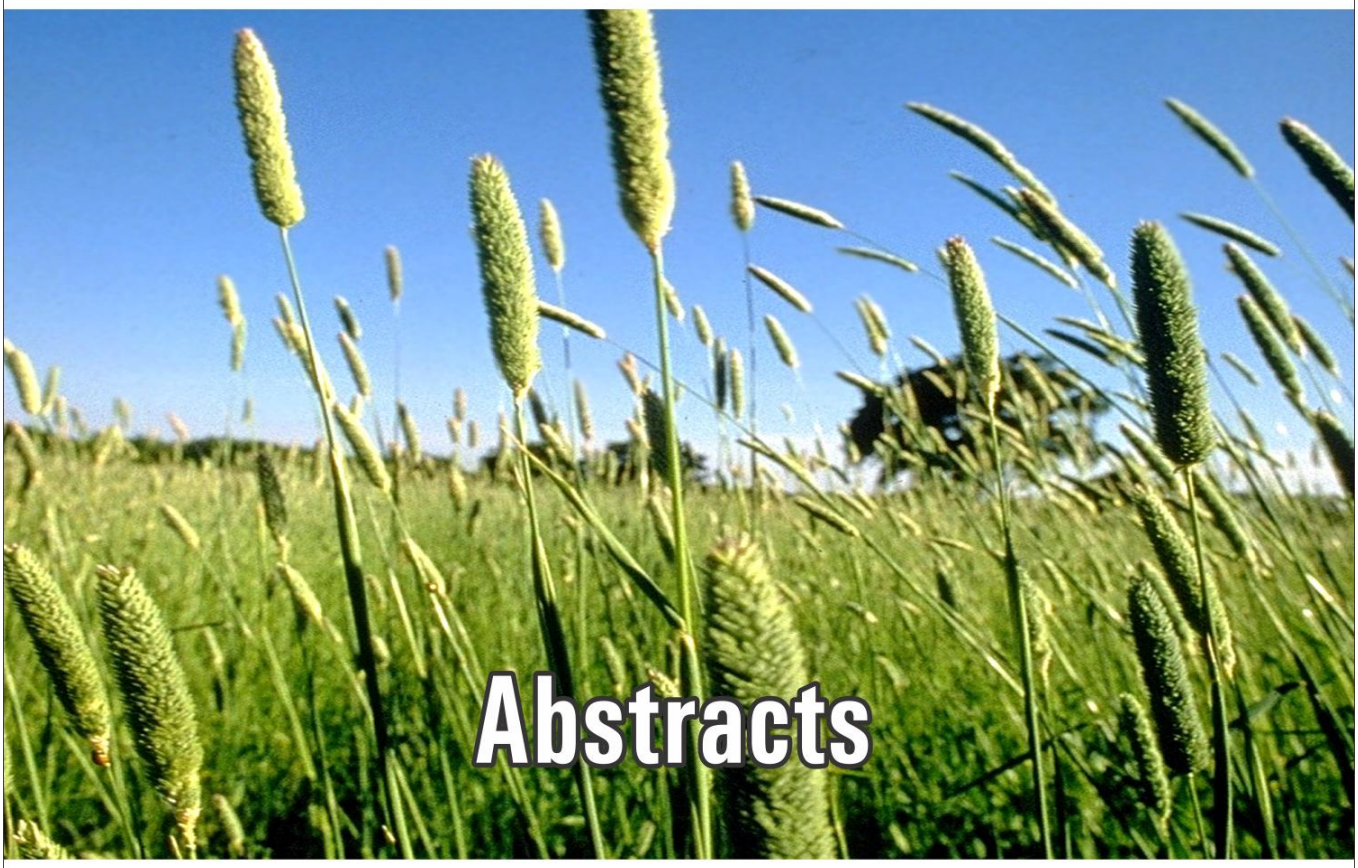
Biennial Conference of ISWS on

# Weed Threat to Agriculture, Biodiversity & Environment

## 19-20 April, 2012

Venue : Kerala Agricultural University, Thrissur



# Abstracts

## Organizers

Indian Society of Weed Science
Kerala Agricultural University, Thrissur
Directorate of Weed Science Research, Jabalpur

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# ABSTRACTS

**Editors**

Dr. Sushilkumar

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Indian Society of Weed Science

Kerala Agricultural University, Thrissur

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# Content

## Invited Lectures

# L - 1 Knowledge sharing in agriculture with special reference to weed management

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Information is critical for accelerating the growth in agriculture. The information gap between knowledge generators and users is mindboggling. The NSSO 2005 report portrays the disturbing picture of an average of only 6% of farmers having access to new technologies through an extension agent. Today extension is in a state of decline in many states, the public extension system especially is inadequate in terms of both human and infrastructural resources. The challenges facing the agriculture today is more complex.Mere transferring technology packages are not going to be sufficient. The information package should aim at increasing the farm productivity and generate employment rather than addressing productivity issue alone. The perspective must be whole chains or even value networks. Extension should evolve to be more effective in meeting information needs of a much wider variety of clientele, including women farmers, agribusiness, rural youth, and the resource-poor farmers.

The advent of internet and the advances made in information and communication technologies (ICT) have revolutionized the way we live and communicate. Some of the major landmarks in the recent past are the world wide web (WWW), popularly known as web or internet in 1990, Google (www.google.com) in the year 1998,Wikipedia (www.wikipedia.com) in 2001, Facebook (www.facebook.com) in 2004 and Youtube (www.youtube.com) in 2005. Wikipedia is a unique digital encyclopedia where the content can be edited and commented upon by individuals. However, the content related to agriculture in Wikipedia is very limited reflecting of the lack awareness and interest amongst agricultural scientists in contributing content. In order to address this imbalance, the ICAR has launched Agropedia in 2009. Agropedia is a knowledge sharing platform developed by IIT, Kanpur under the NAIP consortium project led by ICRISAT. The agropedia portal is different from others. It is semantically enabled, multi-lingual, has a social net working site and an interface for connecting with the farmers and stakeholders. ICAR should strongly promote use of this platform for long term benefits to the country.

Courtesy new telecom policy of the union government, which enabled the participation of private parties, there has been a massive penetration of mobile phones in the country. The number is currently over 800 million and is expected to cross the billion marks by end of 2012. Competition and technology advancement have resulted in hand sets and call charges becoming affordable to the common man. With 3G round the corner, speed and access to value added information would be non-issues. An ordinary farmer or a citizen can now afford to own a mobile phone. This has greatly narrowed down the gap between the urban and rural communities, the rich and the poor and the literate and the illiterate. To a great extent, this has overcome the problem of 'last mile connectivity' and the challenges of 'reaching the unreached' - often quoted as the bottlenecks in the sphere of agricultural extension.

**Agricultural knowledge management in India (AKM):** ICT-enabled AKM in India is still in its infancy. Access to digital content is very limited. As on now there appears to be no concerted integrated approach in creation, holding and sharing of knowledge. Organized institutional repositories are lacking, the website of many organizations lack content, are static and are not updatedregulalry. There is absence of interaction/ sharing through wiki, blogs, discussion forums etc. organizations are not linked to social networking sites/ media. By and large, the scientists are less IT savvy and ICTs are poorly used.

**Constraints in adoption of ICTs:** Some common problems in the adoption of ICT in agriculture are; poor and inadequate infrastructure, absence of digital content in local languages, lack of interest in sharing & collaboration, poor IT culture, lack of enabling policies and old mindset relating to sharing of information.

**The way forward;** The IT industry will continue to come up with more and more affordable ICT tools and technologies which would simplify our lives and would help in accelerating growth in all fields including agriculture. The challenges will be with popularizing and customizing them to our local needs. NARS should develop long term collaboration with the IT institutions and the IT industry to achieve this. NAIP has made huge investments on ICT projects and some very good outputs and outcomes are already visible. The impacts will be felt in the next 3-5 years. What is badly needed is the mobilization of the public and sensitization of senior managers & policy makers, capacity building of scientist and stakeholders and extension personnel.

## L - 2 Herbicide resistance in India : current scenario and prospects

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In the last century herbicide resistance was reported in two major crops in India, wheat and tea plantations to PSII (isoproturon) and PSI (paraquat) inhibiting herbicides. Out of the two, the first one got notoriety due to resistance in *P. minor* – a major weed of several continents. Paraquat resistance was not wide spread and alternate herbicides (glyphosate, 2-4-D, carfentrazone; alone and as tank mixture) were effective to contain the economic damage. *P. minor* emerged as the most pernicious weed of wheat in NW-India under rice-wheat cropping system and also a nuisance in adjoining countries (Pakistan, Iran, Nepal, and others) with the potential to cause significant yield penalty in wheat and other winter season crops. It was controlled successfully by isoproturon for over a decade, before resistance was observed in 1991-92. The resistance was characterized as metabolic one- which has the potential to render herbicides of other groups also useless, if not used judiciously. Cross-resistance in Isoproturon-resistant populations quickly evolved to diclofop-methyl followed by fenoxaprop-P-ethyl and lately to clodinafop-propargyl. Recent studies indicate that *P. minor* biotypes have acquired multiple resistance mechanisms (target site and enhanced metabolism) offering a challenge to weed scientists in its management. Resistant populations of *P. minor* have also been observed in South Africa, Iran, Israel, Mexico and USA to herbicides of different modes of action.

Presently there is no recommended herbicide in India without problems. Regeneration of *P. minor* under field conditions is the major cause of concern with all the recommended herbicides followed by emergence of several flushes in the same growing season. Weather plays a significant role on the efficacy of herbicides along with application time and methods for the control of *P. minor*. The present paper will discuss the role and scope of rotation of crops, herbicides and agronomic practices, use of herbicides in mixture and their sequential application (PRE followed by POST) as well as repeat application of herbicides. An integrated approach combining the knowledge of weed biology, methods of field preparation, selection and seed rate of wheat variety, planting time, rate and method of herbicide application, use of surfactant, and avoidance of weed seed spread to other areas through several mechanisms are needed to contain and delay resistance evolution to herbicides of newer chemistries.

L - 3

# Weed management in conservation agriculture systems: problems and prospects

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Conservation agriculture (CA) has drawn the attention of resource management scientists throughout the globe since early 1970s, following widespread resource degradation problems and rise in energy prices. Over the last 20 years, major gains from the adoption of these technologies have been realized in many countries of America and Australia. It is estimated that > 120 million ha of the cropped area is under conservation agriculture systems in countries like USA, Canada, Australia, Brazil, Argentina, Australia as well as in some Asian and European countries. In south Asia including India, some initiatives were undertaken since early 1990s to develop resource conserving technologies in rice-wheat cropping system. Presently, about 3 million ha of wheat is estimated to be grown under zero-tillage conditions.

Conservation agriculture technologies involves minimum soil disturbance, providing a soil cover through crop residues or other cover crops, diversification of species and sensible crop rotations. In the conventional agricultural systems involving intensive tillage, there is a gradual decline in soil organic matter through accelerated oxidation and burning of crop residues. When the crop residues are retained on soil surface in combination with zero tillage, several changes occur that lead to improved soil quality and overall resource enhancement. Therefore, the CA technologies lead to sustainable improvement in the efficient use of water and nutrients by improving nutrient balances and availability, infiltration and retention by soils reducing water losses, and improving the quality and availability of ground and surface water.

Tillage influences weed infestation, and thus interactions between tillage and weed control practices are commonly observed in crop production. Adequate tillage checks and delays emergence of weeds, and provides a more favourable environment for early crop establishment. Available reports suggest that zero tillage increases as well as reduces infestation of certain weed species in different crops. In rainy season when the weed problem is generally more, growing crops with zero tillage require additional measures for effective weed control, including use of non-selective herbicides like paraquat and glyphosate. Zero-till sowing in standing crop residues along with application of herbicides in proper combination, sequence or in rotation leads to lower weed population and higher yield than conventional planting. Therefore, integrated weed management options are essential for effective weed control under modified tillage and crop establishment practices.

Changing from conventional tillage-based farming to zero-till farming is not easy. The difficulty of the transition, together with the common perception that zero-till incurs a greater risk of crop failure or lower net returns than conventional agriculture, has seriously hindered widespread adoption of this approach in countries outside North and South America. Yields of zero-till crops are often reduced by 5-10% especially on fine-textured, poorly-drained soils, compared with conventional tillage. Further, zero-till may require application of extra N fertilizer and reliance on herbicides to control the weeds. Herbicide-resistant weeds are already becoming more common on zero-till farms in some countries. Therefore, the continued adoption of zero-tillage based farming system is highly dependent on the development of new herbicide formulations and integrated weed management options.

L - 4

# Major weeds and their management in Tamil Nadu

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Tamil Nadu in the southern most part of India lies between the Bay of Bengal in the east and Western Ghats in the west. There are many factors that cause reduction in yield, the maximum loss of 45 per cent is caused only by weeds. Weeds caused 69 per cent yield loss in rice, 34 per cent in wheat, 50 per cent in pulses, 72 per cent in sugarcane and almost 90 per cent in vegetables. The total world food loss due to weeds is estimated to be 33% of 287 million tonnes due to total pest incidence, which accounts for 11.5 per cent of the total food production. In Tamil Nadu, a yield loss of rice is around 111.81 thousand tonnes per year due to weeds alone. The major weeds of rice ecosystems in Tamil Nadu were *Echinochloa crusgalli* (22.0 %), *Echinochloa colona* (23.5%) in grasses, *Cyperus difformis* (21.3%) and *Cyperus iria* (21.0%) in sedges, *Marsilea quadrifoliata* (5.8%) and other broad leaved weeds (6.4 %) during *Rabi* seasons. In general broad leaved weeds are predominant weed flora accounting for 43.2% of total weed flora followed by grasses (29.8%) and sedges (26.9%) in transplanted rice. In garden land ecosystems of Tamil Nadu, *Trianthema portulacastrum*, *Amaranthus viridis*, *Parthenium hysterophorus*, *Echinochloa* sp. *and Cyperus* sp. were dominant weeds. *Cyperus rotundus* (40.03%), *Portulaca oleraceae* (17.77%), *Cynodon dactylon* (13.70%), *Echinochloa columum* (10.00%), *Convolvulus arvensis* (9.25%), *Digeria arvensis* (3.70%), *Euphorbia hirta* (1.85%), *Amaranthus viridis* (1.85%) and *Corchorus olitorius* (1.85%) were the major weeds in winter season. In dry land ecosystems of Tamil Nadu, diverse weed flora was observed in moisture stress ecosystems. Predominant weeds were *Andropogan contortus, Cynodon dactylon, Panicum* sp*, Achyranthus aspera, Amaranthus viridis, Borreria hispida, Celosia argentia, Leucas aspera, Ocimum canum, Phyllanthus niruri, Phyllanthus maderaspatensis, Euphorbia hirta, Boerhaavia diffusa, Cynotis cuculatta, Digera arvensis* and *Cyperus rotundus.* Major weeds of wetland ecosystem can be managed by pre-emergence application of butachlor 2.0 l/ha (or) thiobencarb 2.0 l/ha (or) pendimethalin 2.5 l/ha (or) anilophous 1.25 l/ha along with one hand weeding on 35 DAP. In millet crops like maize, sorghum, pearl millet and finger millet, the predominant weed flora can be managed by the pre-emergence application of atrazine 0.5 kg/ha with one hand weeding. Pre-emergence application of alachlor 1.25 kg/ha (or) pendimethalin 1.0 kg/ha with one hand weeding gave effective control of weeds in major pulse crops in Tamil Nadu. Pre-emergence application of pendimethalin 1.0 kg/ha (or) oxyflourfen 200 g/ha followed by one hand weeding will be a best weed control options for oil seed crops like groundnut, sesame, sunflower *etc.*, Pre-emergence herbicides *viz*., pendimethalin 1.0 kg/ha (or) fluchloralin 1.5 lit/ha (or) oxyflourfen 0.2 kg/ha + metolachlor 1.0 kg/ha sprayed on 3 DAS followed by one supplementary manual weeding at 40 DAS proved to be the best weed control method for cotton. Predominant problematic, parasitic and aquatic weeds were, *Cynodon dactylon, Cyperus rotundus* and *Parthenium hysterophorus* and *Orobanche* spp, *Striga* spp, *Dendropthoe* spp and *Cuscuta* spp. *Orobanche* being complete parasite occurring on tobacco, tomato, brinjal, potato *etc.,* Striga being partial parasite occurring on sorghum, maize, sugarcane and *Cuscuta* being partial parasite occurring on lucerne, bengal gram and plantation crops. *Dendropthoe* being partial parasite occurring on fruit trees and plantation crops. *Eichhornia crassipes* is the most troublesome aquatic weed distributed in lakes, rivers, ponds and ditches. Pre-emergence atrazine 1.0 kg/ha on 3 DAP + POE spraying of 2,4-D Na salt at 5 g + urea 20 g/litre of water on 90 DAP effectively reduced the density and dry weight of *Striga asiatica* with better weed control efficiency. PE pendimethalin 1.0 kg/ha + plant hole application of neem cake 200 kg/ha on 30 day after transplanting direct contact application of imazethapyr 30 g/ha on 55 DAT and crop rotation with pulses (or) sesame (or) sorghum reduced the infestation of *Orobanche*. Non-selective herbicide like paraquat (1% spray) and glyphosate (1%) and others like 2,4,D kill *Cuscuta* effectively in area where *Cuscuta* occurs in pathches. Use of pre-emergence herbicide like fluchloralin, trifluralin or pendimethalin at 0.75 to 1.50kg/ha will lower the menace of *Cuscuta*. Plant hole application of 8 g copper sulphate and 1 g 2,4-D powder, free the trees from *Dendropthoe* for four years.

L - 5

# Successful biosuppression of *Salvinia molesta* using *Cyrtobagous salviniae* in Kerala

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*Salvinia molesta* Mitchell is a non-flowering plant of South American origin. The weed infestation occurred in nearly 7,150 sq. km. out of a total area of 38,900 sq. km. of the State. It is estimated that this molesting weed affects the daily life of about five million people in Kerala. Spilling on them, they lay waste fertile fields, enhance cost of cultivation, reduce crop yields, clog canals and water ways, impede navigation, irrigation and fish production, choke intake screens of hydroelectric projects, spread diseases and interfere with recreation pursuits and even domestic washing.

For suppression of the weed the weevil *Cyrtobagous salviniae* Calder & Sands was introduced in to Kerala, from Australia. Conducted studies on the biology and morphology of the insect. Eggs are inserted singly at the base of leaves and in scars of rhizomes. Freshly laid eggs were pale yellow in colour which gradually darkened during development. The incubation period varied from six to nine days. On hatching, the first instar larva remained outside for a while scraping on the tender plant tissues. After about three to four days they tunneled in to the leaf base on the nodal region of the rhizome and completed the three instars in 28 days. Pupation took place in a spun cocoon and adult lived for 172 to 279 days. Due to feeding of the larvae, the leaves become characteristically darkened, resulting in death and disintegration of plant tissues. The major damage was caused by tunneling of the rhizome by the larvae. Adults fed on unopened leaf buds and tender leaves. Because of their feeding, circular holes were formed on the buds and leaves. The visible symptoms of attack by *C. salviniae* are gradual change of colour from normal green to yellowish green, and then to rusty brown. The leaf size and root length got gradually reduced and finally the weed turned in to brownish black mass.

Field experiments were carried out in three districts of Kerala. In all the areas weevils were established and suppressed the weed. In monsoon floods, the weevil infested weed along with the insect was carried to distant places. The insect thus reached all the nooks and corners of Kuttanad. Regrowth appeared in stagnant side canals, small ponds and a few paddy fields. Within a month after appearance of the regrowth, the weevil also appeared and kept the growth under check. Wheresoever *C. salviniae* weevils exist, this condition of coexistence is likely to prevail and there is hardly any chance of total eradication neither the weed nor the natural enemy. This phenomenal biological suppression has been accomplished over a wide area of 1000 $km^2$ in the comparatively short period of two years. The weevil has remained strictly host-specific to the target plant. The weed suppression obtained is above ninety per cent in Kuttanad. Occasionally weed regrowth has been noticed; but it has perished in 8 to 12 months. The farmers of Kuttanad and kole lands have benefited immensely by the weed suppression. From the 29,000 hectares of paddy fields in Kuttanad alone, the reduction of weed damage has saved Rs. 6.8 million per year. The once chocked navigation canals have been cleared for transportation. Thus Kuttanad and kole lands, the granaries of Kerala, have been cured of a grave cancer gnawing into the economy of the State.

## L - 6 Nanoherbicide : a new tool in modern weed management

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Presently thousands of herbicide formulations are available in the market to combat weed plants under diverse situation. In 2002, global herbicide sales were nearly US$28 billion, constituting 47% of the total agrochemicals used worldwide. With respect to India the consumption has increased rapidly from 4100 metric tonnes (MT) in 1988-89 to 11,000 MT in 2001-02 and it is likely to further increase in future. It is estimated that the herbicide market would grow at over 10 % per annum. (NRCWS)

Although herbicides will continue to be the dominant technology in weed management programs, several problems have arisen from reliance on herbicides including herbicide movement to non-target areas, environmental contamination, and development of herbicide-resistant weeds. Continuous exposure of plant community having mild susceptibility to an herbicide in one season and different herbicide in another season develops resistance to all the chemicals in due course and become uncontrollable through chemicals. The performance of herbicides in tropical environments can sometimes be erratic and inefficient. This is particularly true for soil-applied herbicides where high temperatures, intense rainfall, low soil organic matter and microbial activity results in rapid breakdown and loss through leaching. Further the the irrgation process reduces the herbicide concentration lead to reduced weed control efficiency coupled with leaching and potential ground water pollution. Thus the half life period for many soil herbicides remains very short period of time ranging from few hours to couple of weeks. Whereas some of the herbicide parent material persist in soil for long time and results in residual toxicity problems. Among the herbicides, atrazine is almost a non-volatile and its half-life in neutral condition varies from 4-57 weeks depending on various environmental factors like pH, moisture content, temperature and microbial activity. Although, there are different methods (by activated carbon adsorption, microbes or air stripping) for removal of atrazine residues from aquatic system, there are no established methods for the vast soil phase. Furthermore the herbicides available in the market are designed to control or kill the germinating or growing above ground part of the weed plants. None of the herbicides are inhibiting the viable underground propagating materials.

Hence it is evident that the task is huge and solutions are limited. Amidst this situation, the new science, nanotechnology throws rays of hope for the development of nanoherbicides with highly specific, controlled release and increased efficiency to circumvent the weed competition under different ecosystem of crop production. Nanotechnology is a technology having the potential ability to study, design, create, synthesis, manipulation of functional materials, devices, and systems to fabricate structures with atomic precision by controlling the size of the matter at the scale 1–100 nanometers (one nanometer being equal to $1 \times 10^{-9}$ of a meter). The properties and effects of nanoscale particles and materials differs signi?cantly from larger particles of the same chemical composition. By controlling structure precisely at nanoscale dimensions, one can control and tailor properties of nanostructures, such as nanocapsules, in a very accurate manner for slow release herbicide to achieve season long weed control. Degrading phenolic compounds responsible for dormancy of weeds with suitable functionalized nanoparticle would be an intelligent solution for the exhausting the weed seed bank. Despite their minuscule size, the zero Valent Iron (ZVI) nano particle, a chemical reductant hold the potential to cost-effectively address the issue of atrazine residual toxicity. Hence with the advancement of science in nano-scale level, vast scope is ahead for the weed scientist to resolve the problems encountered in weed management without hampering the natural ecosystem.

L - 7

# Major weeds and their management in Gujarat

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Agriculture is the mainstay of Indian economy. Weeds endanger biodiversity, affect human and animal health, aquatic ecosystem and grasslands. The problems due to weeds are more evident in the era of modern agriculture due to the large scale use of high doses of fertilizers and irrigation in major crops grown in India. Weeds are a big constraint in crop production and are responsible for heavy yield losses in almost all the crops grown in Gujarat. *Eragrostis major*, *Digitaria sanguinalis*, *Dactyloctenium aegyptium*, *Eleusine indica*, *Echinochloa crusgalli*, *Echinochloa colona*, *Setaria glauca*, *Cyperus rotundus*, *Cynodon dactylon* and *Commelina forskalaei* as monocot weeds while, *Trianthema monogyna*, *Boerhavia diffusa*, *Phyllanthus niruri*, *Digera arvensis*, *Parthenium hysterophorus*, *Amaranthus lividus, Amaranthus viridis*, *Convolvulus arvensis, Oldenlandia umbellata, Celosia argentea* and *Physalis minima* as broad leaved weeds noticed as major weeds in *Kharif* crops grown in Gujarat. *Asphodelus tenuifolius*, *Chloris barbata* and *Eleusine indica* as monocot weeds while, *Chenopodium album*, *Boerhavia diffusa*, *Portulaca quadrifida*, *Meliotus indica* and *Chenopodium murale* as broad leaved weeds noticed as major weeds in *Rabi* crops grown in Gujarat.

Results of the experiments carried out at various centres showed that fluchloralin, trifluralin, pendimethalin and atrazine 0.5 to 1.0 kg/ha were highly effective in controlling *Trianthema monogyna, Setaria glauca, Digitaria sanguinalis*, *Dactyloctenium aegyptium* and *Eleusine indica* along with other major weeds in *Kharif* and *Rabi* crops while, *Convolvulus arvensis, Parthenium hysterophorus, Cynodon dactylon* and *Cyprus rotundus* were controlled by post emergence application of glyphosate or glufosinate ammonium. *Asphodelus tenuifolius* was controlled 80 to 90 % by metribuzin 0.70 kg/ha as pre-emergence, while more than 90 % control achieved with the pre emergence application of atrazine 0.50 kg/ha.

On the basis of screening of various herbicides and other weed management practices tested in major crops, pendimethalin 0.5 to 1.0 kg/ha is recommended for weed management in major crops grown in Gujarat *viz;* cotton, groundnut, tomato, chillies, okra, onion, paddy and tobacco nursery, cumin, cluster bean, soybean and wheat. Application of atrazine 0.5 to 1.0 kg/ha is recommended for weed management in sorghum, pearl millet, maize and sugarcane. Post emergence application of quizalofop-ethyl or fenoxaprop-p-ethyl 100 g/ha is most effective and recommended for control of grassy weeds in groundnut and soybean.

