previous two years progress and the activities like training programmes, series of Webinars, etc. conducted by the Society during last two years. He informed that around 150 new life members were added in the Society. The Chief Editor, IJWS, Dr AN Rao could not attend the Conference due to personal reason. The Chief Editor's report was also presented by the Secretary. He presented the current status of the IJWS, which is being published well in time. All the 4 issues of 2022 were published in time. On-line submission of the articles and refereeing system has been developed. Dr. VK Choudhary, the treasurer of the Society presented the audit report 2021-22 of the ISWS. Following agenda points were discussed:



1. **Conduct of ISWS election and selection of Returning Officer:** It was decided that the next election will be completed before March 2023. Mr. Dev Raj Arya was unanimously nominated as the returning officer. It was decided that Secretary ISWS will write a letter to Dr Arya for his willingness.
2. **ISWS Awards:** Discussions were held to increase the number of ISWS lifetime award from 1 to 2. However, it was decided to keep the number only one at present. If the number of ISWS members will increase in future, further decisions may be taken. Members felt that there is need to improve the current guidelines for selection of the ISWS awards in different categories. It was decided to make a committee to suggest the modifications required in the guidelines. It was also suggested that the award application form and its review system should be in ON LINE.
3. **Increase the membership fee:** No change.
4. **General Discussion:** An oral session especially for students may be organized in future conferences. Based on the merit of the presentations, awards and certificates will also be given to encourage the students.

## RECOMMENDATIONS

- There is a need to incorporate traditional knowledge and wisdom in developing modern tools and techniques in weed management.
- There is need to work more on weed population dynamics, weed competitiveness & invasiveness, and breeding crops for competitiveness to biotic stresses.
- More emphasis should be given on nanotechnologies, microbial and bioherbicide products, identification and import of host-specific potential bioagents for biological control of alien invasive weeds.
- Identification of promising allelochemicals for weed suppression in organic farming, persistence and availability of these chemicals in soil environment.
- Application of Digital Technologies for site-specific weed management.
- Impact of climate change on weed dynamics, weed competitiveness and herbicide efficacy.
- Long-term impact of conservation agriculture (CA) on pest dynamics, weed seedbank, and management strategies for difficult to control weeds in CA.
- Focused research on identification of herbicide resistant weeds, molecular basis of resistance and their management strategies.
- Development of non-transgenic herbicide tolerant crops and stewardship programme.
- Utilization of weeds for medicinal purposes, bio-energy production, phytoremediation, vermi-composting, etc.
- On similar lines of insecticide and fungicides, interim approval may be extended to include herbicides for using through drones initially with broad acreage crops like wheat, rice, sugarcane, cotton, soybean by involving all stakeholders (DWR, SAUs, crop protection industry, drone service providers and drone manufacturers, etc.) and generating required data.
- Science-based review of various herbicide molecules, which have been in use in India for last many years without any untoward incidence so far to enable policy makers as well as regulatory authorities in taking pragmatic decisions before banning / prohibiting various herbicide molecules.
- More public and private collaboration is required in weed science research.
- As weeds are one of the major biotic stresses in agriculture, a basic course on Weed Science at UG level should be included.