Among problematic and parasitic weeds, post emergence application of glyphosate 0.50 to 0.75 kg/ha showed 38 to 50% mortality of *Cyperus rotundus,* while application of glyphosate 1.0 to 1.5 kg/ha showed 68 to 96% mortality of *Cyperus rotundus.* In non cropped situation, broadcasting of *Cassia sericea* or *Cassia tora* 15 kg/ha in the month of June was effective to manage Parthenium in non cropped area. Post emergence application of glyphosate 2.4 kg/ha was also effective to manage *Parthenium hysterophorus* in non-cropped situation. Application of pendimethalin 0.5 kg/ha at 10 days after sowing is recommended in forage lucerne crop for control of parasitic weed *Cuscuta.*

L - 8

# Current status of weedy rice in India and strategies for its management

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Weedy rice is a complex of *Oryza* morphotypes widely distributed in the commercial rice fields in more than 50 countries of Asia, Africa and Latin America, especially in areas where farmers have switched to direct seeding due to labour shortage and high cost. India is the centre of origin of rice, and many wild and weedy relatives are seen in the rice growing areas of the country. Introgressions between perennial wild rice and cultivated rice have given rise to highly variable population of weedy/wild rice types, including annuals and perennials. Indian weedy rice belongs to the *indica* group and weedy species in cultivated rice is reported to be *Oryza sativa* f.sp. *spontanea.* Heavy infestation of weedy rice in rice fields of Kerala during recent years is forcing farmers to abandon the crop due to huge reduction in crop yield around 30-60 per cent depending on the severity of infestation (3-10 mature weedy plants per square meter). Variations in plant height, tiller production, pigmentation, length of awn and grain are noticed in the wild and weedy rice types of India. Heavy infestation of weedy rice ecotypes in rice fields is a problem in eastern India (eastern U.P., Bihar, Orissa, Manipur and West Bengal) and southern India. Whereas, in north western states like Haryana and Punjab wild rice is not yet a problem (AICRP, 2010).

Efficient management of weedy rice infestation is complex because of its morphological similarities which makes it difficult to distinguish weedy rice from cultivated rice till it comes to flowering, variable dormancy, staggered germination, high competitiveness and early seed shattering. Weedy rice come to flowering much earlier than cultivated rice and produce grains having awns, with varying pigmentation for ear head. Seeds mature within a short period and shatter immediately facilitating the buildup of weed seed bank before the farmer gets a chance to remove the seeds along with the harvest of rice crop. Number of studies have been done at the molecular level where shattering ability was zeroed down to differentiation of abscission layer and the locus identified for it. Later it was found that the inactivation of the CTD phosphates like gene OsCPL1 enhances the development of abscission layer and seed shattering in rice. Studies have shown that seeds often germinate between 15 to 40ºC and many seeds decay between long periods of flooded condition. Most of the seeds germinate from the upper 0-4cm layer of soil. Dormancy in weedy rice is highly correlated with awning, black hull and red pericarp. Characters like higher Nitrogen use efficiency for biomass production, high and early seed shattering, asynchronous maturity, etc are some of the major parameters responsible for its weedy trait.

Morphological as well as physiological peculiarities of weedy rice make hand weeding incomplete and ineffective. As no single technique can effectively control weedy populations under field conditions, its infestation is a menace in commercial rice fields. As the present recommendations of chemical weed control in rice are not effective for selective control of weedy rice, suitable package for integrated management of weedy rice is to be evolved for increasing the production and productivity of rice. The best method for preventing the infestation is the use of clean seeds. In already infested fields, the strategy is to deplete the weedy rice soil seed bank by various methods like burning of straw left after the harvest of rice to destroy the seeds lying on the surface, stale seed bed technique (removing the germinated weedy seeds mechanically or using non selective herbicides before planting), or by direct contact application of nonselective herbicides like paraquat, glufosinate, glyphosate *etc.,* using special applicators to the ear heads of weedy rice which will selectively dry the panicles. Among the different pre-emergence herbicides tried, surface application of oxyfluorfen 0.3 kg/ha in 2 inches of standing water (after land preparation and three days before sowing of rice crop), effectively

controlled weedy rice during the initial critical period of 12-15 days. Rotation of rice crop with other crops for a few seasons can also free the field from weedy rice infestations. Effective eco friendly management of weedy rice is possible by following other management options like higher seed rate, use of pigmented rice varieties, straw burning, appropriate tillage practices, adoption of mechanized transplanting or dibbling, scientific water management, and hand weeding in an integrated approach.

Biotechnological approaches using genetically modified herbicide tolerant rice varieties may be an efficient strategy in the control of weedy rice. A non transgenic rice variety 'Clearfield' tolerant to herbicide imazethapyr has been in use in red rice infested fields of United States of America since 2002. However, the possibility of out crossing of the resistant variety with wild rice is suspected to taint the advantage of this technology. Efforts to understand and figure out the genesis of weedy rice in India by comparing the genetic backgrounds of different weedy rice biotypes with wild and cultivated rice have been made at the Directorate of Weeds Science Research, Jabalpur. Seventy five weedy rice biotypes across 6 states have been collected through survey and help of AICRP-Weed control centres. A comprehensive study of all these biotypes, wild rice and cultivated rice. Molecular fingerprinting by microsatellites is also planned and work has already been initiated in this direction.

## L-9 Alternative weed management options through farming elements

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Smaller farm holdings in Asia offers scope for using component elements in a farming system for sustainable management of weeds that behave invasive in a changing climate. Altered precipitation, evaporation and temperature patterns due to climate change have resulted in weed flora shifts in northern coastal districts of Tamilnadu state, India. In particular, there has been a preponderance of invasive alien species such as *Leptochloa chinensis* (L.) and *Marsilea quadrifolia* L. in wetlands, *Trianthema portulacastrum* L. in uplands and *Eichhornia crassipes Mart. Solms* in aquatic systems. Management of these weeds is constrained by lack of efficient control by independent approaches like manual or chemical measures. Hence, integrated approaches involving cultural measures assume importance. Research undertaken at Annamalai University in India is providing some alternative solutions to manage these problematic weeds. Innovative use of fish culture and poultry rearing in rice fields was shown to compliment weed control through 400 on-farm experiments, with biomass reductions of invasive alien species ranging from 31 to 38 per cent, in these districts. Similarly, using goats for off-season grazing reduced the biomass of weeds in upland crops. For example, biomass of the dominant *T. portulacastrum* declined by 23 to 29 per cent in 500 on-farm participatory experiments. Involving pigs for burrowing the puddled fields and addition of Tamarind husk complimented control of rice weeds especially nut sedge, which was reduced by 61 per cent. The invasive weed *E. crassipes* in aquatic systems was controlled in seasonal waterbodies within a season, by innovative and integrated use of insect agent (*Neochetina eichhorniae*) and plant product of *Coleus amboinicus* L. Utility modes for consuming the extensive biomass of *E. crassipes* have also been compared (*viz.,* manure, cattle feed and nanofiber extraction). Results indicate that manurial use and tempo mediated extraction of nanofibers offers an innovative tag of utility for management of this weed.

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# Major crop weeds and their management in Haryana

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Haryana, a small state with geographical area of 44000 $Km^2$ is the second largest contributor of wheat and rice to the central pool after Punjab. Although, Haryana tops the nation in productivity of wheat and mustard, but average yield of all the crops is low compared to developed countries. Losses due to weeds is one the major biotic constraints for realizing potiential yields. Use of particular group of herbicides over a long period of time particularly in rice, wheat, sugarcane and maize has led to shift in weed flora also. Infestation of some weeds like *Solanum nigrum*, *Malva parviflora*, *Polypogon monspeliensis* and *Poa annua* in wheat, *Ammania baccifera* and *Saggitaria guanensis* in rice, *Orobanche aegyptiaca* in mustard and tomato, *Euphorbia dracunculoides, Convolvulus arvensis and Asphodelus tenuifolius* in chickpea is increasing every year. So, knowledge of weed species associated with crops in a region is necessary for planning an effective weed control programme.

*Phalaris minor*, *Rumex dentatus*, *Coronopus didymus*, *Chenopodium album*, *Medicago denticulate* and *Melilotus indica* are the major weeds of wheat grown after rice in north-eastern districts and western parts of state, whereas wheat grown after cotton and pearl millet in south-western districts is infested with both grassy and broadleaf weeds such as *Avena ludoviciana* and *P. minor* as grassy and *C. album*, *C. murale*, *M. indica*, *C. arvensis*, *R. spinosus*, *Fumaria parviflora* and *Trigonella polycerata* as broadleaf weeds. Rice crop is infested with *Echinochloa colona, E. glabrescence*, *Ammania sp., S. guanensis*, *Cyperus difformis* and *C.iria*. In sugarcane, infestation of *Dactyloctenium aegypticum, D. sanguinalis, E.colona, E. glabrescence*, *Trianthema portulacastrum*, *Ipomoea spp, Physallis minima*, *Conyza canadensis*, *Cyperus iria* and *Cynodon dactylon* is more common. *A. tenuifolius C. album, M. indica, Trigonella polycerata, C. murale, Cynodon dactylon, O. aegyptiaca, A. ludoviciana and C. arvensis* are highly associated with mustard crop. *Digera arvensis, Trianthema portulacastrum, Cyperus rotundus, Physallis minima, D. aegypticum, Corchorus tridens, and Cucumis callosus* are important weeds found to infest clusterbean and cotton crops in Haryana. *C.rotundus. A. arvensis, C. album, M. indica, C. didymus, M. denticulata* and *Spergula arvensis* among broadleaf weeds & *P. minor, P. annua* and *P. monspeliensis* among grasses are the major weeds infesting garlic and onion fields in the state.

Use of herbicides like clodinafop, sulfosulfuron, pinoxaden, meso+iodosulfuron (R.M.) and sulfosulfuron+metsulfuron (R.M.) are very effective to control weeds in wheat whereas in rice pre-emergence herbicides like butachlor, pretilachlor, oxadiargyl, anilfos and bispyribac(post) are recommended. Pre-emergence use of pendimethalin at 1.0 kg/ha or pre-plant incorporation (PPI) of trifluralin at 1.0 kg/ha along with one hoeing provides effective control in cotton while use of atrazine at 2.0 kg/ha after first irrigation and hoeing takes care of most of the weeds in sugarcane. Pendimethalin 1.5 kg/ha (PRE), early post emergence use of oxadiargyl at 100 g/ha and oxyfluorfen (post emergence) at 150-200 g/h are recommended to control weeds in onion and garlic.

**L - 11**

# Biological control of weeds through fungal pathogens: Indian perspectives

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Herbicides have played a vital role in improving crop productivity. Due to the recent trends in environmental awareness concerning the side effects of herbicides, public pressure is mounting to force industry to develop safer, more environmental friendly approaches for controlling weeds. Biological weed control with plant pathogenic fungi used as mycoherbicides offers such an approach. Considerable progress has been made during the past three decades in the use of fungi as mycohercicides. 3

There has been a great number of naturally occurring fungal strains researched for possible use as mycoherbicides, but only a small proportion (i.e. 16) have been developed to commercial products. Currently, a total of 16 mycoherbicides (7 in the USA, 4 in Canada, 2 in South Africa and one each in Netherlands, Japan and China) have been registered around the globe. Some mycoherbicides have been registered but are not available in the market due to several biological and environmental limitations which must be overcome before they will be widely acceptable for practical use.

The advancement of formulation techniques is of paramount importance to the continued development of mycoherbicides. It is also essential to continue intensive screening programs for the selection of fungal pathogens, especially hemibiotrophs, if mycoherbicides are to become a viable component of integrated weed management in the future. Recent trend is the application of several host-specific fungal pathogens in a bioherbicide mixture as a multi-component bioherbicide system for simultaneous, broad-spectrum weed biocontrol. Weed control with fungal biocontrol agents is being carried out at several laboratories in India. The notable of these are at Jabalpur (M.P.), Thiruvananthapuram (Kerala), Bangalore (Karnataka), Kurukshetra (Haryana), Annamalai and Madurai (T.N.). At Kurukshetra, during the last 30 years, searches for fungal BCAs have been made on 26 weeds (7 aquatic and 19 terrestrial).

Of the several fungal pathogens reported on these weeds, a number of them, have been evaluated for their biocontrol potential against the notorious weeds of this region. *Gibbago trianthemae, Alternaria alternata* and *A. eichhorniae* have shown all the desirable characteristics to be present in a successful biocontrol agent for controlling *Trianthema portulacastrum* and *Eichhornia crassipes* and there is a possibility of developing these fungi as mycoherbicides in India in the near future.

# L - 12 Sanitary and phytosanitary measures and issue of invasive alien species

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The year 1995 saw the birth of the youngest International Organisation by name WTO (World Trade Organisation) to deal with the global rules of trade between nations. WTO and its predecessor GATT (General Agreement on tariffs and Trade) were aimed at regulating global trade and to ensure smooth and free flow of trade between countries. Undoubtedly they promoted trade and merchandise exports grew at an annual rate of 6%. However with this expansion in trade there has been an increased movement of species to new locations – potential invasive aliens.

Vessels of transport, equipment and machinery, packaging material, agricultural produce, timber, international mail *etc.,* are some of the unintentional means of introduction of alien species while introduction for research in agriculture, forestry, biological control and smuggling could lead to intentional introduction of new species which may become future threats to the environment, ecology, agriculture and even food production. The economic losses due to Invasive alien species (IAS) can be huge.

Invasive alien species (IAS) not only affects environment, production and productivity but also the export markets of countries. Imports from countries can be banned for presence of pests or diseases and also for not adhering to quality standards. Prevention measures though costly thus becomes essential.

The WTO is an organization for trade opening and negotiation of trade agreements. It is a place for countries to settle trade disputes. Since WTO came into being tariffs have come down drastically thus opening up markets for trade. Under the WTO there are several agreements of which the Agreement on Sanitary and Phytosanitary measures (SPS) is the one applicable to IAS. SPS sets out the basic rules to ensure food, plant and animal safety and prevention of entry of unwarranted species through trade.

Regulations under the purview of the WTO-SPS Agreement include:

- the protection of animal or plant life or health within a territory from risks arising from the entry, establishment, or spread of pest, disease, disease-carrying organisms, or disease-causing organisms.
- the protection of human or animal life or health within a territory from risks arising from additives, contaminants, toxins, or disease-causing organisms in foods, beverages, or feedstuffs.
- the protection of human life or health within a territory from risks arising from diseases carried by animals, plants, or products thereof, or from entry, establishment, or spread of pests.
- the prevention or reduction of the risks of other damages within a territory from the entry, establishment, or spread of pests

SPS allows countries to set their own standards supported by risk assessment and scientific evidence. Since WTO is mainly intended for trade promotion, it insists that SPS standards should be applied only to the extent necessary to protect human, animal or plant life or health and must not become a trade barrier or create any discrimination between nations.

Member countries are encouraged to use international standards, guidelines and recommendations where they exist. When they do, they are unlikely to be challenged legally in a WTO dispute. However, members can set higher standards based on appropriate assessment of risks so long as the approach is consistent, not arbitrary. And they can to some extent apply the "precautionary principle", a kind of "safety first" approach to deal with scientific uncertainty. The disputes raised by Philippines regarding importation of fresh pineapple into Australia and by Canada on import of salmon into Australia are some of the relevant cases. A case on the alleged EC moratorium on biotech products has also been considered by the WTO Appellate Body.

## L - 13 Role of resource conservation technologies in weed management

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Conservation Agriculture (CA) based resource conservation technologies (RCTs) can play an important role in reducing the cultivation cost, improving soil carbon build up and reducing the water runoff and soil erosion besides improving the irrigation water productivity, input use efficiency, resource base and environment. CA has steadily increased worldwide to cover about 7% of the world arable land (108 m ha). In North west India including Haryana, research and extension efforts are focused on the evaluation and accelerated adoption of many CA based RCTs like zero tillage and long-term zero-tillage in different crops and cropping systems, double no-till and even triple no-till (no cultivation in three crops in sequence in a year), direct seeding and mechanical transplanting of rice, LCC, laser leveling, surface seeding, stale bed technique, infusion of moong bean between rice and wheat, green/brown manuring, relay cropping of moong bean in wheat and wheat in cotton, sugarcane based intercropping and crop diversification through bed planting, dual purpose wheat and barley, herbicide resistance management, improved spray techniques, residue management, controlled traffic, cover crops, seed priming, genotype suitability, grain quality improvement, machinery up- gradation and refinement etc. Most of the aforesaid RCTs are catching interest of growers in one or other part of NW India. Herbicide resistance in *Phalaris minor* is still perceived as most serious issue by wheat growers and this had actually triggered the interest of growers to consider adoption of many emerging RCTs. Instead of opting for any new cultural practices, most of the farmers still depend on herbicides for which the choice is now limited. Early sowing of wheat combined with zero tillage technology has been well accepted by farmers. In Haryana, 11 to 14 years long- term zero-tillage in different cropping systems (rice-wheat, pearl millet-wheat and sorghum-wheat) revealed that the grain yield of wheat under zero-tillage stayed = the conventional method due to earlier/ timely planting, fewer weeds, better plant stand and improved fertilizer efficiency.

ZT helps reduce 30-40 % emergence of *Phalaris minor* in wheat and continuous adoption of this technology has provided an opportunity to skip off herbicidal application at least once after 3-4 years at few locations. Avoiding stubble/straw burning and by opting improved herbicide application practice (alternate herbicides, herbicide rotation, improved spray techniques) could reduce pressure of weeds in different crops. Rice and wheat residues (7-8 t/ha) when burnt instantly generate as much as 13 tons of $CO_2$ /ha, contaminating the air, depriving soils of organic matter, and constraining supplies of fodder for livestock. About 400 million tones of crop residues are produced annually in India, and if it is somehow managed properly preferably *in situ* (mulching on soil surface) by using second generation machinery (Happy/Turbo seeder), can significantly reduce weed infestation besides improving soil health. The bed planting can be used to improve the water productivity, as well as introducing intercropping and diversification (as done very successfully in sugarcane based cropping systems) and non-chemical weed control. After laser leveling, it has been reported that yield remains same or is enhanced from 10 to 25 %, water saving by 10-15 %, a significant reduction in weeds (40%) and labour requirement for weeding (75%) and an increase in the cultivable area by 5 to 7%. Proper land leveling is a pre-requisite for the success of various RCTs particularly bed planting and direct seeded rice. Direct seeded rice (DSR) being cost effective, more water-efficient, less labor-intensive and eco-friendly is also being advocated for accelerated adoption in NW India particularly in Haryana and Punjab. However, weed pressure particularly of aerobic grassy weeds like *Leptochloa chinensis, Eragrostis tenella* and *Dactyloctenium aegyptium* along with other grassy and broadleaf weeds, and sedges remains more in DSR than transplanted rice. But, suitable herbicidal combinations integrated with other methods of weed management are now available to tackle the well realized and complex problem of weeds in DSR. Mechanical transplanting of rice in unpuddled and no-till situations has also been recommended in Haryana as an alternate to manual puddle-transplanting. Green/brown manuring, cover crops, relay crops and competitive genotypes may also be integrated while formulating effective weed management strategies. The paper will include current status of different RCTs, their multifarious impacts and future implications with special reference to their role in weed management.

**L - 14**

# Major weeds and their management in Punjab

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Punjab is an agrarian state. Rice-wheat cropping system dominates the state agriculture followed by cotton-wheat, maize- wheat and sugarcane-wheat cropping systems. Out of total cropped area of 7.9 million ha, wheat and rice account for 44.5 and 35.4%, respectively; the corresponding figure is 6.2% for cotton, 1.7% for maize, 1% for sugarcane, 0.7% for pulses and 0.6% for oilseeds. As 97% of the state cropping area is irrigated, weeds emerge at higher densities and pose major competition with the crop plants and 20-25% losses in economic yields are quite common. The development of irrigation facilities in Punjab have resulted in weed flora shifts in wheat fields from *Carthamus oxycantha, Asphodelus tenuifolius* and *Avena ludoviciana* to *Phalaris minor, Rumex dentatus, Medicago denticulata, Rumex spinosus Chenopodium album, Polypogon monspeliensis* and *Malva neglecta*. *P. minor* dominates in rice-wheat while *A ludoviciana* still a dominant grass weed in non rice-wheat cropping areas; *Coronopus didymus* and *Poa annua are* on the increase under high soil moisture conditions. *P. minor* evolved resistance to isoproturon in early 1990s due to continuous use of this herbicide for more than 15 years. Post application of fenoxaprop, clodinafop and sulfosulfuron effectively controlled resistant *P. minor*; which was showing cross resistance to these herbicides with their continuous use for more than 5 years. Combination of cultural practices viz alternate crop rotations, early sowing in narrow rows, high seed rate and quick growing varieties sufficiently reduce the intensity and growth of *P. minor*. Pre-em trifluralin and pendimethalin effectively control resistant *P minor* and some broadleaf weeds; post application of mesosulfuron + iodosulfuron and pinoxaden provide effective control of resistant *P. minor* and *A ludoviciana*. Post application of 2,4-D, metsulfuron and carfentrazone effectively control major broadleaf weeds like *R. dentatus, C. album, M denticulata and C didymus;* metsulfuron control hardy weed *R spinosus* and carfentrazone control *Malva neglecta,* in addition to other broadleaf weeds. Isoproturon and mesosulfuron+iodosulfuron provide effective control of *P. annua, A ludoviciana* and many of broadleaf weeds. In rapeseed and mustards, having similar weed flora to wheat, pre-plant trifluralin and fluchloralin alone or followed by one hoeing are effective. Change in tillage practices due to rice cultivation shifted weed flora from typical summer annual to water loving weeds like *E crusgalli, P. colonum, Paspalum distichon, Alternanthera* sp*, Cyperus iria, C. difformis, Ischaemum rugosum* and semi aquatic and few aquatic weeds such as *Leptochloa chinensis, Ammania baccifera, Caesulia axillaris* and *Sphenochlea zeylanica*. Pre emergence application of butachlor, oxadiargyl, pyrazosulfuron, pendimethalin and post application of bispyribac effectively control annual grasses; post application of metsulfuron, ethoxysulfuron, bensulfuron, azimsulfuron control broadleaf and sedges in transplanted rice.

In other *Kharif* season crops like cotton, maize, sugarcane, greengram, blackgram soybean, turmeric and summer season forages, *D aegyptiacum, T portulacustrum, D arvensis, C rotundus, D ciliaris, Eragrostis* sp.*, P. colonum, S halepense , Ipomoea* sp dominates weed flora; *Brachiaria reptans, Acrachne racemose* and *Commelina benghalensis* are replacing above weed sp in maize and sugarcane as they are tolerant to field rates of atrazine. In cotton, sequential application of pre-plant trifluralin/pre-em pendimethalin and protected post application of gramaxone/glyphosate or one to two hoeing is effective. In maize and sugarcane, pre-em atrazine is effective against annual grasses and broadleaves while post application of 2,4-D amine manages *Cyperus* sp and *Ipomoea* sp; pre-em metribuzin/diuron in sugarcane and tank mix application of atrazine with either of trifluralin/alachlor in maize effectively controls annual weeds including hardy grasses like *Brachiara, Acrachne* and *Commelina*. Pre-em application of pendimethalin is recommended in greengram, blackgram and soybean, however, follow up post-application of imazethapyr is required for control of *Cyperus* sp and hardy grasses like *Commelina* sp not controlled by pendimethalin. In turmeric, integrated use of pre-em pendimethalin/ metribuzin/atrazine with paddy straw mulch provide long term control of mixed weed flora.

# L - 15 Current status of aquatic weeds in India and management strategies

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Weeds growing in aquatic habitat and completing their life cycle in water are called aquatic weeds. They cause harm to aquatic environment directly and to related eco-environment indirectly. India possesses 28% of irrigated areas and has problems of aquatic weeds. Water is one of the most important natural resources required by all life forms of this world. Aquatic weeds multiply very fast and cover the water bodies posing various problems – interfere with the use of water bodies in terms of navigation, fishing, domestic and industrial water supplies, livestock, irrigation, transportation, communication, sports, recreation, tourism, pollute water bodies, block water-intake points and water flow in irrigation channels, affect other useful plants, health related problems to human beings, lowers bio-diversity, etc.

Aquatic weeds are classified as free floating weeds, emergent weeds/ditch bank weeds, rooted weeds with floating leaves, submersed weeds, algae, etc.

Emergent weeds grow in shallow waters, situations existing near to water bodies, swampy areas – banks of canals, rivers, periphery of water bodies of earthen dams or partly masonry dams, drainage ditches and water ponds near villages, etc. They include *Typha angustata, Phragmites communis, Ipomoea carnea, Alternanthera philoxeroides, Ipomoea aquatic, Jussiaea repens*, *Marselia quadrifoliata*, etc. Algae are the most common group of weeds in aquaculture ponds, may be plankton algae (produce dissolved oxygen in the water during sunlight), filamentous algae (pond moss) and stone warts (*Chara* spp and *Nitella* spp). The major floating weeds are *Eichhornia crassipes*, *Salvinia molesta, Pistia stratiotes, Lemna minor, Saggitaria guayanensis, Ipomoea hederacea, Nelumbo nucifera* and *Nymphaea alba.* The major submerged weeds are *Hydrilla verticillata, Potamogeton* spp and *Vallisnaria spiralis.* The aquatic weeds (emergent, floating and submersed) interferes with the static and flow water system in different parts of India.

Therefore, considering the losses caused by aquatic weeds, it is essential to keep aquatic weeds under control in various situations of aquatic systems to save precious water from evapo-transpiration, maintain quality of water and biodiversity, and make best use of water bodies for profitability, efficiency and to improve socio-economic conditions of our country.

Management practices include prevention, physical and mechanical methods, herbicides and biological control. Preventive measures such as proper pond construction and maintenance will help to maintain ponds weed free. Effort should be made to contain the weed completely in the initial stages of introduction in the water course itself by forming water users' association. Use of manual labour for all types of aquatic weeds is effective, costly tedious, many times impracticable. A large number of machines - floating as well operating from the banks are available for mechanical removal of aquatic weeds - emergent weeds particularly cattails and some submerged weeds. The operation is costly and maintenance of machinery exclusively for weed control is difficult, unless government machinery is involved in such maintenance. Weeds cut down or harvested by the machinery have to be removed from the aquatic body to prevent eutrophication process in water bodies. Herbicides are cheaper, effective and rapid control of aquatic weeds (floating, emergent/ditch-bank) in specific situations of water – not meant for drinking, fish production and irrigation. Herbicides affect ecology of aquatic weeds due to direct effect on target and non-target organisms. Biological control – includes triploid white amur – grass carp (consume ten times the quantity of weed biomass of submerged weeds); and host-specific insects - *Neochetina eichhorniae* and *N. bruchi* (*Eichhornia crassipes* good success in some places, limited success in others) and *Cyrtobagus salviniae* (Salvinia molesta – great success in Kerala). There is need to evaluate pathogens to manage these weeds, apart from expanding the biological control to other weeds and making campaign to create awareness among water users for the periodical management by themselves.

**L - 16**

# Major weeds and their management in Uttarakhand

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Uttarakhand represents a unique geographical area where altitude ranges from 200 m to up to more than 2400 m above MSL. The soil, climate and rainfall offer greatly from place to place. The climate varies from sub-tropical to temperate, where the annual rainfall ranges from 1200-2500 mm and temperature varies from less than freezing point in higher hills to more than 40$^0$C in the plains. The mountain peaks are snow covered during winters while the higher peaks in the cold zones are perpetually under snow.In terms of agro-climatic conditions, the state has got plains of Haridwar, *Tarai* region represented by Udham Singh Nagar and some "*Bhabar*" areas of Nainital, Dehradun and Champawat districts. The remaining part represents the hill region.

In the plains, particularly in the *Tarai* and *Bhabar* region, the climate and highly productive soils favour luxuriant growth of many weed species. During rainy season, annual grasses like *Echinochloa colona*, *E.crus-galli*, *Eleusine indica*, *Brachiaria ramosa*, *Dactyloctenium aegyptium*, *Paspalum distichum, Digitaria* spp. and perennial grasses like *Sorghum halepense*, *Phragmites karka, P. comunis* and *Cynodon dactylon* are the major weeds in crops like maize, soybean, rice, sugarcane, kharif pulses and vegetable crops. Sedges like *Cyperus rotundus*, *C. iria*, *C. difformis*, *Scirpus* spp. and *Fimbristylis milliacea* are very common in the rice fields. Among non-grasses, *Trianthema monogyna*, *Celosia argentea*, *Commelina benghalensis, Commelina diffussa*, *Cleome viscosa*, *Caesulia axillaris, Cynotis axillaris, Eclipta alba, Euphorbia hirta, Lindernia spp., Ludwigia* spp., *Sphenoclea zeylanica, Alternanthera sessilis* are common during rainy season. *Ischaemum rugosum, Eragrostis japonica* and *Leptochloa chinensis* are becoming serious problem in the rice crop. Several species of *Ipomoea* have become serious problem in the sugarcane fields. Density of *Trianthema monogyna* is on continuous increase in almost all upland crops grown during rainy, spring and summer seasons.

During winter season, the major weeds in crop fields are *Phalaris minor, Avena ludoviciana, Chenopodium album*, *Melilotus alba*, *M. indica*, *Medicago denticulata*, *Fumaria parviflora*, *Vicia sativa*, *Anagalis arvensis* and *Lathyrus aphaca*, at some places, *Polypogon monspeliensis*, *Poa annua*, *Lolium temulentum, Cirsium arvense* and *Convolvulus arvensis* are also found infesting *Rabi* crops. Due to continuous use of isoproturon and 2,4-D in wheat, the weeds *Lathyrus aphaca*, *Melilotus indica, Rumex* spp. *a*nd *Medicago denticulata*, which are normally not controlled by these herbicides, are increasing. In wastelands and road-sides, the problem of *Parthenium hysterophorus* and *Lantana camera* are very common. In orchards, gardens and lawns, *Imperata cylindrica* has been found to be the most problematic weed.

In hilly regions, *Oxalis latifolia* is the most common and problematic weed in almost all kharif crops. In addition to that *Galinsoga parviflora, Ranunculus arvensis, Fumaria parviflora*, *Vicia sativa, Medicago denticulata, M. indica* are also found infesting the crop lands.

Negligence towards weed management is one of the most important factors responsible for low productivity of crops, as the losses due to weeds ranges from 10- 90% under different agro-climatic conditions of Uttarakhand. The reduction in crop yield due to weeds depends upon crop cultivar, weed species & density, cropping system, plant spacing, fertility and moisture status of the soil, climate as well as environmental conditions. In Uttarakhand, except Udham Singh Nagar, Haridwar and plains of Dehradun and Nainital districts, the crops are mostly grown in rainfed areas where soil moisture and nutrients are the most limiting factors and weeds compete for these major resources very much. Adoption of appropriate weed management options would improve crop productivity in different crops and cropping system of the state.

# L - 17 Emerging weed problems and their effects on crop production under changing climatic situation

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Climate change poses several challenges for managing weeds. Climate change means more extreme weather events, greater stresses on native species and ecosystems, and climate-driven activities. When native vegetation is stressed or destroyed by droughts, fires, floods or severe storms, weeds gain new opportunities to replace native species. In particular, climate change could cause dramatic shifts in species' distributions, and species' extinctions, particularly across fragmented or vulnerable ecosystems. Globally, there is a growing list of recent changes in species' distributions, abundances and lifecycles that are highly likely to be due to climate change.

Any change in crop/weed interactions which might result from global climatic change could be important in terms of crop production, economics and sustainability. Changes in temperature, precipitation and increasing [$CO_2$] all have potentially important consequences for crop/weed interactions, which is evident from a consideration of the basic biology of weeds and crops. Changes in the weed growth and phenology, weed seed bank dynamics, competitiveness, invasive potential etc. are predicted to be influenced by the climate change.

Any direct or indirect impacts from a changing climate will have a significant effect on chemical management. Changes in temperature, wind speed, soil moisture and atmospheric humidity can influence the effectiveness of applications. For example, drought can result in thicker cuticle development or increased leaf pubescence, with subsequent reductions in herbicide entry into the leaf. These same variables can also interfere with crop growth and recovery following pesticide application. There are number of studies that demonstrate a decline in chemical efficacy with rising $CO_2$.

Biological control of weeds by natural or manipulated means is likely to be affected by increasing atmospheric $CO_2$ and climatic change. Climate as well as $CO_2$ could alter the efficacy of weed bio-control agents by potentially altering the development, morphology and reproduction of the target pest. Direct effects of $CO_2$ would also be related to changes in the ratio of C:N and alterations in the feeding habits and growth rate of herbivores. The, synchrony between development and reproduction of bio-control agents and their selected targets is unlikely to be maintained in periods of rapid climatic change or climatic extremes.

There are invasive plants in waiting to colonise the spaces left bare by drought, fire and storm damage, wind and flooding. In many cases the impacts of invasive species benefiting from climate change are likely to exceed the direct impacts of climate change.

**L - 18**

# Major Weeds and their management in Bihar

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Bihar is proved to be a leading state of eastern zone for bringing second green revolution. Among the major factors contributing to the low productivity in the state weed management is identified as most important. Yield losses due to weed is a major constraints which may be minimized through participatory research and extension approach among farmers, extension workers and weed scientist.The losses incurred due to weed in different crops are to the tune of 23 to 37% in rice, 17 to 40% in wheat, 12 to 28% in maize, 16 to 23% in sugarcane, 19 to 45% in *Kharif* pulses, 13 to 33% in *rabi* pulses, and 21 to 38% in mustard. *Oryza rufipogon*, *Echinochloa* sp., *Dactyloctenium aegyptium, Cyperus deformis, Cyperus irria, Cyperus rotundus, Eclipta alba; Caesulia axillaries, Monochoria vaginalis, Echornea crassipes* and *Commelina diffusa* are major weeds in rice field. *Phalaris minor, Cannabis sativa, Avena fatua, Chenopodium album, Cirsium arvense, Melilotus alba, Physalis minima, Melilotus indica, Cyperus rotundus, Cynodon dactylon, Launea pinnatifida* etc. are major weeds of wheat crop. *Avena fatua, Setaria faberii, Phalaris minor, Cyperus rotundus, Physalis minima, Launea pinnatifida, Chenopodium album, Cannabis sativa, Circium arvense,* etc. are major weeds in maize. *Cynodon dactylon, Phalaris minor, Chenopodium album, Cirsium arvense, Convolvulus arvensis. Amaranthus spinosus, Caesulia axillaris, Ipomoea aquatic, Saccharum spontaneum, Solanum nigrum, Physalis minima, Striga* etc. are the major weeds in sugarcane. *Vicia sativa, Xanthium strumarium, Vicia hirsuta, Parthenium hysterophorus, Solanum nigrum, Phaseolus minima, Argemon maxicana, Cirsium arvense, Oxalis corniculata, Melilotus indica, Leucas aspera, Chenopodium album, Cannabis sativa, Lathyrus sativa, Trianthema monogina, Lathyrus aphaca, Cyperus rotundus, Cynodon dactylon etc.* are major weeds of pulses (gram, lentil, pea, green gram, black gram, arhar). *Argemone maxicana, Cirsium arvense, Chenopodium album, Cannabis sativa, Phalaris minor, Avena fatua, Physalis minima, Lathyrus aphaca, Cyperus rotundus, Cynodon dactylon,* are major weeds of mustard. Management of weed in major field crops. Khurpee weeding, harrowing by deshi plough, use of spade in wider row crop are the common practice which have been used by the farmers of Bihar. But now a days all these practice became difficult and costlier due to scarcity of labourer. Some useful mechanical instruments *i.e.,* "hand hoe,wheel-hoe,rotory-hoe,cono-weeder and power weeder are found to be very effective and economical to control weeds of all line sown crops.Using crop geometry like criss-cross sowing of wheat, paired-row planting in sugarcane, double row planting of rice and wheat on bed,and cultivation of wheat, mustard, lentil, chickpea and linseed, by using zero tillage maching are another effective methods for minimizing the weed population and their growth. Use of herbicides are becoming most popular among farmers for controlling weeds in different crops. Pre-emergence application of Pretilachlor 0.5 kg/ha was found most effective to control complete weed flora under transplanted rice. Post emergence application of Bispyribac sodium 30 g/ha was found very effective to control, most of the sedges and grassy weeds of DSR, planted rice as well as in nursery of rice. In case of broad leaved weeds application of 2,4-D, sodium salt 500 g/ha as a POE is found very effective and also enhance the yield of rice. Most of the weeds in the field of wheat is very effectively controlled by using sulphosulphuron 25 g/ha at 28-30 DAS. POE application of 2, 4-D sodium salt or Amino salt 500-600 g/ha is effective to control all broad leaved weeds in wheat crop except *Physalis minima*. PE application of metribuzine 500 g/ha is effectively used for controlling weeds in most remunerative cropping system of Bihar i.e. maize + potato. PE application of atrazine 1.5-2.0 kg/ha + POE application of 2,4-D, Sodium salt/amino salt *fb* earthing up at 80 DAS are able to control all types of weeds in sugarcane. PE application of pendimethaline 1 kg/ha effectively control weeds in the field of most of pulses crops *i.e.,* chickpea, pea, lentil, green gram and black gram. POE application Imazethpyr 50 g/ha is found effective for suppresing of weeds in the field of pigeon pea and soybean. PE application of isoproturon 1000 g/ha is effectively control all type of weeds in the field of mustard crop. PE application of Oxadiazon 800 g/ha is effectively control all type of weeds in the field of sunflower.

# L - 19 Weed management in zero tillage in India : current scenario and prospectus

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The green revolution boosted the productivity of rice–wheat systems through the introduction of high-yielding varieties and complementary technologies like irrigation and fertilizer in a supportive policy environment. Recent studies however indicate a slowdown in productivity. Zero tillage farming (also called No-till or direct planting or pasture cropping) is a way of growing crops from year to year without disturbing the soil through tillage. No-till is an agricultural technique which increases the amount of water and organic matter (nutrients) in the soil and decreases erosion. The residues from the previous crops will remain largely undisturbed at the soil surface as mulch. It increases the amount and variety of life in and on the soil but may require herbicide usage. The invention of the herbicide Paraquat in 1955 in the United Kingdom was the start of modern no- tillage development in Europe and also world-wide.

Recent studies indicate a slow down in the productivity of growth in the rice-wheat system in India, delayed sowing and weeds are the main constraint out of others. In general, season long competition from major weeds culminates in yield reduction. In this context, one of the most serious incidences is the one associated with isoproturon-resistant grass, *Phalaris minor*. Application of paraquat (two days before sowing) + isoproturon+2, 4-D and two hand weeding resulted highest weed control efficiency and net profit. At GBPUAT, Pantnagar higher weed density and population of *Phalaris minor* in conventional tillage was recorded than zero tillage. Pre-sowing paraquat application had marked effect on weed growth in zero tillage. Maximum reduction in weed density was obtained with the application of 2,4–D and isoproturon as mixture under ZT and CT system. Higher average grain yield was achieved under zero tillage wheat with pre-sowing paraquat (500 g/ha) application and post-emergence isoproturon (1000 g/ha) or mixed application of 2, 4–D and Isoproturon (500 g+ I000 g/ha). Yield achieved in zero tillage without any herbicide application was comparable to conventional tillage with application of Isoproturon.

High input use without any significant yield gains and without compensating in the form of increased price of wheat have drained farmers of cash and squeezed them into financial difficulties. Zero tillage, therefore, can help farmers to pay for new herbicides. The demand for zero tillage is driven not only because it assists in better weed control but also it will replace the lengthy procedure of wheat sowing. The success of zero tillage technology will greatly improve the chances of increasing cropping intensity.

**L - 20**

# Major weeds of Karnataka and their management

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Karnataka state has diverse agro-ecological regions comprising different crops and cropping systems in ten characterized agro-climatic zones with a vast stretch from dry lands to coastal lands. Accordingly, the diversity in weed flora is also seen across the state. In the present day Karnataka agriculture, weeds are posing a major threat to crop production and productivity. Now farmers have realized that weeds are the major pests compared to insects and pathogens. There has been a great shift in the weed management practices adopted by farmers in view of labour scarcity as well as increased costs. In addition to this, moisture budget in the soil is a deciding factor for increasing the crop productivity. In the present uncertainty of changing climate with special reference to rainfall, it is inevitable to conserve water and nutrients in soil for use by crops and cropping systems by effective control of weeds during the critical growth period of crops.

The existing popular cropping systems in Karnataka are - pigeonpea based system with greengram, blackgram, sesamum, sorghum as intercrops in NE transition zone (zone-1). Frequent intercultivation in these systems becomes difficult and the farmers have to depend on chemical weed management. While in North Eastern Dry Zone (zone-2), sole pigeonpea dominates the scene. Northern Dry Zone (zone-3) has majorly maize, sugarcane, paddy and *Rabi* sorghum. In Central Dry Zone (zone-4) groundnut and horsegram, coconut – based cropping system are prominent. In Eastern Dry Zone (zone-5), pulses, finger millet, forage crops, mulberry, sunflower, horticultural crops are the major crops., Southern Dry Zone (zone-6) has sugarcane, rice, ragi and maize, hybrid rice, horticulture; In Southern Transition Zone (zone- 7) tobacco, rice (canal irrigated, tankfed, drill sown) and rainfed cotton, banana and irrigated cropping systems. In Northern Transition (zone-8), the dominant crops are cotton, maize, soybean, sugarcane, chickpea, rabi sorghum, wheat. In Hilly Zone (zone-9) paddy cardamom, pepper, arecanut, multiple cropping systems in plantation crops, vegetables, floriculture, rice-based cropping systems, chilli are important. Coastal Zone (zone-10) has paddy-based cropping systems and horticulture. These zones have a wider diversity of weed flora owing to their specificity in a given cropping situation.

The community of dominant weed flora across different agro-climatic zones are *Parthenium hysterophorus*, *Alternanthera sessilis*, *Trianthema portulacastrum, Digera arvensis, Portulaca oleracea, Commelina benghalensis, Cyanotis* spp*, Digitaria sanguinalis, Dinebra retroflexa*, *Panicum isachne*, *Eleusine indica*, *Celosia argentea* among annuals and *Cynodon dactylon, Cyperus rotundus* among perennials. Farmers have been adopting management strategies to control these weeds.

This paper addresses these issues in general, and in relation to trials and extensive surveys conducted in farmers' fields in all the agro-climatic zones, success stories of farmers in the jurisdiction of UAS Dharwad with additional support drawn from other ecosystems wherever prime examples are available. In the past, the attention was paid towards single weed management strategy, while the current strategy focuses on integrated approach due to availability of a wide range of eco-friendly herbicide molecules. This paper emphasizes the viable weed management strategies in these crops in general for the benefit of farmers.

# L - 21 Parasitic weeds problem and their management in India

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Parasitic weeds are becoming major constraints to many crops in tropical agriculture and the efficacy of available means to control them is minimal. True plant parasites can be hemi-parasitic (semi-parasitic) with photosynthetic leaves (such as witch weed and loranthus), or holo-parasitic and completely dependent on their host (such as dodder and broomrape). It is apparent from the reviews that parasitic weeds often have a significant detrimental effect on their hosts due to direct removal of resources from them. Unlike other weeds, parasitic weeds remove nutrients and extract water from the host plant causing heavy losses to agricultural crops. The adverse effect of these parasitic weeds has been so devastating; the crop yield losses of 10 to 100 per cent have been recorded, which leads to complete crop failure and sometimes abandonment of land.

In India, dodder (*Cuscuta* spp.) poses a serious problem in oilseeds (niger, linseed) and pulses (blackgram, greengram and lentil especially in rice-fallows) and fodder crops (lucerne, berseem) in the states of Andhra Pradesh, Chhattisgarh, Gujarat, Orissa, West Bengal and parts of Madhya Pradesh under rainfed as well as in irrigated conditions. Of the 12 species reported from India, *C. campestris* is the most common. Dodder infestations can weaken the host plant, making it susceptible to other pests and diseases, and may eventually kill its host. Witch weed (*Striga* spp.) is a major weedy pests throughout semi-arid sub-Saharan Africa and parts of Asia on crops like sorghum, sugarcane, maize, pearl millet, dry land rice etc. Resource-poor, small-scale, subsistence farmers are severely affected with *Striga* infestation. Of the 4 important *Striga* species in Asia, *Striga asiatica* (*S. lutea*) is common in India. Broomrape (*Orobanche* spp.) parasitizes various dicotyledonous host plants of family fabaceae, solanaceae, Asteraceae, etc. In India, *O. cernua* and *O. aegyptiaca* are major parasite in tobacco in parts of Karnataka, Andhra Pradesh, Tamil Nadu, Gujarat, mustard in Rajasthan, Haryana, parts of Gujarat, Madhya Pradesh (MP), and Uttar Pradesh, and in vegetables such as brinjal, tomato, potato, etc. and causing significant damage. *Loranthus* is a common parasite on subtropical trees. The plant bears beautiful orange or scarlet flowers in dense, one-sided up curved axillary clusters. In India a wide range of species occur, of which *Dendrophthoe falcata* is perhaps the more common, damaging many fruit, ornamental and forest tree species. The weed occurs on the terminal growing point resulting in stunted growth of the tree, which affects timber value considerably.

The management strategies have largely focused on agronomic practices, the use of resistant/tolerant cultivars and the use of herbicides with marginal success. There is, thus, an urgent need to re-evaluate the control methods in the light of recent developments in herbicide molecules, crop breeding and molecular genetics and to place these within a framework that is compatible with current agronomic practices. Emphasis should be given to understand the interaction between parasitic plants and their hosts in order to implement sustainable means of control. Interdisciplinary research is required to develop effective integrated management strategy for parasitic weeds.

# L - 22 Major weeds and their management in Himachal Pradesh

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Agriculture is the main occupation of the people in the state. It provides employment to more than 76 per cent of the total population. Due to fragmented and small landholdings, the small and marginal farmers predominate in the peasantry sector. Most of the farmers still practicing subsistence farming where he tries to produce everything he needs. The cereals like wheat, maize, rice and barley occupy the major proportion of cultivated land. Maize in *kharif* and wheat in *rabi* are the two important crops in the state. The other important crops of the state include pulses (mash, Rajmash, gram, peas, lentil, kulth, cowpea), oil-seeds (sesame, brassicas, linseed), potato and sugarcane. Cultivated fodder crops do not occupy sizeable area and the state depends on natural grasslands and grazing lands for meeting the fodder requirement. Weeds have been considered enemies of the farmers from the dawn of agriculture. Depending upon their diversity and intensity they cause severe losses in the productivity of field, orchard, vegetable crops and grasslands. Weed problems vary from crop to crop, farm to farm and from region to region and the weed spectrum also varies with the soil types and agro-climatic conditions. *Echinochloa colonum*, *E. crusgalli*, *Setaria glauca, Cyperus* spp. *Digitaria sanguinalis* and *Eleusine indica* grow extensively during *kharif* throughout the state, excepting high hills and dry Zone. Among broad-leaved weeds *Polygonum* sp. and *Ageratum conyzoides* dominate in warm mountaneous regions of Kangra, Mandi, Una, Hamirpur, Sirmour, Solan and Bilaspur districts. *Commelina benghalensis, Brachiaria ramosa* and *Gallinsoga parviflora* have been found dominating in low and mid-hill areas of the state. *Digitaria sanguinalis* and *Amaranthus viridis* predominate specifically in low hills. *Echinochloa* sp., *Cyperus* sp., *Panicum dichotomiflorum* and *Eleusine indica* cause severe infestation in rice fields in low lands as well as uplands.

The important weeds of high hills temperate zone and cold temperate zone are *Amaranthus* spp., *Chenopodium* sp., *Malva* sp., *Conyza stricta, Portulaca oleracea, Digitaria sanguinalis* and *Equisetum typhoides. Medicago denticulata, Ranunculus arvensis, Stellaria media, Anagallis arvensis, Melilotus alba, Silene conidia, Coronopus didymus, Lathyrus aphaca, Euphorbia thymifolia, Vicia hirsuta* and *Vicia sativa* are the major broad-leaved weeds which grow in abundance during winter *(Rabi)* season almost in all parts of the state. These weeds severely infest wheat, barley, gram, lentil, sarson and linseed crops. Grassy weeds like *Phalaris minor*, *Avena ludoviciana, Poa annua* and *Lolium temulentum* are found in *Rabi* crops, however, their incidence is more where preceding crop in *Kharif* is rice. Besides, *Polypogon monsplensis, Alopecurus myosuriodes* and *Poa annua* are also found in *Rabi* crops of the state. Infestation of *Asphodelus tenuifolius, Chenopodium album* and *Fumaria parviflora* in *Rabi* crops is mainly confined to low hill subtropical zone. *Portulaca oleracea, Oxalis latifolia, Poa annua, Gnaphalium luteo-album* and *Gallinsoga parviflora* are the important weeds associated with vegetable crops. *Lantana camara, Parthenium hysterophorus, Chromolaena* sp., *Ageratum houstonianum, Saccharum* sp., *Bidens pilosa, Conyza stricta, Rubus* sp., *Bidens pilosa, Conyza stricta, Zizyphus rotundifolia, Erigeron Canadensis* and *Imperata cylindrical* are some of the important weeds of non-cropped areas, pastures and range lands in the state. *Oxalis* sp has low occurrence in crop fields but it is severe in orchards of low and mid-hills. *Paspalam dilatatum* and *Imperata cylindrical* also cause severe infestation in grasslands and pastures. *Ageratum* sp*, Imperata cylindrical* and *Saccharum spontaneum* are the dominant weeds in orchards almost all over the state. Other perennial weeds, *viz., Cynodon dactylon, Sorghum halepense,* are also found in orchards in different agro-climatic zones of the state. In tea orchards, which are confined to about 2000 hectares area in district Kangra and Mandi, the important weeds that pose serious problems for the growth and development of tea bushes are *Imperata cylindrica, Ageratum* spp, *Chromolaena adenophorum, Conyza stricta, Erigeron canadensis* and *Lantana camara.*

## L - 23 Herbicide residue in soil, water and commodities : Indian scenario

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Over the years herbicides have emerged as an important tool in the management of weeds. Herbicides represent a large chemistry with different modes of action to control variety of weeds. Due to intensive research in herbicide discovery and mode of action, many new molecules are available at g/ha level to cater the farmers need. In India, the herbicides market has grown many folds in the last two decades. Under excessive and repeated use herbicides may pose problems such as phytotoxicity to crop plants, residues in soil and crop produce, residual effects on susceptible inter-crops, succeeding crops, non-targeted organisms, health hazards due to accumulation of residues and ultimately ground water contamination through runoff and leaching. Thus data on residual toxicity of herbicides become indispensable for approving a herbicide for large scale commercial use, environment safety and human health.

The fate and behaviours of herbicides in soil is influenced by the biotic and abiotic process including adsorption, movement/leaching, decomposition etc. In general the residue problem of most of the herbicides is low, however risk of persistence of herbicides and their secondary metabolites in soil, crop produce and water, if any, can not be over looked. Most of the herbicides, specially more recently developed synthetic herbicides are quite selective for specific weeds and have low mammalian toxicity, however few less selective herbicides of the chlorates and dinitrophenols are more toxic to animals. Now herbicides residue analysis is also become an essential part of chemical weed control to provide meaningful residue data to see risk of contamination, if any by these chemicals under laboratory and field conditions. Sophisticated instruments and advance extraction technologies are being used to extract and identify parent or secondary metabolites in environmental samples.

The recognized persistence of several sulfonylureas, substituted ureas, uracil, s-triazines, the benzoic acid derivatives, picloram and other herbicides in soils has received detailed study in India and abroad. It is being recognized that some persistence is necessary property of all herbicides; with no persistence soil applied herbicide would not control weeds. Though sulfonylureas have less persistence in soil but few member of this class and their secondary metabolites were reported to persist longer in soil and affected succeeding crops. Other classes of herbicides which showed moderate to longer persistence in soil are imidazoline, dinitroanilines and triazines. Leaching of herbicides under lab and field conditions is well documented. Pretilachlor, codinafop-propargyl, metribuzin, atrazine etc were reported upto 40-90 cm depth under lab conditions in sandy loam and loamy sand soils, however triabenuron, and oxyfluorfen were reported to move more than 1-metre in soil profile under continuous rain in sandy loam soils. Dinitroanilines and imidazolines were found less mobile in sandy clay and loamy sand soils. In well water herbicide concentration of 2,4-D, atrazine , paraquat, diquat etc were reported between 0.5 to 800 µg/L. residues of most common used herbicides viz. butachlor, sulfosulfuron, imezathapyr, oxyfluorfen, isoproturon, fenoxaprop etc were found below MRL values. It has been found that under tropical, subtropical and high rainfall conditions herbicides rapidly degrade by chemical and biological process, and hence residues are generally not detected above the safe level at harvest in crop produce and soil and hence contamination due to herbicide can be considered as less.

# L - 24 Major weeds and their management in Jammu & Kashmir

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Jammu & Kashmir is India's northernmost state, lying between six mountain ranges and covering an area of 2,22,236 sq. kilometers. It is located between 32°17' and 36°58' North latitude, and between 37°26' and 80°30' East longitude. Weeds pose some of the serious threats to biological diversity. Among the various weed species some are of very offensive nature whether native or of exotic origin that erode the native biodiversity. Major weed species found in in J&K particularly are : **Cultivated fields**: Lowland rice- *Eichnochloa colonum/ crusgalli ;Fibristylis miliacea ;Ammania baccifera ;Cyperus iria/rotundus; Marsillia quadrifolia ;Potamogeton distinctus ;Salvinia auriculata;Lemma minor;* Upland crops- *Papaver dubium, Renunculus arvensis, Lolium temulentum, Bromus japonicas, Poa pratensis, Cynodon dactylon, Vulpia myuros, Polygonum tubulosum, Convolvulus arvensis* and *Galium aparine*.; *Trianthema monogyna; Portulaca oleracea; Ipomoea carnea/hispida ;Elusine indica ; Panicum repens; Sorghum halepense/nitidum ; Poa annua ;Setaria glauca; Amaranthus hybridus/graecizans; Euphorbia hirta/emodi;* **Tourist spots, fruit orchards and grass fields:** *Robus, Rosa, Rubia, Hedera* and *Spiraea Oxalis corniculatus, Tribulus terrestris ;Erodium cicutarium, Gallium aparine, Bellis perennis, Stellaria media, Anagallis arvensis, Eruca sativa, Convolvulus arvensis, Poa annua/pratensis, Bromus japonicus, Eragrostis spp. ; Malva rotundifolia; Setaria viridis* and *Phleum paniculatum.* During summer months *Lotus corniculatus, Melilotus alba;* species of *Trifolium, Lathyrus, Medicago, Sisymbrium, Erigeron, Astragalus; Geranium ocellatum/ pratense;Calamintha clinopodium; Nepeta cataria; Fragaria vesca; Thymus serpyllum; Rumex nepalensis* and *Taraxacum officinale* predominate these land pockets. **Waste lands**: *Ranunculus arvensis/ falcatum, Conium maculatum, Silene conoidea, Capsella bursapastoris, Cynoglossum denticulatum, Goldbachia laevigata, Polygonum tubulosum* and *Anagallis arvensis. Verbascum Thapsus, Cichorium intybus, Euphorbia helioscopia/thymifolia, Xanthium strumarium, Sisymbrium loeselii/Sophia, Bupleurum lanceolatum, Galinsoga parviflora, Utrica dioica, Marrubium vulgare, Cousinia microcarpa, Centaurea iberica, Digitaria marginata, Setaria verticillata* and *Eragrostis nigra, Cronopus didymus, Ttribulus terrestris* and species of *Oxalis, Herniaria, Geranium* and *Veronica.* **Water bodies:** Submerged weeds in lakes are *Potamogeton lucens/pectinatus/crispus, Hydrilla verticillata, Myriophyllum spicatum, Ceratophyllum demursum* and *Chara spp.* Free floating water ferns are *Salvinia natans* and *Lemna spp.* Towards the water margins a free floating herb *Nymphoides peltatum* with small lotus like leaves is predominant. Besides the side projections and shallow portions are full of tall reeds and cat-tails like that of *Phragmites cummunis* and *Typha angustata.* Some of the herbicidal management measures practised in the state are: **Rice:** *Chemical methods:* 1) Butachlor granules 5 G 30 kg/ha at 4-6 days after transplanting in standing water 2-3 cm deep and do not drain the field for one week. 2) anilophos + ethoxy sulfuron 0.375+0.015 kg/ha at 10 DAT. 3). 3 lt of butachlor 50 EC in 150 kg sand and broad cast in standing water within 2 DAT. **Maize:** *Chemical methods:* 1) Atrazine 1.0 kg/ha in 800-1000 liters of water should be soil applied just after sowing in sole maize crop; 2) For maize+pulse mixed cropping, apply pre-emergence pendimethalin 1.0 kg/ha or pre-plant incorporated fluchloralin0.75 kg/ha. Wheat: for broad spectrum weed control isoproturon0.75 kg + 2,4-D ethyl ester500 ml/ha may be sprayed with 500-600 lts of water at 30-35 days after sowing; 2) Metribuzin 200-250 g/ha should be sprayed at 30-35 DAS where isoproturon is not able to control *sitti*. **Rapeseed and Mustard:** Fluchloralin 0.70 kg\ha ppi, isoproturon 1.0 kg\ha pre-em, , pendimethalin 1.0 kg\ha pre-em. **Marigold:** 2 hand weedings at 20 and 40 days after transplanting or application of trifluralin 1.0 kg/ha pre plant incorporation (PPI)+1HW (46.2q/ha). Gladiolus: 2 hand weedings at 20 and 40 days after transplanting or application of pendimethalin 2 kg/ha +1HW. **Okra:** Fluchlorian 1.0 kg/ha PPI, alachlor 2.0 kg/ha pre emergence application (PRE), trifluralin 1.0 kg/ha PPI and oxyflorafen 0.35 kg/ha PRE along with 1-hand weeding.

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# Weed management in organic farming:challenges and prospects in India

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Organic farming is being practiced in more than 120 countries of the world. An estimated area of 0.65% of the total agricultural land is grown organically world over. It is gaining momentum in India owing to the concerns expressed on the safety of environment, soil, water and food chain. It is estimated that only about 0.3% of the total cultivated area in India is under organic farming, mostly in the states like Madhya Pradesh, Odisha, Maharashtra, Jammu & Kashmir, Rajasthan, Karnataka, West Bengal and Gujarat. Cultivating crops organically, and at the same time maintaining higher production levels is a big challenge. Since organic farming is different than natural farming, availability of organic resources for soil cultivation, manuring, plant protection etc. are also a limiting factor.

Herbicides, for weed management are seen as a better alternative in areas of labour scarcity. However, over-reliance on herbicides may lead to development of herbicide resistant weeds as seen in the case of isoproturon resistant *P. minor* in the Indo-gangetic plains. In any organic agriculture system, adopting cost effective weed management practices is a major issue for achieving sustainable production levels. Weed management in organic agriculture should simulate the principles of biological processes for desired suppression of weeds. Preventive weed management practices, higher plant population, manipulating crop geometry, stale-bed technique, competitive crop varieties, intercrops and cover crops, crop rotation can be followed in an integrated manner where ever feasible. Weeding through non-chemical means have to be undertaken within the critical period of the crop. More dependence on the use of efficient mechanical weeding tools is also advocated in organic agriculture.

Effective training and education mechanism needs to be developed for utilizing the multiple tactics of weed management in organic agriculture. Since organic produce sells at a premium price, the farmers, particularly in tribal areas may be educated for scientific weed management to be adopted under organic agriculture for higher income and upliftment of their socio-economic status.

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# Major weeds in field crops of Chhattisgarh and their management

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The Chhattisgarh with an average rainfall of 1250 mm, of which 85% occurs during June to September is mainly a rice growing and consuming area. During *kharif*, rice occupies an area of 3.52 m ha i.e. nearly 75% of the total cultivated area followed by urd ( 1.83 m ha), maize ( 1.71 m ha), pigeonpea ( 1.41 m ha), soybean ( 1.33 m ha) and miner millets, moong, groundnut, sesame, niger, vegetable *etc.* in rest of the area. While during *rabi* season, an area of 1.52 m ha is under different crops like lathyrus (0.35 m ha), chickpea ( 0.32 m ha), wheat ( 0.18 m ha), mustard ( 0.16 m ha) and rice, maize, field pea, lentil, moong, urd, linseed, safflower, sunflower, groundnut, sugarcane, vegetable etc. in rest of the area. During *kharif* season, major weed flora consists *of Echinochloa* spp., *Ischeamum rugosum, Dinebra retroflexa, Brachiaria ramosa* among grasses*, Cyperus iria, Cyperus difformis, Cyperus rotundus, Fimbrisyllis miliacea* among sedges and *Caesulia axillaries, Commelina benghalensis(monocot), Monochoria vegenalis, Eclipta alba, Alternanthera triandra etc.* among broad leaved under mid-lowland ecosystem*,* while under upland situations; *Echinochloa* spp*, Brachiaria ramosa, Dinebra retroflexa, Sporobolus diander* among grasses*, Cyperus iria, Cyperus difformis, Cyperus rotundus* among sedges and *Euphorbia geneculata, Alternanthera triandra, celocia argentia, Eclipta alba, Corchorus octavalia, Ludvigia parviflora etc.* among broad leaf weeds. Whereas, during *rabi* season, *Echinochloa colona, Brachiaria retroflexa, Cynodon dactylon etc.* among grasses and *Chenopodium album, Medicago denticulata, Melilotus alba, Alternanthera triandra, Rumex dentatus, Anagalis arvensis, Spilanthes acmella etc.* among broad leaf are the pre-dominant weeds of the region.

Up-till 2005, manual weeding was the main method of weed management in the state with a very meager area of 0.13 m ha through integration of herbicide plus manual weeding. Butachlor, pretilachlor, anilophos, Pendimethalin, trifluchloralin, atrazin and 2,4-D were the only herbicides in use for weed control in different crops. Moreover, rice, soybean and wheat were the only crops where these herbicides were generally used as pre and post emergence. The reasons behind this was (1) ample availability of agricultural labourers at a very cheap wages (2) Wider range of post-emergence herbicides was not available as is available today especially for rice, soybean, wheat *etc.* (3) Least technical know-how towards herbicide technology. However, 2005 onwards, speedy increase in urbanization, industrialization, education, employment opportunities in the state sharply reduced the availability of agricultural labourers at peak periods of agricultural activities as well as their increased wages forced the farming community to look for an effective, labour-less and economical alternative over existing manual weeding method. Fortunately, the need of farmers and time of launch of very effective post-emergence herbicides in the recent past coincided and have given an alternative of labour depended weeding in field crops. Presently, post-emergence application of new molecules like fenoxaprop-p-ethyl for the control of grasses in paddy, wheat, mustard, soybean *etc.,* Chlorimuron+metsulfuron, pyrazosulfuron, ethoxysulfuron for broad-leaved in paddy, bispyribac Na for mixed weed flora of rice, metsulfuron, sulfosulfuron, in wheat, Imazethapyr for mixed weed flora of soybean, moong, urd, groundnut etc. have attracted the farmers towards herbicide technology. This has resulted in a growth of 82 per in last 6-7 years as well as area under these herbicides has crossed 0.70 m hectares with a minimum monetary saving of Rs. 140.0 million by not employing costly manual labor for weeding only.

## L - 27 Weed shift in long term cropping system

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Adoption of a single method of weed management over a long period of time may cause weed shift especially when the given weed management practices do not control all kinds of weeds. In view of this, long term impact of various weed management strategies in crops and cropping systems has been reviewed. Tillage and cultivation are the traditional means of weed management in agriculture. Tillage depth and kind of implements used affects the establishment of weed flora in field. These factors considerably influence weed seed and propagule distribution over the soil profile and therefore they directly affect the number of weeds that can emerge in a field. Crop rotation is an effective weed management tool which prevents the proliferation of a particular kind of weed species.

Weed species vary in their response to fallow situation which is often included in many crop rotations to conserve moisture. Several factors may contribute to unfavourable shift in weed flora composition due to changes in cropping systems. Weed seed bank density and species composition is often get altered due to changes in cropping strategies. Although herbicides offer a better option to mechanical weeding, their indiscriminate use lead to concerns like weed shift, toxicity and residue problem, and adverse effect on soil microorganisms**.** Extreme narrow biological spectrum of the modern herbicides may contribute to significant changes in the agro-ecosystems. Climate change with global warming and increasing atmospheric carbon di-oxide are likely to influence the weed dynamics in different ecosystems. The growing menace from alien weeds is likely to intensify under such changes and in the context of increasing trade, globalization and liberalized economy.

An integrated approach comprising two or more tools or strategies has to be evolved for an efficient weed management system so that any kind of weed shift does not occur. Literature shows that use of IWM system approach has to be preferred as it considers all appropriate tools for effective weed management and prevention of weed flora shift. Some of the integrated approaches have been found to prevent weed flora shift on a long-term basis, whereas probably due to the effect of climate change and some other edaphic factors IWM favoured weed shift in few locations.

## L - 28 Major weed problems and their management in Madhya Pradesh with special reference to Gird zone

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In this review an attempt has been made to put forth the important research work carried out on weed management in Madhya Pradesh with special reference to Gird Zone during 25 years (1985-2010) of research. Survey of the weed in difficult crops and cropping systems in districts of Madhya Pradesh, testing of herbicides in different crops, crop weed competition yield loss studies methods of weed management and their recommendation has been covered in this article.

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# Major weeds and their management in Andhra Pradesh

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Andhra Pradesh is the fifth largest state in India accounting for 9 and 8 per cent of the countrys area and population, respectively. The state has three major river basins (Krishna, Godhavari and Pennar) that drains in to the Bay of Bengal and has 972 km long coastal line along its eastern border. Rice is the principal food crops cultivated throughout the state under irrigated ecosystem. In rainfed ecosystem groundnut, castor, pulses and cotton are the major crops. In peri urban areas vegetable cultivation is more fetching. Though there are many factors that contribute to yield reduction, maximum yield loss of 40-45% is caused by weeds only. The lowland ecosystem with rice was infested by terrestrial, semi aquatic or aquatic plants, the major weeds of rice ecosystem in A.P. were *Echinochloa colona, Echinochloa crusgall*i among grasses, *Cyperus difformis, Cyperus iria* among sedges, *Marselia quadrifoliata, Rotala densiflora, Eclipta alba, Monochoria vazinalis* and *Ammania baccifera* among broad leaves. In dry lands that constituted 65% of the cultivated area in A.P., diverse weed flora was reported. Predominant weeds are *Cyperus rotundus, Cynodon dactylon, Dinebra arabica, Rottoboelia exaltata, Celosia argentia, Commelina benghalensis, Euphorbia hirta, Digera arvensis, Legasca mollis,and Allamania nodiflora, Boerhaevia diffusa* were predominant weeds. Broad leaved weeds contributed major weed flora (81%) followed by grasses (7.9%) and sedges (7.9%). In orchards also, of the total weed flora, broadleaved weeds were dominant (66%) followed by grasses and sedges. Major weeds of rice can be managed by pre emergence application of butachlor ( 1.0 kg/ha) or benthiocarb ( 1.0 kg/ha) or anilophos 0.4 kg/ha or pretlachlor + safener ( 0.5kg/ha) or pyrazosulfuron ethyl 25g/ha oxadiargyl (60g/ha) along with one hand weeding at 40 DAP. Several other herbicides like bensulfuron methyl + pretilachlor (6.0GR) 10.0kg product /ha, metsulfuron methyl+ chlorimuron ethyl (4g/ha), bispyribac sodium (25g/ha), cyhalofop-p-butyl(100g/ha), fenoxaprop-p—ethyl (60g/ha), ethoxysulfuron, 2,4-D sodium salt are being recommended for selective weed control in Andhra Pradesh. In crops like maize, sorghum and pearlmillet, preemergence application of atrazine 0.5-1.0 kg/ha with one hand weeding or intercultivation at 35-40 was effective. In cotton, preemergence application of pendimethalin 1.0 kg/ha or alachlor 1.25 kg/ha followed by hand weeding or intercultivation or post emergence of pyrithiobac sodium + quizalofop ethyl 50 g/ha was very effective for weed management. In major pulse crops of Andhra Pradesh, preemergence application of pendimethalin 1.0 kg/ha or alachlor 1.25 kg/ha with one hand weeding or early post emergence application of imazethapyr 75g/ha gave efficient weed control. In rice fallow pulses where grasses were predominant, Fenoxaprop-p-ethyl 60 g/ha was effective for control of grasses especially *Echinochloa crusgalli*

In oilseed crops like groundnut, castor, sunflower, sesame and safflower pre emergence applicatioin of herbicides *viz.* pendimethalin 1.0 kg/ha pr oxyflourfen 0.2 kg/ha or alachlor 1.25 kg/ha supplemented with one manual weeding or intercultiation or post emergence application of quizalofop- p-ethyl 50 g/ha was proved to be the best weed control method. In vegetable crops, pre emergence application of pendimethalin 0.75 kg/ha or alachlor 1.0 kg/ha fb one hand weeding or post emergence application of quizalofop ethyl 50g/ha was found effective and vaiable weed control option. In sugarcane, pre emergence application of 2,4-D 1.0 kg/ha at 45-50 DAP gave efficient weed control.

Among the parasitic weeds, C*uscuta* infestation in pulses especially in rice fallows and lucerne, *Orobanche* spp. in tobacco, tomato, brinjal and carrot. Striga infestation in sugarcane are important. For excellent control of *Cyperus rotundus*, post emergence application 1.5 kg/ha +0.2% ammonium sulphate on three weeks old *Cyperus rotundus* was recommended in non-cropped areas. Removal of Parthenium before flowering reduced soil seed bank. Preemergence application of pendimethalin 1.0 kg/ha or early post emergence application of imazethapyr 75 g/ha effectively controlled Cuscuta menace. Management of Orobanche in solanaceous vegetables through application of imazethapyr and metribuzin have not been encouraging, Cuurently research on soil solarization is in progress. Research on striga infestation in sugarcane is also under progress.

## L - 30 Concept and procedure of importing bio agents for biological control of weeds in India

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India is one of the 12-mega diverse countries of the world. With only 2.5% of the land area, India accounts for 7.8% of the global recorded species. This rich biodiversity is threatened by the invasive pests. Alien weed species or alien invasive species are aggressive invaders outside their natural range and they directly affect resource management schemes, such as land use, watersheds and native biodiversity. These have been recognized as the second largest threat to biological diversity and other natural resources after habitat destruction due to manmade causes. Managing such invasive species can be ideally attempted through Classical Biological Control (CBC) by introducing effective co-evolved natural enemies from the home range of the given species in order to re-establish the lost balance between the weed pests and the natural enemies. Several successful attempts have been made to overcome these dreaded invasive weeds and insects. The first recorded success in biological control of a weed was obtained in India, where a bug *Dactylopius ceylonicus* introduced for production of cochineal dye, spread on *Opuntia vulgaris* in central and northern parts of the country and completely eliminated it. The first deliberate attempt was made only in 1921 against *Lantana camara*. Although several well known alien weeds occur in India, only a few sporadic biological control attempts were made until 1980. After the success achieved against *Opuntia* spp., releases of exotic natural enemies were made against *Eichhornia crassipes*, *Lantana camara, Chromolaena odorata*, *Mikania micrantha*, *Parthenium hysterophorus* and *Salvinia molesta*. The recent spectacular successes on CBC of Papaya mealybug *Paracoccus marginatus* and the eucalyptus gall fly *Leptocybe invasa* was overwhelmingly appreciated across the country. Presently, we are facing a challenge to combat and manage several of the quarantine weeds waiting to enter our country to save our biodiversity from already entered weed like giant mimosa (*Mimosa diplotricha*). Although several introduction of natural enemies of weeds have been done in the country for Classical Biological Control, there exists a need to understand the procedural formalities to be followed in exploration, importation, quarantine studies and host specificity studies. The paper attempts to clarify several of these doubts.

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# Weeds as potential source of genetic material for crop improvement : future prospects

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Weeds are reservoir of naturally available gene pool and can be used as a source of genetic material for traits like competitiveness, abiotic and biotic stress tolerance in crop plants. Weedy ancestors of food crops can cope far better with climatic changes than their domesticated counterparts. Coping with adverse conditions, after all, is what weeds have always done best. We have already set in motion far-reaching and unstoppable changes in regional temperatures and precipitation and in the composition of our atmosphere and despite of actions we take, these changes will continue 'at least' for decades. If we have to avoid disaster due to these unavoidable climate changes, experts agree that we need to be tenacious but flexible, ready to identify and exploit any opportunity. In this new world that we have made in search of fast track run for development, weeds, our old adversaries, can be not only tools but mentors to solve the crisis due to climate changes. Weed species which grows along with crop plants act as a dampener for crop production despite of enormous efforts made by farmers for removal of the weeds to get better yield.

Weeds are 'strategically' stronger than crop plants and can dominate crops in almost every aspect. Scientific basis of weedy and invasive traits of weed species along with their evolution is poorly understood, yet, strategy behind this is to utilize soil resources more efficiently than crop plants to achieve a fast and vigorous growth which results in greater biomass and once they successful in doing so, then they can easily capture the other resources like space and photosynthetically active radiation; thus provide a tough competition to the crop plants. Development and availability of the sophisticated molecular tools provide us liberty to play with different metabolic pathways at molecular level and to transfer the desirable genetic materials into crop plants, thus breaking the reproductive barriers for inter-specific and inter-generic transfer of the genetic material. Advancement of the modern biotechnological tools offers tremendous promise for elucidating these important weedy traits in detail and further exploration for the various aspects of crop improvement in 'cut and paste' style.

Weeds are harder plants, co-existing with crops and out-compete them in almost every aspect. Competitiveness and tolerance to abiotic and biotic factors are the important traits which can be observed among various weed species and can be transferred into crop plants. Co-existence of the weeds with crop plants provide an edge over the other wild species and model species like *Arabidopsis thaliana* ensuring the better chance of integration of the transferred material and survival of the transgenic with minimum yield penalty. However, success of such approaches requires collaborative efforts from all the corners of plant science to bring together expertise in weed science, molecular biology and plant physiology. An effort has been made to point out the useful traits of the weeds which can be transferred into crop plants for improvement along with the few successful case studies.

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# New Molecules in weed management

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High production agriculture characterized by growing dwarf or semi dwarf cultivars, responsive to increased applications of irrigation and fertilizer has simultaneously increased the problem of weeds. The dominance of little seed canary grass (*Phalaris minor*) in wheat and barnyard grass (*Echinochloa* spp.) in rice are a case in point. The control of these weeds through conventional means is difficult. Herbicides such as isoproturon in wheat and butachlor and anilofos in rice have been increasingly used to manage the problem. The use of chemicals to control weeds is increasing in almost all crops. Wheat, rice and tea are the major crops where maximum amount of herbicides are used in the country. The use in crops like onion, groundnut, soybean, cumin is showing a steady increase. The consumption of herbicides is likely to increase in the future due to the unavailability of labour in rural areas during peak crop season. The evaluation of new molecules is a continuous process and their commercialization is important in Indian agriculture. In present weed management scenario the use of low dose molecules contributes more.

Carfentrazon is a relatively new herbicide that controls broadleaf weeds primarily through the inhibition of the protoporphyrinogen oxidase enzyme in cereals. The study conducted at various DWSR centres revealed that cyhalofop butyl and metamifop are effective herbicide for post emergence control of *Echinochloa* in rice. Like wise herbicide mixtures are now a-days play an important role in single shot of application. For example fomasofen +fluazifop-butyl and saflufencil+imazethapyr in soybean, Application of cyhalofop butyl could bring down the population of *Echinochloa* drastically. However, in the treatments, where cyhalofop butyl was combined as tank mix or as follow up with 2, 4-D the effect on *Echinochloa* was adversely affected. On the other hand when 2,4-D application was delayed by 3, 6, 9, 12 or 15 days this antagonistic effect could be avoided. Application of carfentrazon+sulfosulfuron, metsulfuron+sulfosulfuron, clodinafop+sulfosulfuron in wheat resulted in a better weed control efficiency.

A reduction in herbicide rates, with efficacy maintained would be beneficial because of savings resulting from less herbicide use. Reducing herbicide rates may be achievable for several reasons, including (1) registered rates have been made to ensure satisfactory weed control over a wide range of environmental conditions, (2) maximum weed control is not always necessary for optimal crop production, and (3) there is a critical time period during which weed control is essential for profitable crop production. However, reducing herbicides rates resulted in increased weed infestation if not supplemented with other weed control methods. Great efforts have been made to determine the efficacy and risk of using herbicides at rates below the manufacturer's suggested use rates, although most of this kind of work has been conducted in corn (*Zea mays*) and soybean (*Glycine max*) weed growth stage, as well as temperature, relative humidity, and soil water content, affect the weed's susceptibility to herbicides and should be considered when implementing reduced rate herbicide programme.

## L - 33 Herbicide tolerant crops: opportunities and challenges

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Weeds not only compete with crops for water, nutrients, sunlight, and space but also are the abode of insect and disease pests. This has resulted in crop damage which in extreme cases have been reported to be up to 100 per cent. Therefore effective and timely weed management is the most important consideration for maximizing the yield in the crop protection system. In recent times the farmers have been facing difficulties in pursuing mechanical weeding due to substantial increase in cost of labour and more importantly the non-availability of labour at critical times of the crop. Farmers have also found it difficult to enter the field to undertake weeding operations when there is excess rain during monsoon season. Manual weeding practices can also lead to disturbance of soil and pruning of root tips during active crop growth period.

Chemical herbicides have offered a very remunerative option for weed control to Indian farmers and is being used in crops like Wheat, Rice, Soybeans, Vegetables, Tea, Cotton, Maize and Sugarcane mainly in the irrigated areas. The use of herbicides in rain fed areas is also gaining importance. However there are certain limitations in herbicide use practices for soil-active herbicides that depend on moisture for activation in the field . The window of application for pre emergent herbicide is a limited period of time i.e. 2-3 days of planting the crop which can cause problems in certain weather situations. Any weed control measure taken after the critical weed control period leads to unrecoverable loss to productivity. Under such conditions use of an effective post-emergence herbicide is a good option for the farmer to control the weeds during the critical stages of the crop. The best candidate for post emergence herbicides should be having no or minimal residual activity in the soil.

Alternate new technologies using biotech approaches like herbicides tolerant crops with broad spectrum non-selective and non- residual herbicides were discovered which complements with existing weed management practices & have proved to be cost effective solutions in many countries. International Service for the Acquisition of Agri-biotech Applications (ISAAA), recently mentioned that herbicide tolerance has consistently been the dominant trait from the genesis of commercialization in 1996 to 2011, In 2011, herbicide tolerance deployed in soybean, maize, canola, cotton, sugarbeet and alfalfa, occupied 59% or 93.9 million hectares of the global biotech area of 160 million hectares. The interesting fact is that out of the 29 countries planting biotech crops in 2011, 19 were developing and 10 were industrial countries. Herbicide tolerance technology has consistently delivered excellent benefits to farmers across the globe. Herbicide-tolerant (HT) crops offer farmers a vital tool in fighting weeds and are compatible with no-till methods, which help preserve topsoil. They give farmers the flexibility to apply herbicides when needed, to control total input of herbicides and to use herbicides with preferred environmental characteristics. The technology will be very useful in agriculture even for small/marginal farmers.

The advent of these herbicide tolerant crops has allowed farmers to control weeds more effectively usually with only one herbicide application at a significantly lower cost. These crops can also make a very important contribution to sustainable farming systems. The use of these crops is compatible with farming systems that reduce or eliminate the need for tillage or cultivation, which in turn are helpful in reducing soil erosion, conservation of moisture, nutrients and soil structure. The use of herbicide tolerant crops are one of the powerful and important components of Integrated Pest Management (IPM) farming systems that enable farmers to implement long term sustainable systems of crop production. Experience in some countries reveal that introduction of herbicide tolerant crops in conjunction with no-till has resulted in significant benefits and management flexibility. The herbicide tolerant crops are fully compatible with no-till systems and encourage soil conservation.

With any new technology there are often significant benefits and sometimes challenges and this is true for the crops developed with the help of biotechnology. Herbicide tolerant crops have generally been enthusiastically embraced by farmers because they haveprovided significant economic benefits. The policy decision taken recently in India requiring the No Objection Certificate (NOC) from respective States for even conducting field trials is an significant obstacle in the process of regulatory approval system. The social activist groups and NGOs further continue to spread misinformation by continuing anti-GM programs and propaganda in collaboration with like-minded environmental institutions and civil society organizations. Lack of clarity in the existing system cripples the progress lowering the confidence of public and private sector in the country. The media further add complications by publicizing inadequate and in many cases false information that negatively impacts the public's opinion of the technology which slows regulatory actions.. The engagement of the public scientific communities to ensure that the scientific facts are presented to the public will greatly influence public acceptance of these technologies and thus impact the speed upon which these technologies can be available to farmers.

In countries where approved, glyphosate herbicide has sometimes been used as the sole method of weed control for many years in glyphosate tolerant crops. This has increased the chance of developing resistance in few of the weed species. In order to reduce the evolution and spread of glyphosate resistant populations, broad based stewardship programs have been implemented to encourage farmers to implement diversified programs. In India, we will also need to evaluate our strategies to explore the potential of these crops and develop weed resistance management strategies in advance by incorporation of various components of weed management tactics that include the use of glyphosate in combination with weed management methods, such as hand hoeing and mechanical cultivation, and/or with other herbicides to ensure best weed management programs.

In this context we need to understand that any new technology has advantages and challenges. We need to focus on proper evaluation and if it provides value to our farmers and country as a whole, we should not hesitate to accept, manage, and steward the technology for the long term. We believe that this is the right time to discuss and debate more about herbicide tolerant crops and evaluate these crops for their benefits to farmers of our country in order to remain self reliant and to feed increasing population. The weed scientist can play a vital role in educating public about nuisance of weeds and importance of weed management practices including herbicide tolerant crops.

# L - 34 Best weed management practice (BWMP) of major weeds under various ecosystem in inceptisol of West Bengal

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Global food security in agriculture has to face new challenges for developing countries like India of 1.21 billion (2011 Census, Government of India -17.7 % more than 2001 Census) & in world of 9 billion people by 2050 and this is an arduous task. India has achieved 3.2% average annual growth in agriculture and allied sectors in the first four years of the 11th Five Year Plans but this is still below the targeted growth rate of 4%. It is also true that productivity of food grains in India has increased by about 10% to 1921 kg $ha^{-1}$ in the last four years but the yield of most crops are still lower than the world average The 'System of Intensification' through Best Management Practice (BMP) of the available resources (Rainbow Revolution) is the best alternative methodology to overcome our food security problem. Management of weed is one of the key factors for BMP. Weed, the major pest, causing yield reduction 37 % among the pests and to the tune of 78%. Weed infestation is more severe in upland ecosystem (71%) than in wetland. In Gangetic alluvial soil the yield loss is hovering around 40-45%. Climate change is going to affect livelihoods and food security of millions of farmers and fisher folk, but unless immediate steps are taken, the agricultural (contributing more than 25 % in global warming) operations will continue to add (invasion of pests) to the problem of global warming.

In anaerobic ecosystem during rainy season among the monocots Brachiaria platyphylla , Echinochloa spp. Ischaemum rugosum, etc. and among the dicots Alternanthera philoxeroides, Ammania baccifera, Cyanotis axillaris, Eclipta alba, Hypericum japonicum,etc. are most common. In aerobic crop fields during winter and summer and in uplands during rainy season the dominant weeds are *Cyperus rotundus, Digitaria* spp..*Echinochloa colona, Eleusine indica, Dactyloctenium aegyptium, Ageratum conyzoids, Alternanthera* spp., *Amaranthus* spp. *Argemone mexicana, Chenopodium album etc.*

Hand weeding is very common among the Physical method. In SRI the mechanical method (various paddy weeders) is widely used. Ecological methods are very useful as it increases the soil health by crop diversification technology, more particularly using the legumes either as intercrops or as mixed crop or as Guard crop etc. Chemical weed control is becoming more acceptable to farmers among all other pesticides. During 2007-11 considering the average from 142 experiments 39.27 - 58. 95 % WCE and 52.61 % more yield in chemical herbicides plot was observed showing the advantage of application of PE herbicides. Averaging of all POE herbicides applied to different field crops 48.02 - 67. 31 % WCE for EPOE & 39. 68 - 71. 34 % WCE for POE and 50.66 % more yield in chemical herbicides plot was recorded proving the advantage of application of POE herbicides. Utilization of weed in human welfare is another important options for managing many pernicious weeds In conclusion for best weed management practices (BWMP) training & awareness to improve the farmers thinking, the seed bank study, survey on new invasion of weed flora, annual planning of weed management, critical crop weed competition period of different crops and environment safety are the major factors to be considered. In general utilization of weeds in human welfare, diversification of crops, the use of mechanical weeding as POE and chemicals either the botanicals or safer synthetic chemical herbicides are gradually becoming more acceptable and also have tremendous prospects to replace the traditional costly, time consuming and tedious hand weeding to increase the productivity of major crops in Inceptisol without much disturbing the biodiversity and environment.

## O - 1 Weed management in rice in India – a review

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Rice is cultivated in India in a very wide range of ecosystems using direct-seeded and transplanted methods of establishment. Irrespective of the environment and the methods of rice establishment weeds are major constraints hindering the efforts to enhance rice productivity and production in India. The research carried out on weed management in rice in India during the past three and half decades is reviewed. Rice yield losses range from 12% to complete crop failure depending on method of rice establishment and the ecosystem. Rice yield losses due to weeds were reported to be higher under dry direct-seeded rice and relatively less with transplanting method of establishment. *Echinochloa colona* and *E. crus-galli* are the most serious weeds affecting rice in all methods of rice establishment. Other weeds of major concern in rice in India are *Ammannia baccifera*, *Cyperus iria*, *Cyperus difformis*, *Eclipta alba*, *Fimbristylis miliacea*, *Ischaemum rugosum*, *Leptochloa chinensis, Monochoria vaginalis*, *Paspalum distichum* and *Spaenoclea zeylanica*. *Cyperus rotundus* and *Cynodon dactylon* are other major problems in upland conditions, particularly in poorly managed fields. First thirty to seventy days are critical for crop weed competition, depending of the type of rice cultivar and the method of rice establishment. Reported research is primarily focussed on chemical method of weed management in rice in India. Anilofos; butachlor; chlorimuron+metsulfuron; cyhalofop butyl; 2,4-D EE; ethoxysulfuron; fenoxaprop-p- ethyl; fentazamide; flufenacet; fluroxypyr; oxadiargyl; oxyfluorfen; pendimethalin; pyrazosulfuron; quinclorac; thiobancarb were some of the herbicides reported to be effective in managing weeds in different method of rice establishment. Several effective integrated weed management methods combining preventive, cultural, mechanical and biological weed control methods in an effective, economical and ecological manner were also identified. The need for basic on-farm studies to understand ecology of weeds in rice agro-ecosystems of India and develop ecological weed management approaches is emphasised.

## O - 2 Bio- efficacy of pendimethalin CS against weeds in transplanted chillies and its residual effect on succeeding jowar crop

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A field experiment was conducted during *Kharif* 2008-09 and 2009-10 to study the bio-efficacy of pendimethalin 38.7% CS at four rates (483, 580.5, 677.25 and 1354.5 g/ha) in comparison with pendimethalin 30% EC 750 g/ha alone and followed by (*fb*) inter-cultivation at 30 and 60 days after transplanting (DAT). Fluchloralin 45% EC 1125 g, trifluralin 48% EC 960 g/ha and weedy check on transplanted chillies and their residual effect on succeeding jowar crop in a randomized block design with three replications. Results indicated that pre-planting application of pendimethalin 38.7% CS 483 to 1384.5 g/ha significantly reduced the weed growth and increased dry pod yield of chillies ranging from 62 to 206% compared to weedy check without any crop injury. Among the different doses, pendimethalin 38.7% CS at 1354.5 g/ha recorded the highest pod yield (2717 kg/ha) and was on par with its lower dose of 677.25 g/ha (2407 kg/ha) and these treatments were significantly superior to other doses of 483 and 580.5 g/ha. The unchecked weed growth throughout the crop growing period caused 78 percent reduction in dry pod yield compared to recommended practice of pendimethalin 750 g/ha *fb* inter-cultivation at 30 and 60 DAT. Residual effect of pendimethalin 38.7% CS was not observed on germination and growth of succeeding jowar crop.

## O - 3 Effect of time of sowing and weed management on direct seeded rice

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A field experiment was conducted during *Kharif* seasons of 2008 and 2009 at University farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur on inceptisol to study the effect of sowing time and weed control practices on weed flora and grain yield o f direct seeded rice. The soil of the experimental field was sandy loam ( inceptisol), low in available N (208 kg/ha), medium in available P (17.6 kg/ha) and high in available K (321 kg/ha) with a $P^H$ of 7.1. The experiment was laid out in a split plot design comprising two levels of time of sowing (sowing before onset of monsoon and sowing after onset of monsoon) in main plots and seven levels of weed management (pretilachlor-S 0.5 kg/ha PE, butachlor 1.5 kg/ha PE + 1 HW, fenoxprop-p-ethyl 60 g/ha POE + (chlorimuron-ethyl + metsulfuron-methyl), cyhalofop 90 g/ha + 2,4-D 0.5 kg ha at 30 DAS, azimsulfuron 35 g/ha , Weedy check and hand weeding twice at 20 and 40 DAS) in sub-plots. The treatments were replicated thrice. *Echinochloa colona, Ischaemum rugosum*, *Alternathera triandra, Cynotis axillaries, Commelina benghalensis* and *Cyperus iria* were the predominant weed species observed in the experimental field. Though, the dry matter of weeds at harvest did not differ significantly between pre and post-monsoon sown rice crop but seed yield was significantly higher by 15.41% under post monsoon than pre-monsoon sown crop. The treatment of two hand weeding registered significantly lowest dry matter than rest but was comparable with the treatment of Butachlor 1.0 kg/ha *fb* one hand weeding at 60 DAS. Accordingly, significantly higher seed yield was recorded from two hand weedings but was at with Butachlor 1.5 kg/ha *fb* one hand weeding. Post-emergence application of fenoxaprop 60 g/ha + chlorimuron + metsulfuron 4 g/ha and cyhalofop-p butyl 90 g/ha + 2, 4-D 0.5 kg/ha 30 DAS were next, in order.

## O - 4 Natural plant oils: broomrape killers?

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The effect of natural plant oils on broomrape (*Orobanche cernua* Loefl.) was assessed in a naturally infested tobacco (*Nicotiana tabacum* L.) field at the Agricultural Research Station, Nipani, Karnataka. Natural plant oils which are biodegradable and available at low cost differed in their ability to kill the young broomrape spikes. Neem (*Azadirachta indica* Juss.), coconut (*Cocos nucifera* L.), and sunflower (*Helianthus annuus* L.) oils showed knock down effects on the bud part of the parasite within 2-3 days, gastor (*Ricinus communis* L.) and niger (*Guizotia abyssinica* (L.fil. Cass) oils killed the buds within 3-4 days. Mustard(*Brassica juncea* (L.) Czernjaew) oil took 5 days to kill the bud.Coconut and sunflower oils also killed the broomrape stam more quickly than niger and castor oils. Neem oil and mustard oil did not kill the stem part of the parasite. These findings give new information on relative efficiency of different plant oils in controlling broomrape. None of oils was phytotoxic to tobacco. After optimization of application techniques, the use of such oils in practice will be cheap, environmentally safe and effective.

## O - 5 Parthenium menance in north-east India and efforts of its management through biological control based approach

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*Parthenium hysterophorus* L.is an alien invasive herbaceous weed causing severe health hazards and environmental problem. The objective of this study were to make a systematic survey of 12 National highways and 3 railway tracks of North-Eastern India during 2009-2011 and thereby make an effort to manage it using biocontrol agents (botanical agents, *Zygrogramma biocolorata* and some selected fungi). Studies have revealed that growth of *Parthenium hysterophorus* L. was found growing luxuriantly along the surveyed sites. Aqueous extracts of different botanical agents like *Gynura cusimba, Amaranthus spinosa, Mimosa pudica, Cassia tora, Cassia occidentalis, Sida spinosa, Riccinus communis, Xanthium strumarium, Cassia sericeae, Chromolaena.* Sp and *Urena lobota* at different concentration were studied for their allelopathic effect against *Parthenium*. 100% inhibition of Parthenium seed germination were recorded at 20% of leaf and stem extracts of *Riccinus communis*, *Cassia sericeae, Mimosa pudica* and *Cassia tora*. Leaf and stem extracts of *Amaranthus spinosa, Cassia tora, Mimmosa pudica* and *Riccinus communis* showed maximum inhibition on root and shoot growth of Parthenium even in low concentration. Leaf and stem extracts of *Riccinus communis, Amaranthus spinosa* and *Cassia sericeae*, stem extract of *Mimosa pudica* and *Cassia tora* showed maximum effect in reducing vigour index and dry matter production of Parthenium as compared to control. Among the tested botanical agents *Cassia sericeae, Riccinus communis, Mimosa pudica, Cassia tora,* and *Amaranthus spinosa* showed maximum allelopathic effect. The efficacy of certain fungal metabolites *viz., Aspergillus niger, Trichoderma viridae, Penicillium* sp, *Fusarium oxysporium, Alternaria alternata* were tested against Parthenium. *M*aximum inhibition on seed germination and seedling growth of Parthenium was observed in *Fusarium oxysporium*. Different stages of *Zygograma bicolorata* i.e. adult and larvae were tested against Parthenium in net cage condition. It was observed that there was great reduction in plant height, shoot length, root length and biomass due to significant defoliation of Parthenium leaves except the midribs.

## O - 6 Biological management of water hyacinth by use of pathogenic microbes

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Water hyacinth (*Eichhornia crassipes*) is one of the most predominant, persistent and troublesome aquatic weeds. Among different control methods available, biological method using native pathogens is the most viable and environmentally safe method. Periodical surveys of various water bodies in and around Jabalpur lead to the isolation of four important fungal pathogens, *viz*., *Cochliobolus* sp. *Fusarium* sp., *Curvularia* sp. and *Alternaria* sp. on water hyacinth plants. The pathogens were evaluated for their pathogenicity on water hyacinth and further the pathogens were integrated with the insect pest *Neochetina bruchii* to study their combined effect on the target weed. Results indicated that all the four organisms were found to infect and kill water hyacinth, though at varying intensities. Among the organisms, *Cochliobolus* was found to be very aggressive and when applied as a consortia with the other three pathogens, was found to be very effective and kill the entire population of about 15 plants in an aquatic tank of size of 3 feet diameter . *Fusarium* sp which is a vascular pathogen can be used as a major agent in the consortia because being a vascular pathogen; it is capable of rapidly killing the individual plants in 15-20 days of inoculation. However *Fusarium* was not very effective in its spread to other plants and hence when there was no infection in the new rammets. There was no complete killing of all the plants in the in causing disease in non-injured plants. Neochetina beetles when applied before 10 days of fungal treatment were found to act as facilitator for the fungal pathogens to enter the plants and kill them rapidly.

## O - 7 Comparative effect of soil solarization, herbicides and incorporation of various plant materials on weed growth and productivity of soybean

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An investigation was carried out during *Kharif* 2006 to study the effect of soil solarzation, herbicide application and incorporation of various plant materials on weed growth and productivity of soybean at the Research Farm of Indian Agricultural Research Institute, New Delhi. The experiment was laid out in a randomized block design on a sandy loam soil with twelve treatments and was replicated four times. Soybean (*Cv*. Pusa 9712) at 100 kg/ha was sown on July 15, 2006 at row spacing of 50 cm. The recommended doses of 30 kg N, 80 kg $P_2O_5$ and 60 kg $K_2O$/ha was applied as basal dressing in soybean. Soybean was infested with *Triantherma portulacastrum, Dactyloctenium aegyptium, Digitaria sanguinalis, Commelina benghalensis, Amarnthus, spinosus, phyllanthus niruri* and *Digera arvensis.* Hand weeding twice was on a par with pre-emergence application of ready mix of pendimethalin+imazethapyr (1.0 + 0.02 kg/ha) and pendimethalin application alone at 1.5 kg/ha. The solarization of soil for 40 days during May-June with transparent polyethylene film (TPE) of 0.05-0.10 mm thickness significantly reduced the weed density. Among the plant materials, incorporation of *Dalbergia sisoo* (sheesham) dried leaves 4 t/ha resulted in the highest reduction in weed density followed by Parthenium, Eucalyptus, neem leaves and sunflower stalk. Hand weeding twice recorded the highest seed yield of soybean (2.26 t/ha), which was on a par with that of pre-emergence application of ready mix of pendimethalin+imazethapyr (1.0+0.02 kg/ha) and pendimethalin alone at 1.5 kg/ha. Pre-plant incorporation of fluchloralin at 1.25 kg/ha and soil solarization were on a par in terms of seed yield of soybean. Among the plant materials, Eucalyptus 4 t/ha recorded the highest seed yield of 1.54 t/ha, which was closely followed by incorporation of Sheesham dried leaves. Incorporation of Parthenium dried leaves and neem leaves resulted in poor crop stand.

## O - 8 Role of fungal pathogens of water hyacinth in integrated biological control of the weed in South Africa

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Waterhyacinth, *Eichhornia crassipes* (Mart.) (Solms-Laub.) (Pontederiaceae) continues to be the worst aquatic weed world-wide. In South Africa the biological control programme was initiated in 1973 and since then, six arthropods and one pathogen have been released in an attempt to reduce infestations. Despite all efforts the results have been variable and more control agent species are being considered for release. Although significant research has been undertaken using the insect biocontrol agents of waterhyacinth, the role that native phytopathogenic fungi play has been neglected in South Africa. During recent studies we obtained 250 isolates of fungi from diseased plants of waterhyacinth collected during several field trips throughout South Africa during 2010-11. The fungi were evaluated for their efficacy against waterhyacinth, 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. Preliminary pathogenicity show several isolates to be promising agents, including *Alternaria eichhorniae*, *A. alternata*, *Acremonium zonatum*, *Bipolaris hawaiiensis* and *Fusarium* spp. 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.. Our studies under controlled conditions showed potential their complementary effect with the *Neochetina* spp and *Eccritotarsus catarinensis*, insect biocontrol agents of waterhyacinth. Thus their use as supplements with insects for effective biological control of waterhyacinth is highly recommended.

## O - 9 Effect of seed rate and weed control methods on productivity and profitability of wet land rice under medium land condition

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The experiment was conducted during rainy seasons of 2010 and 2011 with treatments comprised of four levels of seed rates i.e. 60, 80, 100, and 120 kg/ha and five weed management practices i.e. butachlor 1.5 kg /ha pre emergence, Pyrazosulfuron 0.02 kg/ha post emergence, Almix (chlorimuron + metsulfuron) 4 g/ha post emergence, two and weedings at 20 and 40 days after sowing and weedy check. The experiment was conducted in a randomized block design replicated thrice. Treatment comprising of seed rate were put in one factor and weed control practices in another factor. The rice variety was 'Lalat. The soil was low in available nitrogen (242.2kg/ha) and potassium (123.00kg/ha) and medium in available phosphorus. The recommended dose of fertilizers 100 kg N, 60 kg $P_2O_5$ and 40 kg/ha were applied in the form of urea, di ammonium phosphate and muriate of potash respectively. 80 kg seed being similar to 100 and 120 kg seed /ha recorded significantly reduced weed density compared to 60 kg seed/ha. The mean of total weed observed under 80, 100 and 120 kg seed/ha recorded 56.69% at 40 days after sowing and 22.00% at 60 days after sowing reduced total weed density compared to 60 kg seed/ ha. The mean reduction of grassy, broad leaved and sedges weeds at 40 days after sowing were 52.32, 35.27 and 33.47% respectively at 40 days after sowing while, at 60 days after sowing the density of grassy, broad leaved and sedges weeds reduced to the extent of 54.86, 19.80 and 22.00% respectively. Pyrazosulfuron 0.20kg/ha being similar to Almix 4g/ha at 20 and 40 days after sowing also similar with two hand weeding recorded 61.03, 66.37 and 74.25% at 20 days after sowing; 40.14, 6.4 and 59.15% at 40 days after sowing and 48.68, 40.53 and 51.87% at 60 days after sowing significantly reduced total weed density compared to butachlor 0.5kg/ha, hand weeding and weedy check respectively. 80 kg seed/ha being at par with 100 and 120 kg seed/ha recorded 24.17 and 28.04% significantly reduced dry matter accumulation by weeds compred to 60 kg seed/ha at 40 and 60 days after sowing respectively. Among weed control methods, application of pyrazosulfuron0.20kg/ha being similar to butachlor 0.5kg/ha, Almix 4g/ha and hand weeding recorded 70.38, 87.10 and 81.00% significantly reduced dry matter accumulation by weeds compared to weedy check. Rice crop sown with 80 kg/ha being similar to 60 and 100 kg/ha recorded 23.53% significantly higher effective tiller compared to 120 kg seed/ha. 80 kg seed/ha remaining similar with 100 kg/ha registered 635 and 24.47% higher grain (2701 kg/ha) and 70.96% and 35.79% higher straw (3809 kg/ha) yield compared to 60 and 120 kg seed/ha respectively. Among weed control methods, application of pyrazosulfuron0.20kg/ha being similar to butachlor 0.5kg/ha, almix 4g/ha and hand weeding recorded 107.90% higher grain (2867 kg seed/ha) and 110.10% higher straw yield compared to weedy check, thereby registering maximum net return (Rs. 24,147 /ha) and B:C ratio (2.21). it can be concluded that rice crop sown as direct seeded under wet land condition a seed rate of 80 kg/ha and among weed control application of pyrazosulfuron 0.20kg/ha was most productive and profitable.

**P - 1**

## Phyto-sociology and seed production potential of weeds of vegetables in lateritic belt of West Bengal

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To generate information on the weed infestation, dominance and seed production potential of important weed species in different vegetables, the present study was conducted in Birbhum and part of Burdwan district under lateritic region of West Bengal during 2009-2010. The result revealed that altogether 38 species (broad leaved – 29, grass – 6, sedge – 3) belonging to 32 genera and 18 families infested winter and summer vegetables *viz.* cabbage, cauliflower, potato, tomato, brinjal, radish, spinach, onion, bhindi, red amaranth and red pumpkin. The diversity of the species was found with in the family *Poaceae* and *Asteraceae* (6 species in each), *Amaranthaceae* (5 species), *Papilionceae* and *Cyperaceae* (3 species in each), *Euphorbiaceae* and *Solanaceae* (2 species in each) and remaining families had one species each. The largest genus was *Cyperus* containing 3 species followed by *Amaranthus, Alternanthera, Gnaphalium* and *Vicia* (2 species in each). Most frequent species was *Cyperus rotundus, Anagallis arvensis* and *Digitaria sanguinalis* in winter and *Echinochloa colonum, Croton bonplandianum* in summer. The most dominant species on the basis of importance value indices (IVI) in both winter and summer vegetables was *Cyperus rotundus* followed by *Gnaphalium purpureum, Chenopodium album* and *Digitaria sanguinalis* in winter and *Echinochloa colonum, Croton bonplandianum* in summer. Seed production potential of 12 important species studied during harvesting of crop revealed that *Spergula arvensis* recorded the highest seed production (8036/plant) followed by *Solanum nigram* (4665) and *Gnaphalium indicum* (3864). Seed rain (number of seeds/$m^2$) was higher in *Spergula arvensis* (40180/$m^2$), *Gnaphalium indicum* (38640) and *Gnaphalium purpureum* (18096) as the number of plants / $m^2$ was higher at the time of harvesting of crop.

**P - 2**

## Effect of poultry manure on weed dynamics in maize

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Maize (*Zea mays L.*) is one of the most important cereal crop grown all over the globe as poor man's food and also as cattle and poultry feed. Field investigation was carried out during *kharif* and *rabi* seasons of 2008 and 2009 on sandy clay loam soil at the irrigated upland farm of Eastern Block, Tamil Nadu Agricultural University, Coimbatore. The experiment was laid out in randomized block design, replicated thrice. The experiment consisted of ten treatments comprising four treatments of different organic manures and their combinations *viz.*,100% RDF through farmyard manure, vermin-compost and poultry manure and all the combination at 1/3, 1/3, 1/3 proportion. The four treatments were integrated i.e., 50 per cent RDF through organic manures and 50 per cent RDF through inorganic fertilizers. The remaining two treatments were 100 per cent RDF through inorganic fertilizers and control (without organic and inorganic). The application of organic manures and fertilizers in the *kharif* and *rabi* seasons of 2008 and 2009, significantly influenced the weed dry weights. Lowest dry weights of weeds and weed density was recorded with 100% RDF through poultry manure and it was comparable with 50 per cent RDF + 50 per cent RDF through poultry manure during both the years of study. This is due to when poultry manure is added, aerobic fermentation occurs with the production of heat and loss of $CO_2$ and ammonia. The heat produced and the immediate higher availability of N have caused the caustic effect on the germinating weeds and reduced the weed biomass. Another reason is that poultry manure is totally free of weed seeds because of the use of broken grains in poultry rations.

**P - 3**

## Effect of integrated weed management on weed dynamics and yield of maize

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Fields experiments were conducted during *kharif* 2010 and 2011 at the Main Research Station, Hebbal, Bengaluru to evaluate the performance of herbicides for control of weed types, yield and economics of weed management practices in maize. The trial was laid out with eleven treatments comprising of oxyfluorfen 23.5EC 200 g, atrazine 50WP 1.0 kg and pendimethalin 30 EC 0.75 kg/ha (as pre-emergence at 3 DAS) alone or in combination with mechanical weeding at 30 DAS or post emergence application of 2,4-D Na salt 80 WP 0.5 kg ai/ha at 30 DAS in comparison to hand weeding (20 and 40 DAS) and unweeded control replicated four times in a RCBD design. Major weeds were *Cyperus rotundus, Cynodon dactylon, Eleusine indica, Digitaria marginata, Echinochloa colona*, *Commelina benghalensis, Ageratum conyzoides* and *Borreria articularis*. Mean data of two years indicated that all weed management practices resulted in significantly higher kernel yield than unweeded control due to effective control of weeds as evident from lower weed density (33.5 to 66.5/$m^2$ as against 95.0/$m^2$ in unweeded control at 60 DAS) and dry weight (16.6 to 37.4 g/$m^2$ as compared to 80.9 g/$m^2$ in unweeded control at 60 DAS). Hand weeding twice gave slightly higher kernel yield (7254 kg/ha), but comparable to pendimethalin, oxyfluorfen or atrazine along with mechanical weeding at 30 DAS (6858 to 6942 kg/ha) and oxyfluorfen fb 2,4-D Na salt at 30 DAS (6817 kg/ha). While other herbicides – pre-emergence of pendimethalin, oxyfluorfen or atrazine alone or pendimethalin or atrazine fb 2,4-D Na salt usage at 30 DAS gave slightly lower yields (5442 to 6510 kg/ha) than hand weeding (7254 kg/ha). Unweeded control gave lower kernel yield (3452 kg/ha, owing to severe competition from weeds of all types and had a weed index of 51%. The cost of pre-emergence herbicides alone (Rs.1150 to 2370/ha) or followed by mechanical weeding (Rs.2150 to 3370/ha) or 2,4-D Na salt application at 30 DAS (Rs. 1820 to 3040/ha) was cheaper than hand weeding (Rs. 6250/ha). Thus herbicides usage could save weeding cost to an extent of Rs. 2880/ha to Rs. 4600/ha over hand weeding

**P - 4**

## Estimation of viable weed seeds in cultivated fields

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Knowledge of weed seed density present in soil and weed seed emergence pattern will help the farmer to know the optimum time to apply a herbicide or the weed control practice. Keeping this in view, an experiment was conducted during summer 2008, 2009 and 2010 with an objective to study the weed seed density in soil depth of 0-15 cm depth in different fields of Acharya N G Ranga Agricultural University, Regional Agricultural Research Station, Lam, Guntur, A.P. in a randomized block design with three replications. Soil samples from 0-15 cm depth collected randomly from different fields were spread over shallow trays for germination of weed seeds. Observations were recorded species wise emerged weeds. After observation, all weed seedlings were uprooted and the soil was treated with $GA_3$ at 100 ppm to induce germination of the dormant weed seeds and observations were recorded as number of weeds germinated per kg of soil. Results indicated that there is a significant difference in total weed seed in different fields of RARS, Lam. Significantly the highest weed density was observed in field No.3 before and after $GA_3$ treatment. Among different weed groups, broad leaf weeds were dominant than grasses. Among the different weed species observed. *Trainthema portulacastrum, Digera arvensis* (BLW), *Echinochloa colona, Dinebra retroflexa* (grasses) were the predominant species.

## P - 5 Effect of rice establishment techniques on crop productivity and weed dynamics under different weed control methods in Uttarakhand

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A field experiment was conducted at Norman Ernest Borlaug Crop Research Centre, Govind Ballabh Pant University of Agriculture & Technology, Pantnagar (U.K.) with an aim to find out the effect of different rice establishment techniques on crop productivity and weed dynamics under various weed control method during *kharif* 2010. Total 16 treatments consisted with 4 rice establishment techniques (system of rice intensification (SRI), transplanting method direct dry seeding (unpuddled) and wet seeding through drum seeder (sprouted seed sown in puddle situation) and 4 weed control methods (pyrazosulfuron (25 g/ha) + conoweeder (40 DAT/DAS), twice conoweeder (20 and 40 DAT/DAS), twice hand weeding (20 and 40 DAT/DAS) and weedy check) were tested in strip plot design with 3 replications. The pre-dominant weed species in the experimental plots were *Echinochloa colona*, *Echinochloa crus-galli* and *Leptochloa chinensis* among grasses, *Ammania baccifera*, *Caesulia axillaris* and *Alternanthera philoxiroides* among broad leaved weeds and *Fimbristylis miliacea* and *Cyperus rotundus* among sedges at 60 DAT/DAS. Significantly higher grain yields (4492 kg/ha) was found with SRI method among all the establishment methods followed by transplanted rice with grain yields of 3833 kg/ha which was also higher than those obtained with wet seeded rice (3610 kg/ha). Direct dry seeded rice produced the lowest grain yields (2815 kg/ha) among all the 4 establishment techniques tested. Productivity of rice between different weed control methods, twice hand weeding (20 and 40 DAS/DAT) produced maximum grain yields (4434 kg/ha) followed by pyrazosulfuron + conoweeder (4184 kg/ha), conoweeder (3863 kg/ha) and weedy check (2270 kg/ha).

## P - 6 Biology and management of *Caesulia axillaris* and other weeds in transplanted rice under *'tarai'* conditions of Uttarakhand

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A pot culture experiment was conducted only to study the growth and developmental pattern of *Caesulia axillaris* Roxb., at Department of Plant Physiology, College of Basic Sciences and Humanity and one field experiment was also conducted at Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar (Uttarakhand) to study the management of *Caesulia axillaris* and other weeds in transplanted rice. *Caesulia axillaris* was found to be dominant weed of transplanted rice in *'tarai'* region of Uttaranchal. It is an annual, dicot, glabrous semi-aquatic herb of family compositae which grows vigorously and infest wetland rice. It grows upto the height of 50 cm and have on an average 7.0 branches per plant thus accumulating large biomass and impose serious competition for various resources i.e. nutrients, light, space, $CO_2$ *etc.* against transplanted rice. Other important weeds were *Echinochloa crusgalli, E. colona, Cyperus* spp. and *Paspalum distichum. Caesulia axillaris* along with other weeds controlled effectively mainly by application of metsulfuron methyl at 8.0 or metsulfuron methyl + chlorimuron ethyl at 8.0 g/ha when applied at 2-3 leaf stage of *Caesulia*. Application of these herbicides resulted in reduced crop-weed competition and ultimately higher grain yield. Maximum reduction in weed density and dry matter was observed in two hand weeding treatments followed by metsulfuron methyl at 8.0, metsulfuron methyl + chlorimuron ethyl at 8.0 and 2,4-D at 500.0 g/ha were found to be most effective in controlling all types of weeds in decreasing order. Highest grain yield was recorded in treatment receiving metsulfuron methyl at 8.0 g/ha and metsulfuron methyl + chlorimuron ethyl at 8.0 g/ha which were statistically at par with weed-free treatment.

## P - 7 Effect of nutrient management and cropping system on weed dynamics in rice based cropping systems

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A field experiment was conducted with four different rice based cropping systems ($CS_1$-green manuring sunhemp-rice-wheat, $CS_2$-rice-chickpea-sesame, $CS_3$-rice-berseem, $CS_4$-rice-veg.pea-sorghum) and three nutrient managements ($M_1$- 100% organic{1/3 N through each of FYM, vermi compost and neem oil cake}, $M_2$-100 % inorganic{100 % NPK through fertilizers, $M_3$-INM(50%NPK through fertilizer+50% N through organic sources) with un-replicated strip plot design at research farm, J.N.K.V.V, Jabalpur ( M.P) in the year 2009-10 and 2010-11 to evaluate the effect of change in cropping system and nutrient management on weed flora, weed intensity, weed biomass, nutrient uptake and weed control efficiency. In the rice based cropping system season dominant weed species in *kharif* were *Cyperus iria, Cyperus difformis, Fimbristylis miliacea, Echinochloa colona, Eleusin indica, Digitaria sanguinalis, Celosia argentea* and *Euphorbia hirta.* In *rabi* season the $CS_1$-green manuring sunhemp-rice-wheat and $CS_3$-rice-berseem had maximum weed intensity and weed dry weight as compared to $CS_2$-rice-chickpea-sesame and $CS_4$-rice-veg.pea-sorghum. During summer season, the intensity and dry matter of weeds was more at 30 DAS and at maturity in $CS_4$-rice-veg.pea-sorghum. The weed intensity and weed dry matter were maximum in all the three seasons in $M_1$-100% organic {1/3 N through each of FYM, vermin-compost and neem oil cake}, which reduced in $M_3$-INM {50%NPK through fertilizer+50% N through organic sources} and $M_2$-100 % inorganic {100%NPK through fertilizers in a decreasing order. While considering the economics the $CS_2$ with $M_2$ resulted the highest GMR (23493 Rs/ha), NMR (170200 Rs/ha) with a B: C ratio of 4.5 as compared to all the other cropping systems and nutrient managements. It was obtained that introduction of change in rice-wheat system under organic and INM can reduce the weed intensity and biomass and can control perennial weeds in the cropping system.

## P - 8 Studies on weed flora and crop weed competition in mulberry

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A field survey was carried out in mulberry maintained in Block A, B and C at Department of Sericulture, University of Agricultural Sciences, Bangalore during 2010-11. The major weed flora observed were *Cyperus rotundus* (a sedge); *Cynodon dactylon1 Dactyloctenium aegyptium Chloris* barbata, *Echinochloa colona*, Digitaria marginata (among grasses); *Parthenium hysterophorus*, *Phyllanthus niruri., Euphorbia geniculata*, *Euphorbia hirta Borreria stricta, Spilanthes calva* and *Tridax procumbens* of weed flora, *C. rotundus, C. dactylon, D.marginata*, *E.hirta* and *S.calva* were dominant weeds occurring in mulberry crop. To know the critical period of weed completion, five treatments namely weed free for first 20 days, 40, 60 and 75 days after pruning in relation to weedy check, were tried in RCBD with four replications. Averaged over *kharif* and summer seasons of 2010-11, leaf yield was maximum in plot kept weed free for 75 days (6.45 t/ha), followed by 60 days (5.49 t/ha), while weedy check lowered the leaf yield by 70% as compared to weed free upto 75 days Thus, mulberry require a weed free period of 60-75 days for obtaining higher leaf yield in red sandy loam soil under protective irrigation.

**P - 9**

## Identification of invasive alien weed flora of Greater Hyderabad, Andhra Pradesh

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IUCN defines alien invasive species as an alien species which becomes established in natural or semi-natural ecosystems or habitat, an agent of change, and threatens native biodiversity. Introduction of these species may occur accidentally or through their being imported for a limited purpose and subsequently escaping, or deliberately on a large scale. Invasive alien species are the second largest cause to biodiversity loss in the world and impose high costs to agriculture, forestry, and aquatic systems. Introduced species are a greater threat to native biodiversity than pollution, harvest, and disease combined. Therefore, the study was carried out during 2009-11 to identify the invasive weed flora in the Greater Hyderabad. The present study revealed that 245 weed species spread over 177 genera belonging to 60 families of Magnoliophyta. Of the 245, the class Magnoliopsida comprises 202 species belonging to 143 genera and 48 families and the remaining the class Liliopsida comprises 43 species belonging to 34 genera and 12 families. There are about 191 species of herbs, 22 species of under shrubs, 11 species of shrubs, and 21 species of climbers and twines. Maximum weeds recorded from the family Fabaceae with 32 species, 26 species from Asteraceae, 13 species from Amaranthaceae and 11 species from Euphorbeaceae. Out of 245 weed species 109 weeds are aliens. Of these 21 weed species from Asteraceae, 16 weed species from Fabaceae, 7 weed species each from Convolvulaceae and Poaceae and 6 weed species each from Amaranthaceae and Solanaceae. About 44% of the Greater Hyderabad weed flora constitutes aliens, of which 73% are American, 15 % African and remaining from Mediterranean, European, Brazilian, West Indian, Peru and Medagascar weed species. The following alien weed flora were found to dominate causing threat to native vegetation in study area *viz. Alternanthera spp* Forssk., *Croton banplandianum*, *Calyptocarpus vialis*, *Hyptes suaveolens*, *Lantana camara*, *Parthenium hysterophorus*, *Senna uniflora* and *Eichhornia crassipes etc.* Since invasive alien species are a great threat to native biodiversity, they should be monitored carefully to avoid imposing high cost to agriculture and ecosystem.

**P - 10**

## E-module on weed seed identification

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Correct identification of weeds is the first step for an effective integrated weed management programme. Acquaintance with the plant morphological features, such as leaf and stem shape, flower type and colour, and the presence of hairs make identification relatively easy compared with relying on seed physical characteristics. Identification of weed seeds with the support of color illustrations and description of seed morphological features is an easy method of weed seed identification. However, identification of weeds/weed seeds by reference manual is time consuming besides adding difficulties in carrying and maintaining the books. The e-module on weed/weed seed identification will be helpful for easy retrieval of the information. Seed images, along with weed images, are grouped by their scientific name and common name and also the family to which they belong. Seeds size, shape, color and texture characteristics are described. The purpose of this e-module is to assist the researchers, students and those who attempt to identify weeds by their seed morphological characteristics.

**P - 11**

# Weed seed bank and dynamics as affected by different tillage and plating management in rice –wheat system

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Weeds have a greater genetic diversity than rice crop. Consequently, if a resource (light, water, nutrients or carbon dioxide) changes within the environment, it is more likely that weeds will show a greater growth and reproductive response. In central part (Madhya Pradesh and Chhattisgarh) of India rice grown in variable climatic condition. The field experiment were carried out at Krishi Nagar Research Farm, JNKVV, Jabalpur, (M.P.) continuing 2 years 2007-08 to 2008-09. Sixteen treatments consisted with 4 tillage and planting management for both crop components under rice-wheat system were tested in strip plot design with 3 replications. Tillage and sowing methods were $P_1$- direct drilling in dry field, $P_2$-direct seeding of sprouted seeds through drum seeder in puddled field, $P_3$-manual transplanting and $P_4$-transplanting through self propelled transplanter (SPT) for rice cv. Kranti and $T_1$-conventional tillage sowing, $T_2$-zero till sowing, $T_3$ -strip till sowing and $T_4$-bed planting for wheat. Soil samples of 0.5 kg by weight were taken with the help of core auger at 3 soil depths *viz.*, 0-5, 5-10 and 10-15 cm from each treatment plot before sowing of both crop components under a fixed rice-wheat system. The existing seed bed conditions before sowing of each crop was taken into consideration to decide the time of sampling. Then collected soil samples were well labelled with tags and allowed to sun-drying. After proper sun-drying, these samples were grounded into fine particles with help of mortar and pistal. Then these samples spread on the peteriplates separately in almost homogeneous and uniform layer. The peteriplates were marked for each treatment separately with glass pencil .After this, regular watering was done upto 15 days with the help of water cane uniformly in all peteriplates. The numbers of germinated weed seedlings were counted under each treatment at 15 days after regular watering. Finally, weed seed counts/kg soil was worked out for each treatment. On top layer of soil (0-5 cm) ,mean weed seed counts/kg soil was maximum (55.2) in DSR-$P_1$ among all tillage and sowing methods , which reduced as 38.7 ,37.4 and 35.6 weed seeds/kg soil in $P_2$,$P_3$ and $P_4$ ,respectively . But variation between the latter three tillage and sowing methods were not significant. On the middle (5-10cm) and lower (10-15 cm) layers of soil, the mean weed seed counts was significantly minimum as 32.6 and 23.2 weed seeds/kg soil, respectively under $P_1$ among all tillage and sowing methods of rice. The mean number of weed seeds / kg of soil before sowing of rice as affected by different sowing methods of preceding wheat ($T_1$, $T_2$, $T_3$ and $T_4$) ranged from 40.9 to 42.3, 39.2 to 40.2 and 27.2 to 27.4 at top, middle and lower layers of soil, respectively, but variations did not reach to the level of significance . However, it is remarkable to note that zero till sown wheat ($T_2$) had numerically maximum weed seed counts/kg soil at each layer of soil.

## P - 12 Effect of long term application of herbicides on soil properties

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Butachlor, pretilachlor and 2,4-D are the three major herbicides widely used by farmers for weed control in wet seeded rice. These herbicides are applied at the rate of 1.25, 0.45 and 1.00 kg/ha respectively at 6-9, 3-5 and 20 days after sowing. Soil characteristics affect the herbicide use efficiency and crop yields. Little information is available on the impact of long term application of herbicides on soil characters. Soil samples(0-15 cm depth) were taken from the "Long term herbicide trial in rice- rice system" which is being conducted with six treatments since 2001 under AICRP on weed Control, KAU Centre. The treatments were (i) hand weeded control (100% NPK through fertilizer): (ii) continuous application of butachlor +2,4- D (100% NPK through fertilizer): (iii) butachlor alternated with pretilachlor between seasons +2,4-D (100% NPK through fertilizer) :(iv) butachlor alternated with pretilachlor between seasons +2,4-D ( 75% NPK+25% N through FYM: (v) butachlor alternated with pretilachlor between years +2,4-D (100% NPK through fertilizer):(vi) butachlor alternated with pretilachlor between years +2,4-D (75% NPK+25% N through FYM). Soil sampling was done in the month of March every year ( about at two months after the harvest of second crop) so as to reduce the temporary fluctuations in soil properties due to cropping. Differences in soil properties *viz.,* organic carbon, pH and available P and K due to the different treatments were calculated and expressed as % change over the years ( 2002-2011). Effect of the treatments made during last 10 years (20 crop seasons) is presented here. In the case of pH and organic carbon, the per cent change over the years was in the range of 0 to -10.7 and 2.5 to -23.0, respectively. Greater and positive changes were observed in the case of available P and K, the range being +52.88 to + 141.76 and +47.16 to+114.27, respectively. Both hand weeding and the herbicide treatments recorded no considerable changes in pH and organic carbon. In the case of available P, the hand weeding treatment and the herbicide application without FYM recorded lesser changes. Application of FYM resulted in significant increase (105 (T4) to 141% (T6)) in the available P. All the herbicide treatments resulted in significant increase in the available K content of the soil (96 to 118%). The study showed that herbicide application do not have any deleterious effect on soil quality. Instead, considerable positive effects were observed on available P and available K.

## P - 13 Evaluation of residues of butachlor 50 EC herbicide applied to rice–rice system

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A field experiment was conducted to evaluate the persistence of butachlor 50 EC herbicide applied to paddy crop in a long term herbicidal trial in rice-rice cropping system at Agricultural Research Station, Kathalagere, Davanagere District. The experiment consisted of six treatments i.e., three weed management practices consisting of butachlor 50 EC at 0.75 kg/ha + 2,4-D EE 38 EC at 0.4 kg/ha applied in sequence both during *kharif* and summer and same treatment applied in *kharif* followed by pretilachlor 50 EC at 0.75 kg/ha during summer and twice hand weeding at 20 and 45 DAP and two sources of soil fertility replicated four times in a RCBD design. The soil and water samples were collected at periodic intervals and residue estimation was carried out in grain, straw, soil and underground water (ppm) during summer and *kharif* 2011. During summer, at the time of harvest the residue of butachlor were below the detectable level of 0.01 ppm in soil, grain and straw samples (118 days after herbicide application) at recommended level of application. Same trend was noticed during *kharif*. At the time of harvest the residue of butachlor were below the detectable level of 0.001 ppm. in soil, grain and straw samples (113 days after herbicide application).

## P - 14 Influence of organic matter sources on adsorption of butachlor and pretilachlor in laterite soil

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Adsorption is a major factor of determining the fate and persistence of herbicide in soil. In laterite soil, leaching loss of herbicides is more because of its low capacity for retaining these chemicals. Addition of the organic matter is an important measure to improve herbicidal efficiency, as it can greatly increase the amount of dissolved organic carbon (DOC) in solution which affects the sorption and leaching of pesticides. A pot culture study with rice as test crop grown under submerged condition was conducted to quantify the adsorption of herbicides on soil. The treatments consisted of two herbicides (butachlor 1.25 kg/ha and pretilachlor 0.45 kg/ha) which were sprayed at six days after sowing. Three carbon sources *viz.,* farmyard manure (FYM), vermicompost and soil alone were applied in the pots before sowing. The soil samples were taken at one day, one week, two weeks and four weeks after herbicide application and after harvest. Results indicated that there was significant variation in the quantity of herbicides adsorbed by soil in the different treatments. Higher concentration of butachlor compared to pretilachlor in the soil at one day after application was due to the differences in their rate of application. Initial adsorption (one day after spraying) of butachlor as well as pretilachlor was highest in vermicompost treatment. The treatment with FYM recorded higher DOC than that of vermicompost which would have resulted in an increase in the mobility of chemicals and thereby reducing the quantity adsorbed by soil. Persistence of butachlor and pretilachlor in terms of half life was highest under FYM treatment (17.0 and 18.5 days for butachlor and pretilachlor, respectively).

## P - 15 Residual effect of sulfentrazone applied to planted sugarcane on succeeding crops

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The field experiments were conducted during June-July and March-April of 2010 and 2011 with fifteen treatments. The treatments consists of pre emergence application of sulfentrazone at 720, 840, 960, 1080, 1200, 1320, 2400 g/ha and pre plant incorporation of sulfentrazone at 1080, 1200, 1320, 2400 g/ha, PE-atrazine 1250 g/ha, POE -2,4-DEE 1200 g/ha, HW on 30 DAP and control. The experiments were laid out in a randomized block design with three replications. it was found that the pre plant incorporation of sulfentrazone at 1200 g/ha recorded lower weed density, weed dry weight, higher weed control efficiency and higher cane and sugar yield which was at par with pre emergence of sulfentrazone at 1200 g/ha. To study the residual effect of herbicides applied to sugarcane, the succeeding crops such as, maize, sunflower and cowpea were raised without disturbing the layout of sugarcane experiment. Total weed density in the succeeding crops significantly altered due to the weed management practices followed in preceding herbicide. In succeeding crops like maize, sunflower and cowpea, lower density of total weed was recorded with sulfentrazone at 1200 g/ha which was on par with pre emergence application of sulfentrazone at 1200 g/ha. Germination percentage, dry matter production and yield of the succeeding crops *viz.,* maize, sunflower and cowpea were not affected due to the application of sulfentrazone to the preceding crop of herbicide. Among the weed management treatments, there was no significant variation in germination percent, dry matter production and yield of the succeeding crops, given to preceding sugarcane in both the years of study.

## P - 16 Best management strategies for preventing herbicide resistance evolution: experiences from the midsouth united states

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Herbicide resistance in arable weed communities has been a growing issue worldwide. Although the majority of the existing resistant weeds have been documented in the industrialized nations, there is an increasing risk for resistance evolution in the developing world. This is particularly true for countries like India where rapid industrialization has resulted in the inevitable shortage of agricultural labor, forcing the growers to depend more and more on herbicides as the primary tool for weed control in their production systems. Inadequate herbicide stewardship measures coupled with a lack of awareness has already led to the evolution of herbicide-resistant weeds in some production systems. For instance, herbicide resistance has been a persisting issue in the rice-wheat systems of north India. In areas where herbicide usage is high, growers need to be proactive and employ appropriate strategies for preventing resistance evolution. In this respect, experiences in preventing or managing herbicide resistance elsewhere will be highly valuable for developing such measures. The presentation focuses on our learning's with herbicide-resistant weeds in the Midsouth U.S. crop production systems. A number of best management practices have been identified, using herbicide resistance simulation models, for preventing herbicide resistance evolution. The discussion particularly focuses on tactics that are applicable across a range of crop production systems in India.

## P - 17 Effect of glyphosate K salt applied in preceding transgenic stacked cotton hybrids on succeeding crops

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Biological modifications can be made through gene transfer or by selection of genetic mutations using seed or tissue-culture screens. Herbicide-resistant crops (HRC's) developed with these technologies quickly had an important impact on agriculture. In this view, the field experiments were conducted to study the carry over effect of glyphosate K salt applied in preceding transgenic stacked cotton hybrids (Mon 15985 x Mon 88913) in succeeding sunflower, soybean and pearl millet in the experimental site of Tamil Nadu Agricultural University, Coimbatore during winter season of 2009-10 and 2010-11. Glyphosate was applied as early POE application on 25 and 65 DAS at 900, 1350, 1800, 2700, 3600 and 5400g/ha in MRC 7347 BG-II RRF test hybrid. These treatments were compared with hand weeding on 15 and 30 DAS and unweeded control. Succeeding crops like sunflower, soybean and pearl millet were sown immediately after the harvest of herbicide tolerant transgenic cotton. Observations like germination percentage, visual phytotoxicity, plant height, total weed density, dry matter production and yield were recorded. The result showed that, germination percentage and vigour of residual crops were not significantly influenced by weed control treatments imposed on the previous cotton crop and also there was no crop phytotoxicity in residual crops observed with different doses of glyphosate and other weed control treatments applied in transgenic cotton hybrid. Total weed density in the succeeding crops significantly altered due to the weed management practices. During both the seasons, in the succeeding crops like sunflower, soybean and pearl millet, lower density of total weeds was recorded with glyphosate at 5400, 3600 and 2700 g/ha compared to other treatments and also higher density of total weeds was observed under unweeded check. There was no significant influence on plant height, dry matter and grain yield of residual crops by post emergence application of glyphosate in preceding transgenic cotton hybrid.

## P -18 Has little seed canary grass evolved cross resistance to clodinafop and sulfosulfuron in Punjab?

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Little seed canary grass (*Phalaris minor*Retz.) is the dominant grassy weed of wheat especially in rice-wheat cropping system which dominates inceptisols of northern India. It developed resistance to isoproturon herbicide in early 90's. Alternate herbicides *viz.,* clodinafop, sulfosulfuron and fenoxaprop were recommended for its control and were widely adopted by the state farmers. Complaints of poor efficacy of these alternate herbicides started appearing from 2008-09. In this context, performance of alternate herbicides was evaluated through farmers' field survey conducted at 73 farmers' field in six districts *viz.,* Patiala, Fatehgarh Sahib, Ludhiana, Moga, Jalandhar and Ropar in Punjab. The survey indicated that clodinafop and sulfosulfuron are widely used by the farmers; clodinafop being safe for succeeding crop is preferred over sulfosulfuron. The farmers used to apply field rates of these herbicides till 2008-09 and were getting effective control of *P. minor* (>85%). During 2009-10, clodinafop started showing signs of reduced efficacy and >30% farmers used 1.5 times of field dose and control was still poor (<65%); few farmers (<10%) used 2 times the field dose with little success. The situation become alarming in 2010-11 when clodinafop at field dose did not show any toxic effect on *P minor* and the farmers (<50%) used 2 times and <30% used 3 times or higher dose of clodinafop alone/ tank mix of clodinafop + sulfosulfuron/both herbicides in sequence and control was still poor ( <60%); re-growth recorded particularly in Patiala, Fatehgarh Sahib, Ludhiana and Moga districts. Few farmers (<8%) used higher (1.5 times) dose of sulfosulfuron in Patiala and Moga districts only. Sulfosulfuron efficacy also showed declining trend (<60%) during 2010-11; reduced efficacy was more prevalent in fields having history of continuous use of sulfosulfuron but poor efficacy of clodinafop was even recorded in field having continuous use of sulfosulfuron. The spray methodology adopted by the farmers was better than they were using in the previous years hence it cannot be related to the reduced herbicide efficacy. The survey results pointed towards the evolution of cross resistance in *P. minor* to clodinafop to a large extent and that sulfosulfuron was likely to meet the same fate in the near future. The situation is likely to be worse in the coming years. Proper and regular monitoring of all the existing herbicides is desirable before the situation comes out of control at farmers' field.

## P -19 Persistence of pretilachlor in soil and food chain under direct seeded rice

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A field experiment was conducted at Central Research Station OUAT, Bhubaneswar, Orissa to study the persistence of pretilachlor in soil and food chain under direct seeded rice during *kharif*, 2011 in sandy clay loam soil- low in N and K, medium in P. Pretilachlor was applied x (1 kg/ha), 2x (2.0 kg/ha) to the soil and its persistence was analysed sampling soil at 0 10 20 30 45 60 90 days and Harvest from a depth of 0-15 cm, grain and straw using gas chromatograph (ECD) with a detectable limit of 0.001 mg/kg in temperature conditions-column $210^0$C, injector $230^0$C, detector $250^0$C-carrier gas nitrogen and flow rate 40ml/min. The residues of pretilachlor in soils when applied at recommended dose of 1.0 kg/ha were recorded up to 45 days and at 2. 0 kg/ ha were observed up to 60 days. In post harvest soil, grain and straw samples, the residues were below detectable limit of 0.001ppm.

## P -20 Study of persistence of herbicides in rice rhizosphere under different tillage systems

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Rice – wheat cropping system was rotated for four consecutive years with different tillage systems vis-à-vis weed control practices and in fifth year (2009) studies were conducted to evaluate the period of persistence of applied herbicides in rice rhizosphere under different tillage systems in terms of their effect on microbiological and biochemical properties of soil. Four types of tillage system were evaluated and put in main plots *viz.,* (1) conventional-conventional (ii) conventional–zero (iii) zero-conventional and (iv) zero-zero tillage system. Among weed control practices performance of hand weeding and recommended herbicidal application was tested, comparing with a weedy check and put in sub plots. As recommended herbicides for *kharif* rice butachlor was sprayed in pre emergence and fenoxaprop-p-ethyl and ethoxysulfuron in post emergence stages of crop 1.5 kg, 56.25 g and 15 g/ha, respectively. The pre emergence and post emergence herbicides were applied at 3 and 20 days after sowing of the crop. The treatments were replicated thrice under split plot design. Soil from rhizosphere was collected from 7.5-15.0 cm. The results revealed that quantity of soil enzymes like phosphatase and dehydrogenase changed significantly due to different tillage systems at 30 and 50 days after sowing. However, the effect of the systems persisted up to harvest in terms of their effect on dehydrogenase activity. The enzymes' activities were found maximum under conventional-conventional and minimum under zero-zero tillage system During microbial population study the population of fungus and bacteria was found maximum under conventional-conventional tillage system and minimum under zero-zero tillage system. The use of recommended herbicides application significantly inhibited the enzymes' activity, basal soil respiration rate, microbial population and microbial biomass carbon status of rhizosphere soil of rice. The weedy check condition improved the bio-chemical and microbiological properties of the soil during active growth stages (30 and 50 DAS) of the crop. The data on microbial population & microbial biomass carbon content also shown the similar trend. It was concluded from the above study that conventional-conventional systems facilitated the growth of microbes in the crop rhizosphere in comparison to three other systems. Among different weed control practices hand weeding practice found better than chemical (herbicidal) control of weeds. However, applied herbicides were completely degraded by reaching to the harvest stage of the crop which indicated that applied herbicides were environmentally safe at the applied rates.

## P -21 Characterization of leaching behaviour of oxyfluorfen in soil

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A laboratory experiment was conducted during *kharif*, 2011 to characterize the leaching behaviour of oxyfluorfen. Sandy clay loam soil collected from Central Research Station OUAT, Bhubaneswar was filled in the columns of PVC pipes 60 cm long and 10 cm internal dia cut vertically into two and joined together by adhesive tapes with lower ends covered with muslin cloth. Water was applied to precondition the soil. Calculated quantity of oxyfluorfen i.e the recommended dose (0.15 kg/ha-x) and double the recommendation (0.30 kg/ha-2x) were applied to the column. Water was added everyday to the columns and each column was replicated twice. After 15 days the soil columns were split vertically and dissected into 5 cm increments. Each section was allowed to air dry, and the soil samples from different layers were analyzed for oxyfluorfen residues by GLC. The residues decreased significantly with depth. Residues could be detected up to 15 cm depth irrespective of concentrations. The leachate collected at 60 cm depth were analyzed for residue and no residues could be detected there.

## P -22 Survey on efficacy of herbicides against resistant population of *P. minor* in wheat at farmers' fields in Haryana

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During 1997, clodinafop, fenoxaprop and sulfosulfuron were recommended for the control of *P. minor* in wheat. After 10-12 years of their use, complaints of poor or no efficacy of these herbicides particularly clodinafop are being received from different districts of Haryana state. Keeping in view of alarming situation of poor control of *P.minor* in various parts of Haryana, present survey was conducted by dividing state in three zones during *rabi* 2011-12 in Kaithal, Karnal, Fatehabad, Jind, Kurukshetra (Pehowa), Ambala (Naggal block), Panipat districts (zone 1), Yamuna Nagar, Ambala (N.Garh and Barara tehsils) and Kurukshetra (Shahbad Markanda tehsil) districts (zone 2), Fatehabad (Ratia tehsil) and Sirsa districts (zone 3) of state. Complaints of poor efficacy were reported mainly from zone 1, where farmers are using alternate herbicides continuously since the last 12 years. In all 163 farmers were interviewed in all three zones. In zone 1, during 2010-11 out of 75 farmers, only 3 farmers (4%) used recommended dose of clodinafop with 22% control of *P. minor* because of poor efficacy achieved last year whereas in zone 2 even 28% farmers used ¾ th dose of clodinafop with more than 90% control. In zone 1, 25% farmers used double of recommended dose of clodinafop with only 36% control of *P. minor*. Forty five per cent farmers reported using clodinafop continuously since 1998. Remaining 55% followed herbicide rotation with sulfosulfuron, fenoxaprop but frequency of clodinafop use was more in these years. Choice for clodinafop is decreasing in this zone as shown by clodinafop use from 2008 to 2010. In 2008, 84% farmers used recommended dose of clodinafop and achieved 73% control. In 2009, only 48 farmers used recommended dose of this herbicide but achieved only 47% control where as only 4% farmers used recommended dose of clodinafop in 2010 with merely 22% control. But in zone 2, efficacy of clodinafop and number of users of clodinafop did not decrease and is same as in year 2008 and 2009. None of the farmer used double to recommended dose of clodinafop in this zone. All herbicides gave more than 90% control of *P. minor*. Even in zone 1, use of sulfonylurea herbicides like meso+iodosulfuron (Atlantis), SSN+MSM (R.M) and sulfosulfuron proved very effective against *P. minor* with 80-90% control, indicating cross-resistance against clodinafop only. In zone 3, situation is very comfortable as *P. minor* is less subjected to herbicides due to crop rotation. In this zone as 72% farmers used clodinafop this year whereas only 26% farmers, who are not following crop rotation, have to go for sequential application or double dose of clodinafop with only 41–75% control. Based on the observations from farmers' interviews and experiments conducted at farmers fields and bioassay studies, it seems that *P. minor* has developed resistance against clodinafop herbicide in Kaithal, Karnal, Jind, Panipat and parts of Fatehabad, Ambala and Kurukshetra districts of Haryana.

## P -23 Studies on residual effect of herbicides applied in rice on succeeding wheat crop

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Field trials were laid out during *rabi* 2009 and 2010 in a randomized block design with four replications at Agronomy Research Farm as well as Weed Science Laboratory of Department of Agronomy, NDUAT, Kumarganj, Faizabad. The application of almix 6 g and 12 g/ha, pretilachlor 0.5 kg and 1.0 kg/ha and oxadiargyl 0.1 kg and 0.2 kg/ha applied at 7 DAT in rice did not show their significant effect on density ($m^2$), dry weight ($gm^2$) of weeds and grain yield of rice (q/ha). Thus, the results revealed that almix 6 and 12 g/ha, pretilachlor 0.5 and 1.0 kg/ha and oxadiargyl 0.1 and 0.2 kg/ha at 7 DAT applied in rice to control the weeds did not showed their residual effects on weed density, weed dry weight and wheat yield significantly.

## P -24 Retention and movement of oxyfluorfen in different soils under compacted soil column

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Laboratory soil column experiment was conducted to study the leaching behaviour of oxyfluorfen in different soils using PVC pipes. One day before the herbicide application columns were pre treated with 500 ml distilled water. The treatments imposed were oxyfluorfen 200 g recommended (x) and 400 g/ha double the recommended dose (2 x) and control (no herbicide). Sufficient quantity of water was added everyday to govern the movement of herbicides. Each column was replicated thrice. At the end of experimental period (7 days) column was sectioned into different depths *viz.,* 0-5, 5-15, 15-30, 30-45 and 45-60 cm. The leachates were collected from all the treatments on 5$^{th}$ and 7$^{th}$ day. Soil samples and leachates were analyzed for oxyfluorfen residue using gas chromatograph equipped with ECD detector. Results showed that the oxyfluorfen residue decreased with increase in soil depth and residue was present up to 60 cm depth under both the levels of application with irrespective of soil types. Increased dose of application enrich the soil with that herbicide molecule besides transporting considerable quantity to lower depth also. After 7 days, 7-10, 13-16 and 17-64 per cent of the applied quantity of oxyfluorfen remained in the soil across different depths respectively in silty clay loam, peat and clayey soils and the per cent retention is more in double the recommended dose. Retention of oxyfluorfen is in the order of clayey > peat and silty clay loam soils. While more than 17 per cent of the applied oxyfluorfen retained in top layer of 0-5 cm depth in clayey soil, only 4.2 and 3.7 per cent was retained in silty clay loam and peat soils, respectively. The residue of oxyfluorfen was also detected in the leachates collected at 60 cm depth. Leaching of oxyfluorfen in different soils were in the order of peat soil > silty clay loam > clayey soil.

## P -25 Residual effect of oxyfluorfen applied to *kharif* groundnut on succeeding *rabi* crops

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Field investigation were carried out at the Agricultural Research Station, Bhavanisagar of Tamil Nadu Agricultural University, during *kharif* season of 2009 and 2010 to evaluate the new formulation of oxyfluorfen (23.5% EC) on weed control in groundnut and their residual effect on succeeding crops. Based on two years field experimentation, it was found that pre-emergence application of oxyfluorfen (23.5% EC) at 400 g/ha gave significantly lower total weed density and higher weed control efficiency at all the intervals. Application of new formulation of oxyfluorfen (23.5% EC) at 250 g/ha as pre-emergence herbicide can keep the weed density and dry weight below the economic threshold level and increased the growth and yield attributes significantly over unweeded control in groundnut. Uncontrolled weeds reduced the pod yield upto 55-59%. After harvesting of the groundnut crop to know the residual effect of herbicides, without disturbing the layout of each plot was manually prepared for sowing of succeeding crops *viz.,* sunflower and pearl millet during *rabi* season. Results revealed that germination of succeeding sunflower and pearl millet recorded at 10 DAS was not significantly affected by residual effect of herbicide applied to irrigated groundnut. Though, the plant stand of sunflower ranged from 84 to 89 per cent and pearl millet from 87 to 94 per cent under all the treatments at 10 DAS. Further, plant height and dry weight of plants recorded at 30, 60 and 90 DAS were also unaffected due to residual effect of different doses of oxyfluorfen applied in groundnut. Yield of sunflower and pearl millet showed no distinct variation due to different dose of oxyfluorfen. It might be inferred that new formulation of oxyfluorfen with different doses could be very effective against most of the broad leaved and grassy weeds in groundnut. But residual toxicity of oxyfluorfen can be ruled out even on sensitive crops such as sunflower and pearl millet in rotation.

## P -26 Leaching behaviour of butachlor and pretilachlor in soils as affected by texture

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The fate of herbicide in soil is influenced by its adsorption, degradation and leaching through the soil profile. Soil parameters like organic matter content, soil type, water transmission characteristics influence the leaching behaviour of a soil. Butachlor and pretilachlor are used as pre-emergence herbicides in rice crop, both under dry seeding and transplanted situations. In high rainfall areas, like Assam, with shallow water table leaching may be an important factor contributing to the contamination of groundwater by herbicide residue. A laboratory experiment was conducted with air dried soils, passed through 2 mm sieve, of sandy loam (organic carbon 7.6 g/kg, bulk density 1.48 $Mg/m^3$ in o-30 cm and 1.58 $Mg/m^3$ in 0-30 cm depth) and sandy clay loam (organic carbon 8.5 g/kg, bulk density 1.36 $Mg/m^3$ in 0-30 cm and 1.52 $Mg/m^3$ in o-30 cm depth) textures. PVC pipe of 10 cm diameter and 5 cm length, fixed from outside with adhesive tape was filled with respective soils in sequential order of soil depth into 60 cm column in duplicate. The soil at the bottom of the column was held with a muslin cloth. The recommended and double the recommended doses of herbicides butachlor (1.0 kg/ha and 2.0 kg/ha) and pretilachlor (0.75 kg/ha and 1.5 kg/ha) were applied and water was leached through the column at rates equivalent to the soil permeability. Soil column was dismantled after leaching of one pore volume of water. The leachate was collected at the bottom of the column and soil samples were analysed for herbicide residue. Highest residue was detected in the 0-5 cm layer of soil irrespective of herbicide and doses applied, which decreased with depth. The leaching of herbicide at recommended dose was observed up to 30 cm in case of butachlor (sandy loam soil) and 25 cm with pretilachlor (sandy clay loam soil), while at double recommended dose herbicides leached to a depth of 30 cm in sandy loam soil for butachlor and sandy clay loam soil in pretilachlor. The maximum herbicide residue concentration of 0.262 ppm was detected for butachlor and 0.207 ppm in pretilachlor, both in sandy clay loam soil and with double recommended doses.

## P -27 Herbicide use pattern and 2,4-D residue status in groundwater and natural water resources in some tea growing areas of Assam

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The major consumption of herbicides in Assam is confined to tea crop, which covers approximately an area of more than 0.2 m ha. The peak crop productivity from May to September coincides with monsoon rain and consequently profuse growth in weeds. Accordingly, several applications of herbicides are required for achieving optimum yield. Besides, the use of herbicide in tea has been in practice for over three decades in this region. The present study was thus undertaken to have an account of the use pattern and residue status of the herbicides in some tea growing areas of the state. During the period from March 2005 to July 2007, 42 water samples were collected covering 11 districts of the state, and analysed for 2,4-D residue in a GC (Thermofisher, India GC 1000) following standard procedures. Information pertinent to herbicides and their application dose and frequency were collected from the stakeholders. All the gardens under survey reported use of same herbicides, i.e. 2,4-D, glyphosate and paraquat, except one tea garden in Sivasagar district which used oxyfluorfen as additional herbicide. The intensity of herbicide application, in general, was 2 to 3 rounds of spray in a year and was followed by 50% of the gardens. About 43% adopted 4 to 5 applications during the year while the rest have a practice of application of more than 5 applications per year. Residue of 2,4-D was detected in 4 out of 42 samples, which ranged from 0.13 to 0.37 ppm, while in the rest it was found below detectable level (0.1 ppm). All the four water samples, with detectable levels of 2,4-D residue, were from surface water resources adjacent to tea crop and the contamination might have resulted from run off.

## P -28 Effect of alternate wetting-drying of soil on the efficacy and dissipation of butachlor, pretilachlor and pendimethalin

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Degradation of applied herbicide and consequently its persistence in a soil is an important aspect of chemical weed control measure. In one hand it should persist in the soil for managing weeds in the existing crop, on the other hand longer persistence may be a problem for the succeeding crop to be grown the field. Under field condition, sometimes soil remain continuously moist for a sufficiently long period of time, while at times it passes trough alternate spell of drying and subsequent rewetting due to irrigation or rainfall. In view of this, an experiment was conducted under laboratory condition to study the persistence of butachlor, pretilachlor and pendimethalin in soil under such varying soil moisture conditions and its implication on the growth of *Echinochloa colona*. Recommended doses of butachlor, pretilachlor and pendimethalin were sprayed to the soil taken in a series of small pots. The pots were randomly divided into two sets, namely, Set-A and Set-B. Set-A was watered everyday to keep the soil at field capacity (FC) level, while the soil of Set-B was allowed to pass through alternate wetting-drying (WD) cycle and watered to FC level at 7 days interval of time. All the pots were kept under laboratory condition and 6 pots from each set were taken out randomly at 7, 15, 25, 35 and 45 DAA of herbicide. Out of six, 3 pots were analysed for herbicide residue content, and in the remaining 3 pots *E. colona* was sown and observation on its germination and shoot length were recorded at 5 DAS. The dissipation of pendimethalin was relatively faster under continuous FC moisture regime than in the soil passed through alternate wetting drying resulting in a relatively lower half-life value of 18.1 days in former compared to 29.9 days at later moisture regime. Relative growth of *E. colona* sown after 45 days of pendimethalin application was 84% in the soil that received alternate wetting-drying treatment, whereas its 100% growth was recorded when the soil was kept at FC moisture level. This indicated relatively longer persistence of pendimethalin under alternate wetting-drying condition. Similar observations were recorded in case of pretilachlor and butachlor.

## P -29 Evaluation of herbicide resistant transgenic maize hybrids containing stacked events

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Maize is the third most important crop in the world agricultural economy after wheat and rice. The major yield reducing factors for corn cultivation are weeds and insects. Yield losses due to weeds varied from 28 to 29%. Transgenic corn hybrids with stacked event, (TC1507 X NK603) having both insect protection and herbicide tolerant traits provide protection to the crop against target inset pests and weeds. Field experiment was carried out during *kharif,* 2010 at experimental site of Tamil Nadu Agricultural University, Coimbatore and the experiment was laid out in randomized block design with replicated thrice. The treatments consisted of two transgenic hybrids (30V92 and 30B11 HR) resistant to glyphosate were tried with two different doses of POE of glyphosate at 900 and 1800 g/ha and these were compared with pre-emergence application of atrazine at 0.5 kg/ha followed by hand weeding on 40 DAS in non-transgenic maize hybrids like 30V92, 30B11, BIO 9681 (national check) and COHM5 (local check). From the study it was concluded that, early POE application of glyphosate at 1800 g/ha recorded lower weed density, higher weed control efficiency in transgenic maize hybrid compared with other treatments. Higher grain yield was recorded with POE application of glyphosate at 1800 g/ha in transgenic stacked maize hybrid of 30V92HR.

**P -30**

# Biosafety assessment of transgenic stacked corn hybrids (MON 8903 x NK603)

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Corn now ranks as the third most important food grain crop in India. Its area has slowly expanded over the past few years to about 6.2 million ha (3.4% of the gross cropped area). Major constraints in achieving the desired potential of corn are biotic factors as weeds, rats and insect pests which reduced the maize production levels by more than 50%. Keeping in view the above facts to achieve the desired potential of corn, an experiment was carried out at DWSR for the consecutive two years during *kharif* 2010 and 2011 to study the bio-efficacy and residual study of glyphosate in transgenic corn (MON 89034X NK 603). Two transgenic corn hybrid Hishell and 900M Gold, resistant to Glyphosate as well as to stem borer (*Chilo partelus*) and cob borer (*Helicoverpa* sp.), were tested and compared with its non-transgenic counterpart Proagro-4640 and HQPM-1. There was no natural infestation of borers in transgenic and conventional hybrids. Hence *Chilo partelus* and *Helicoverpa* sp. was introduced artificially from ICRISAT, Hyderabad for artificial inoculation with a view to assess the resistance against stem borer incidence. Although, inoculation was done late but there were symptoms of injury and infestation of the pest in the treatments which showed severe attack of the pest on the crop. The observations on per cent infestation and mean leaf injury score were taken after 15 days of inoculation.

Major weeds, present in the experimental field were *Echinochloa colona, Cyperus iria, Corchorus* sp*., Phyllanthus niruri, Dinebra* sp., *Physalis minima, Commelina benghalensis, Alternanthera sessilis etc*. and major insects recorded were coccinalid, spider, syrphids, pollinator, aphids *etc*. Results revealed 100% weed control in Hishell and 900M Gold transgenic hybrids receiving K salt of Glyphosate. Per cent infestation after 15 DAS showed complete absence of stem borer infestation and leaf injury score (LIS) 1 in all the transgenic entries of Hishell and 900M Gold. Where as, in all other conventional entries, stem bore infestation was observed and the LIS was more than 1. There was about 31 to 43 per cent infestation in conventional 900 Gold while in local check conventional, it was 100 per cent (HQPM-1) followed by national check (Proagro 4640). Tunnel length taken at the harvest time after tearing the stems also revealed highest tunnel length in national check and local check which correlates the highest infestation per cent of stem borer after artificial inoculation. No infestation of *Helicoverpa* in all transgenic entries of Hishell and 900M Gold was observed. Where as, in the remaining non-transgenic corn treatments, significantly higher infestation was observed as compared to transgenic hybrids. Significantly 36-71 per cent infestation was observed in all the non-transgenic lines which showed that transgenic entries are resistance to *Helicoverva* spp. also. In case of yield parameters, maximum total cob weight was recorded in Hishell and 900M Gold stack corn treated at 900, 1800 and 3600 g/ha levels of glyphosate and was found significantly higher than rest of the treatments. Fodder yield/plot of 900M Gold stalk at all the level of glyphosate was significantly higher than rest of the treatments. Although the fodder yields did vary significantly amongst transgenic hybrids. Hishell and 900 M Gold transgenic hybrids performed better with regard to grain yield ranging between 6-8 t/ha which was approximately three times higher than the average yield of maize crop per hectare *i.e*. 2.30 t/ha.

## P -31 Evaluation of residues of pyrazosulfuron ethyl 10 wp herbicide applied to paddy

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A field experiment was conducted to evaluate the persistence of pyrazosulfuron ethyl 10 WP herbicide applied at 25 g/ha (x Dose) and 50 g / ha ( 2x Dose) to paddy crop at Agricultural Research Station, Kathalagere, Davanagere District. The experiment consisted of six treatments i.e., pyrazosulfuron ethyl 10 WP applied at 25 g/ha and 50 g/ha with and without farm yard manure in comparison to hand weeding and unweeded control replicated four times in a RCBD design. The soil and water samples were collected at periodic intervals and residue estimation was carried out in grain, straw, soil and underground water (ppm) during *kharif* 2011. The results showed that there was no detectable residue of pyrazosulfuron ethyl 10 WP both at 25g/ha (recommended dose) and 50g/ha (double the recommended dose) at different intervals and at harvesting stage (120 days after planting) in soil, paddy grain and straw. The residue of pyrazosulfuron ethyl 10 WP were below detectable level at 45$^{th}$ day after application of herbicide in underground water in rice cultivated field at both 25 and 50g/ha. In the soil, pyrazosulfuron ethyl degraded fast at both 25 and 50g/ha. The persistence pattern indicated that residue of pyrazosulfuron ethyl was not observed after 45 days at 25g/ha and also at 50g/ha.

## P -32 Persistence of herbicides applied to soybean and its effect on soil microbial population

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A field experiment in soybean was conducted during the *kharif* season of 2010 and 2011 at research farm RVSKVV, College of Agriculture, Gwalior. Treatments consisted of recommended (1.0 kg/ha) and double the recommended (2.0 kg/ha) doses of pendimethalin (PE), recommended (9 g/ha) and double the recommended (18 g/ha) doses of chlorimuron ethyl (PoE) along with weedy check and weed free (two hand weeding at 30 and 45 days after sowing) were tested in a randomized block design having four replications. Soil samples (0-15 cm depth) from each plot were collected immediately after application and then at 15 days interval up to 60 days and after harvest of crop for persistance studies. Persistence of herbicides was measured by bioassay technique using maize as indicator plant. Observations on plant height, fresh weight and dry weight of maize were recorded 25 days after sowing. Soil samples collected after 0,7,15 and 30 days after application of herbicides and at harvest were collected for determination of microbial population. Serial dilution plate technique was applied using the rose bengal agar medium for fungi, Ken-Knight and Mundal's medium for actionomytes and Throrntон medium for bacteria. Plant height of maize was significantly reduced up to 60 days by pendamethalin 2.0 kg/ha and both the doses of chlorimuron ethyl while pendimethalin 1.0 kg/ha could reduce the plant height up to 45 days only. Fresh weight of maize plant was significantly reduced up to 45 days by double the recommended doses of both the herbicides i.e. 2.0 kg/ha pendimethalin and 18 g/ha chlorimuron ethyl. Both the herbicides applied to soybean could not affect the growth of indicator plant in post harvest soil. Results on microbial count reveal that total population of bacteria, actinomycetes and fungi in soil reduced considerably up to 15 days after application of both the herbicides. Pendimethalin 2.0 kg/ha and chlorimuron 18 g/ha showed more suppressive effect on microbial count as compared to their lower doses. However the population was restored after 30 days of application and at harvest.

## P -33 Residual effect of pre emergence mixed herbicides in transplanted rice on succeeding crops

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The field experiments were conducted in wetland farm, Tamil Nadu Agricultural University, Coimbatore during *kharif,* 2010 and 2011, to study the residual effect of pre-emergence mixed herbicide on greengram. Based on the two years of experimental result, the pre emergence application pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 20 kg/ha$^{-1}$ recorded lower weed density, dry weight and higher weed control efficiency at different intervals. The application of pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 12.5 kg/ha were also recorded lower weed density, dry weight, higher weed control efficiency and grain yield compare to unweeded control. The weedy check resulted in lower weed control efficiency and grain yield. The results revealed that the different weed management practices did not affect the germination percentage of succeeding greengram. The plant height and dry weight of plants recorded at 25, 45 and 65 DAS were also not affected due to the residual effect of different doses of pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309). There was no significant difference in yield among different treatments. The new formulation of herbicide effectively controlled the weeds. The green gram was sowed after the harvest of transplanted rice did not show any phytotoxicity symptoms. This showed that the succeeding green gram was not affected by the residue of new formulation of pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at different doses.

## P -34 Residual effect of imazethapyr applied to *kharif* groundnut on succeeding *rabi* crops

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Field investigations were carried out at the agricultural research station, Bhavanisagar of Tamil Nadu Agricultural University, during *kharif* season of 2009 and 2010 to evaluate the new formulation of early post-emergence (EPOE) herbicide imazethapyr on weed control in groundnut and their residual effect on succeeding crops. Based on two years field experimentation, it was found that the application of imazethapyr 200 g/ha gave significantly lower total weed density and higher weed control efficiency. Application of new formulation of imazethapyr at 100 g/ha can keep the weed density and dry weight below the economic threshold level and increased the growth and yield attributes significantly over control. After harvesting of the groundnut crop to know the residual effect of herbicides, without disturbing the layout, each plot was manually prepared for sowing of succeeding crops in *rabi* season. Results revealed that germination of succeeding sunflower and pearl millet recorded at 10 DAS was not significantly affected by residual effect of herbicide applied to groundnut. Though, the plant stand of sunflower ranged from 85 to 90 per cent and pearl millet from 92 to 97 per cent under all the treatments. Yield of sunflower and pearl millet showed no distinct variation due to different dose of imazethapyr. It may be concluded that new formulation of imazethapyr (10% SL) with different doses could be very effective against most of the broad leaved and grassy weeds in groundnut. Dry matter production and yield of sunflower and pearl millet did not show any variation among the weed control treatments and there was no residual toxicity due to imazethapyr on the succeeding crops.

## P -35 Field persistence and dissipation of herbicides under sunflower crop

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Sunflower is one of the vital oil seed crops grown in 0.29 lakh hectares in Tamil Nadu. To control the weeds at early growth stages, either pendimethalin or alachlor is applied by the farmers as pre emergence herbicides. Field experiment in sunflower (variety CO 1) was conducted during 2010-11 to study the persistence and dissipation behavior of pendimethalin and alachlor in sandy clay loam soil. Treatments imposed were the control (no herbicide), recommended dose and double the recommended dose of herbicides. Soil samples were collected at periodical intervals, extracted for herbicides and quantified by Gas Chromatograph (GC-Chemito Model 8610) equipped with $^{63}$Ni electron capture detector. Results showed that the application of pendimethalin at 1.0 kg/ha persisted in soil up to 60 days while up to 90 days at 2.0 kg/ha application rate. However 50% of applied herbicide was degraded from the soil before 30 days after application. Within 60 days of application more than 90% of the pendimethalin dissipated from the soil. For complete degradation from the soil, pendimethalin took 60-90 days. The residues of alachlor persisted in soil up to 30 and 45 days after application under 0.5 kg /ha (x) and 1.0 kg/ha (2x) applied plots. Thereafter the residue concentration went down below detectable level. The residue of pendimethalin and alachlor were below detectable limit in sunflower grain and straw when applied at recommended and double the recommended dose. The dissipation of both the pendimethalin and alachlor followed first order kinetics in the field study. The mean half life for the pendimethalin was 14.1 days while it was 9.8 days for alachlor. Significant correlation was observed between the days after herbicide application and herbicide residue level.

## P -36 A study on the mode of evolution of cross resistance against fenoxaprop-p-ethyl in some populations of *Phalaris minor*

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The mode of evolution of resistance to isoproturon in *Phalaris minor* from Haryana was found to be due to detoxification of the herbicide by the enzyme cytochrome P450 monoxygenase. A study on the mode of evolution of cross resistance against ACCase inhibiting herbicides was felt important in providing leads for use of alternate herbicides. This is because, if detoxification mechanism was involved as mode of evolution of cross resistance, herbicides, with different mode of action may not prove effective. On the other hand if target site changes were involved, herbicides with alternate mode of action could be used for managing the resistant populations. The objectives of the study conducted during 2009-2011were to differentiate between involvement of detoxification mechanism versus target site alterations as mode of evolution of cross resistance to fenoxaprop-p-ethyl. Four populations *viz.,* Hisar and Tohana as relatively sensitive and Fatehbad and Jind as relatively more resistant to fenoxaprop were selected for study. The study revealed that cytochrome P450 monoxygenase inhibitors used as (i) a combination treatment of aminobenzotriazole with fenoxaprop or as (ii) a spray of malathion prior to spray of fenoxaprop did not cause reversal of cross resistance as tested by mortality index. Pollen bioassay for determination of target site resistance revealed expression of cross resistance in the pollen grains. $GR_{50}$ value of 0.08, and 0.09 µM was observed in two population *viz.,* Hisar and Tohana. The pollen from Jind population showed a higher $GR_{50}$ value of 0.50 µM and that from Fatehbad showed a value of 5.0µM, thus distinguishing the susceptible from the resistant populations. The data indicated involvement of alteration at the target site as a mode of evolution of cross resistance to fenoxaprop in *P. minor* populations.

## P -37 Effect of glyphosate K salt applied in preceding transgenic stacked maize hybrids on succeeding green gram

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Transgenic stacked maize hybrid was developed for preventing yield losses of maize crop to improve productivity. The field experiments were conducted to study the carry over effect of glyphosate K salt applied in preceding transgenic stacked maize hybrids (Mon 89034X NK 603) in succeeding green gram in the experimental site of Tamil Nadu Agricultural University, Coimbatore during *kharif*, 2009 and *rabi,* 2009-10. Glyphosate was applied as POE at 900, 1800 and 3600 g/ha in Hishell and 900 M Gold transgenic maize hybrids compared with non-transgenic counterparts with PE application of atrazine at 0.5 kg/ha *fb*. HW on 40 DAS. Succeeding green gram crop was sown immediately after the harvest of herbicide tolerant transgenic stacked maize hybrids. Post emergence application of glyphosate at various rates in preceding transgenic stacked maize hybrids did not affect the germination percentage and vigour of succeeding green gram. The germination percentage of green gram was in the range of 85 to 98% and also there was no crop phytotoxicity in residual crops observed with different doses of glyphosate and other weed control treatments applied in transgenic and conventional maize hybrids during both the seasons. Total weed density in the succeeding crop significantly altered due to the different preceding weed management practices. During both the seasons, lower weed density was recorded with glyphosate at 3600 and 1800 g/ha when compared to other weed control treatments and also higher total weed density was observed under unweeded check. There was no significant influence on plant height, dry matter, yield attributes and grain yield of residual green gram by application of glyphosate at various rates in preceding transgenic maize hybrids.

## P -38 Study on carry over effect of glyphosate K salt applied in preceding transgenic stacked maize hybrids on succeeding green gram

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Transgenic stack hybrid corn was developed for preventing yield losses of corn crop to improve productivity. A field experiment was conducted to study the carry over effect of glyphosate K salt applied in preceding transgenic stacked maize hybrids (TC 1507 x NK 603) in succeeding green gram at the experimental site of Tamil Nadu Agricultural University, Coimbatore during *kharif*, 2010. Succeeding green gram crop was sown immediately after the harvest of herbicide tolerant transgenic maize. The treatments consisted of two transgenic hybrids (30V92 and 30B11 HR) resistant to glyphosate with two different doses of POE of glyphosate at 900 and 1800 g/ha and these were compared with pre-emergence application of atrazine at 0.5 kg/ha followed by hand weeding on 40 DAS in non-transgenic maize hybrids like 30V92, 30B11, BIO9681 (national check) and COHM5 (local check). Glyphosate was applied to preceding transgenic maize hybrids as early POE application at 900 and 1800 g/ha. The result shows that germination percentage of residual green gram was not significantly influenced by weed control treatments imposed on the previous maize crop and there was no crop phytotoxicity in residual crops observed with different doses of glyphosate and other weed control treatments applied in transgenic maize hybrids. Total weed density in the succeeding crops significantly altered due to the weed management practices. There was no significant influence on plant height, dry matter and grain yield of residual crops by post emergence application of glyphosate in preceding transgenic maize hybrids.

## P -39 Mobility of herbicides in different types of soils under saturated and unsaturated conditions

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Movement studies were carried out using packed soil columns to know the mobility of technical grade oxadiargyl and butachlor in an Alfisol (sandy loam) and Vertisol (clay loam) under saturated and unsaturated conditions. The study was conducted by taking soil columns as described by Harris (1966). Among two soils, herbicide extracted from vertisols was comparatively more than alfisol in both the herbicides might be due to stronger adsorption in clay soils. Depth of movement was more in alfisols than vertisols due to higher leaching of herbicides in loamy soils than clay soils.Herbicide movement was more in saturated conditions than unsaturated conditions. Higher movement of butachlor in soil column as compared to oxadiargyl could be attributed to higher water solubility of butachlor (23 mg/L) than oxadiargyl (0.37 mg/lt) and stronger adsorption of oxadiargyl on to soil colloids as compared to butachlor which restricted the movement of oxadiargyl in soils. The lower solubility of oxadiargyl than butachlor was mainly responsible for lesser leaching of oxadiargyl than butachlor in soils. Absence of herbicide residues in leachates collected beyond 30 cm depth of the soil column in spite of the high dose of application revealed no risk of ground water contamination. To find the association between movement of herbicide with depth of soil and time correlation was employed. Correlation studies revealed that there was stronger inverse relationship between movement of herbicide and depth for both herbicides, where as week positive relationship between movement of butachlor and oxadiargyl with time. Regression coefficients reveals that type of soil has significant effect on movement of butachlor than oxadiargyl. Further, depth of the soil and time had higher effect on the butachlor than the oxadiargyl. In case of butachlor highly significant association was observed and the independent variables contributed 82 % of the variation in the movement of butachlor, "r" value for movement with depth and movement with time was 0.83 and 0.28, respectively. Among two herbicides studied butachlor exhibited highly significant effect on movement than oxadiargyl.

## P -40 Evaluation of weed control efficiency and yield of transgenic stacked maize hybrids

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The development of crop cultivars with resistance to selected herbicides has the positive impact on agricultural production systems and food safety. Transgenic stacked maize hybrids evolved by Monsanto India Ltd., NK603 is gyphosate tolerant. While all other weed flora suppressed after application of herbicides. The transgenic maize hybrids were evaluated during *kharif,* 2009 and *rabi,* 2009-10 at experimental site of Tamil Nadu Agricultural University, Coimbatore. Glyphosate was applied as POE at 900, 1800 and 3600 g/ha in Hishell and 900M Gold transgenic maize hybrids compared with non-transgenic counterparts with PE application of atrazine at 0.5 kg/ha followed by HW on 40 DAS. The total weed density was significantly reduced with POE application of glyphosate at 1800 g/ha in transgenic 900 M Gold and at 3600 g/ha in transgenic Hishell during *kharif,* 2009 and *rabi,* 2009-10 seasons, respectively. POE application of glyphosate at 900, 1800 and 3600 g/ha recorded lower weed dry weight due to effective and timely weed control offered by glyphosate. Higher grain and stover yield was recorded with POE application of glyphosate at 1800 g/ha in transgenic 900 M Gold and 3600 g/ha in transgenic Hishell during *kharif* 2009 and *rabi* 2009-10 seasons, respectively. It was comparable with other doses of glyphosate during both the seasons. Average yield obtained in transgenic hybrids were 10 t/ha and conventional hybrids were 8 t/ha.

## P -41 Integrated management of *Striga asiatica* in early planted sugarcane under red sandy loam soils of Tamil Nadu

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Sugarcane (*Saccharum officinarum* L) is one of the most important cash crops in India and in Tamil Nadu, it is cultivated in an area of 2.2 lakh hectares with 244.60 lakh tonnes of sugarcane, with an average productivity of 110 t/ha. Especially in western and north western zones of Tamil Nadu more than 50% cane is cultivated in red gravel soils and infestation of *S. asiatica* is also more in this type of soils. Considering these situations a field experiments were conducted in the farmer's field with the objective to evaluate an efficient herbicidal management technique for the control of *Striga asiatica* in sugarcane. Field experiments were conducted during the main season of 2009-10 and 2010-11 in the farmer's field of Tamil Nadu. Trials were laid out in RBD with three replications. Atrazine 1.0 kg/ha PE; 2,4-D Na salt 1.0 kg/ha + urea 1% + soap solution 1% as POE; Directed spray(DS) of 20% urea of *Striga* plants; DS of 5% ammonium sulphate on *Striga* plants; DS of paraquat 0.5% on 70-75 DAP; PE atrazine 1.0 kg/ha 2,4-D Na salt 1.0 kg/ha + urea 1% + soap solution 1% as POE + mulching with cane trash on 120 DAP and Unsprayed control. Reduction in density and dry weight of *Striga asiatica* with better control efficiency was achieved with POE of 2,4-D Na salt 1.0 kg/ha + urea 1% + soap solution 1% on 70-75 DAP. Productivity and profitability of sugarcane increased by POE of 2,4-D Na salt 1.0 kg/ha + urea 1% + soap solution 1% and PE of atrazine 1.0 kg/ha +2,4-D Na salt 1.0 kg/ha + urea 1% + soap solution 1% as POE on 75 DAP followed by mulching with cane trash on 120 DAP.

## P -42 Post-emergence herbicidal management of water hyacinth in the water bodies of Tamil Nadu

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Water hyacinth (*Eichhornia crassipes*) has become a major weed of rivers and dams, and now a days water hyacinth becomes a notorious problem weed in southern parts of India, reduces access to and quality of available drinking and irrigation water. Hence, a study has been initiated to quantify the biological characteristics of water hyacinth and evaluate efficient post- emergence herbicidal management in stagnant water bodies in Tamil Nadu, during 2008 to 2011. Tank culture experiments were carried out to quantify the biological characteristics and to evaluate herbicidal management of water hyacinth in RBD with three replications. The biological characters of water hyacinth indicated that the mother plants grow very fast from one week after inoculation up to six weeks after that the growth rate decreased and it involved in seed maturation, senescence and ramet production. But in case of ramets they emerged from third week onwards and they involve in fast growth up to six weeks because of this continuous growth process the multiplication of water hyacinth resulted in very high rate and cause enormous problems to environment. Considering these situations, the tank culture experiment was conducted on *Eichhornia crassipes* to evaluate the efficacy of different post emergence herbicides like paraquat, glyphosate and 2, 4-D Na salt on both *Eichhornia crassipes* plant and on aquatic eco system. The results revealed that spraying of glyphosate at 10 ml/lit + ammonium sulphate 2% + 1% surfactant effectively reduced the *Eichhornia crassipes* density as well as biomass considerably.

**P -43**

## Effect of dosage of herbicide on entry, translocation and root exudates in water hyacinth

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Water hyacinth (*Eicchornia crassipes)* has become threat to fishing industry and farming community owing to reduced fish movement and depletes irrigation water in the pond. Spraying of foliar herbicide to control water hyacinth may lead to mortality of the fish by root exudation of herbicide or accidental drift of herbicide. Increase in dosage will overcome herbicide-divalent cation complex formation in hard water spray. Using radioactive glyphosate and 2,4-D, effect of herbicides dosage on herbicide retained on the cuticle as dried out residue, translocation in plant system and moved out of plants as root exudates was assessed. Twice the recommended concentration of herbicide per drop and drop density per fed spot significantly increased the dried residue of both the herbicide retained on the cuticle. Twice the dosage of 2,4-D significantly increased the amount of herbicide penetrated into the cuticle but difference in translocation to different plant parts was not significant except in root (recommended dose had higher activity than double the recommended dose ). At higher dosage root exudates of both herbicides was more after 8 days. Half-life of these herbicides in pond water was around 2 days for both herbicides compared to tap water 5 and 10 days of glyphosate and 2,4-D respectively. The chances of herbicide toxicity to fishes are unlikely by foliar applied herbicides like glyphosate and 2,4-D .

**P -44**

## A comparison of host-parasite interaction between three members of loranthaceae

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Hemi-parasitic plants are dependent on their host for water and nutrients for their growth and development. A study was initiated to evaluate the nutrient content, relative water content (RWC) and transpiration rate of three loranthaceae members commonly found in the fruit trees of Kerala. The samples of the parasites were collected from the same mango and sapota trees in the case of *H. elastica* and *D. falcata. M. capitellatum* was collected from Jack fruit tree from the same location. The $^{18}O$ studies was conducted at UAS, Banglore as per the method given by Scrimgeour,1995 using mass spectrophotometer continuous flow model. (Tracermass, PDZ-Europa, UK). RWC was estimated as per the method given by Barrs and Weatherly (1962). Among the three genus, *D. falcata* was found to have higher transpiration pull as revealed from $O_{18}$ isotope accumulation in the leaf biomass of the parasite. The parasite was also found to have higher N, Ca and Mn content as compared to the other two parasites. Estimation of RWC between the host and parasite showed that, in the case of *D. falcata* (86% as compared to 83%)) and *H .elaticus* (89% as compared to 83%) the water content of parasite was higher than the host where as for *M. capitellatum* (86% as compared to 87%) it was on par with the host. From the results obtained, it can be inferred the *D.falcata* is a more competitive parasite to the host as compared to *H. elastica* and *M. capitellatum.*

## P -45 Management of parasitic weed *Cuscuta chinensis* in niger

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A field experiment was conducted at Central Research Station OUAT, Bhubaneswar, Orissa to study the effect of various management practices of *Cuscuta* in niger during *kharif*, 2008-10 in split plot design with two main plot treatments viz summer deep ploughing and no summer ploughing and seven sub-plot treatments (weed control methods) *viz.,* pendimethalin 1.0 kg/ha PE as sand mix, pendimethalin 1.0 kg/ha at 15 DAS, imazethapyr 75-100 g/ha as PPI, imazethapyr 75-100 g/ha as post emergence, early post-emergence (10-12 DAS) of pendimethalin 0.5 kg/ha, stale seedbed (chemical-paraquat 0.5 kg/ha), stale seedbed *fb* pendimethalin 0.5 kg/ha (PE) and farmers' practice, replicated thrice with all other management practices remaining same. The germination of *Cuscuta* was 11.17% less in summer deep ploughing and significantly less in pendimethalin 1.0 kg/ha PE as sand mix (0.47 no./$m^2$).The method of summer deep ploughing in niger was effective in reducing the density of *Cuscuta* by 8.02% at 30 DAS and 5.76% at 60 DAS over no summer ploughing. The *Cuscuta* control efficiency was highest (54.0%) in stale seed bed *fb* pendimethalin 0.5 kg/ha PE which was closely followed by pendimethalin 1.0 kg/ha PE as sand mix (53.8%). The practice of summer deep ploughing increased the grain yield of niger by 2.67% over no summer ploughing. The treatment of stale seed bed *fb* pendimethalin 0.5 kg/ha PE recorded significantly the highest grain yield of 741.7 kg/ha followed by application of pendimethalin 1.0 kg/ha at 15 DAS (734.13 kg/ha). Among the weed control treatments, application of pendimethalin 1.0 kg/ha PE as sand mix produced the highest B:C ratio (1.79) followed by imazethapyr 75 g/ha as PPI (1.72) which is equal to summer deep ploughing.

## P -46 Studies on the pathogenesis of *Cuscuta campestris* on chickpea

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Chickpea (*Cicer arietinum* L.) is the most important pulse crop of India and India is the largest producer as well as consumer of chickpea in the world. Chickpea is grown in an area of about 6.67 million ha with an annual production of 5.3 million tonnes. Weeds are one of the important factors for reduction in yield of chickpea and *Cuscuta campestris*, a stem parasitic weed is a major production constraint in some areas of the country. *C. campestris* (field dodder) is a total stem parasitic angiosperm with a wide host range, belonging to the family Convolvulaceae, formerly Cuscutaceae. Once infected with *Cuscuta*, the host plant depending upon its age will not produce any flowers yield and wilt within a period of 15-20 days. Yield loss up-to 80-90% in individual cases of infections has been reported. Studies under controlled conditions in containment chamber were conducted on aspects like host search, haustorial initiation, progress, attachment, penetration and establishment in the host. Two plant growth promoting rhizobial microbes (PGPRm) isolated from the native rhizosphere of chickpea, *Pseudomonas fluorescens* and *Trichoderma viride* were evaluated for the induction of systemic resistance against *Cuscuta* under controlled conditions. Results of the experiment indicated that *P. fluorescens* and *T. viride* were found to elicit defense reactions in the treated plants. The microbes were applied as seed treatment and foliar application at 20 days and 45 days of sowing. The number of haustorial attachments was significantly less in the microbe treated plants leading to the increased life of the host plants. The defense enzymes *viz.,* peroxidase, polyphenol oxidase, catalase were found to be activated upon the application of the microbes. *T. viride* was found to activate more amounts of peroxidase, polyphenol oxidase enzymes while *P. fluorescens* was found to activate more of the other two enzymes.

## P - 47 Weed management prectices in direct seeded rice using different weed management practices in Alfisols of Chhattisgarh

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Chhattisgarh is popularly known as the "rice bowl". Out of 13.51 million ha geographical area, 5.9 million ha area is under cultivation among which rice occupies an area of 3.5 million ha with a production of 4.5 million tones and productivity of 12.6 q/ha. Aerobic or upland rice is direct seeded in non-puddle and non-flooded fields. It requires less water and labour than flooded rice but is usually subject to much higher weed pressure. In direct-seeded rice heavy seed rate is common practice that affects crop micro-environment by influencing the degree of inter-plant competition. Seeding rate was inversely correlated to weed interference. The clayey loam in texture soil (Alfisols) locally known as "Dorsa" is neutral in reaction. It had low nitrogen, medium phosphorus and high potassium contents. The weeds namely *Echinochloa colonum, Cyperus rotundus and Alternanthera triandra* were predominantly infested the field. Various chemical treatments showed significant effect on weed density. The grasses constitutes (56-65%), sedges (22-28%) and broad leaved weeds (10-17%) in the un-weeded plot (100% RSR) during 25 DAS to harvest. The application of 80% RSR +butachlor 1.5kg at 4 DAS + MW at 25 DAS resulted in significantly lower weed density (11.48/$m^2$) and dry matter which was an indication of effective weed control. The maximum WCE (%) and relative weed density were recorded in 80% RSR + butachlor 1.5kg at 4 DAS + MW (43.65%) followed by 80% RSR + MW at 25 and 40 DAS. Whereas, at later stages, the maximum WCE was observed in treatment 80% RSR + FPE 60 g + CME + MSM 4 g + MW at 25 DAS . However, it was statistically similar to 60% RSR + FPE 60 g + CME + MSM 4 g at 25 DAS + MW at 25 DAS ($T_3$) at 75 DAS.

## P - 48 Effect of integrated weed management practices on growth, yield and microbial population of direct seeded rice under puddle condition of Chhattisgarh

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The experiment was laid out in randomized block design comprised of eight treatments of various combinations of different herbicides *viz.,* T1:PIH 2023 10% SC 15 g/ha at 18 DAS; T2 : PIH 2023 10% SC 20 g/ha at 18 DAS; T3 : PIH 2023 10% SC 25 g/ha at 18 DAS; T4 : PIH 202310% SC 30 g/ha at18 DAS; T5 : PIH 202310% SC 60 g/ha at 18 DAST6 : Almix 20% WP 4 g/ha 18 DAS; T7 :control (unweeded check) and hand weeding at 30 DAS with three replications. Rice cultivar *"IR-64"* was grown as a test crop. The plant height, number of tillers ($m^2$), number of effective tillers ($m^2$), dry matter accumulation was higher under PIH 2023 10% SC 25 g/ha as compared to other weed management practices whereas the minimum growth of rice recorded under unweeded. Maximum grain yield and straw SC 60 g/ha *Echinochloa colona*, *Cyperus* spp., F. *miliaceae*, *L. hyssopifolia* were the pre-dominant weeds in experimental plot. Minimum weed density was noted under post emergence application of almix 4 g/ha and PIH 2023 25 g/ha at 20, 40, 70 and 90 DAS. Whereas, at harvest lower dry matter of weeds and highest weed control efficiency was recorded under lmix 4 g/ha , PIH g/ha and PIH 60 g/ha, respectively. Maximum bacterial and fungal population was obtained in treatment with post-emergence application of PIH 25 g/ha followed by almix 4 g/ha, PIH 20 g/ha, respectively. The lowest bacterial and fungal population was observed in unweeded check and was inferior than application of different dose of PIH, almix as well as hand weeding.

## P - 49 Chemical weed control in wet rice nursery

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The field experiment was conducted in wet rice nursery during summer 2010-*kharif* 2011 for three consecutive seasons at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bangalore under Cauvery Command area of Karnataka to study the effect of different pre-emergence use of herbicides on weed control and phytotoxicity in wet rice nursery. The treatment details consisted of application of butachlor (50% EC) 625 and 1250 g/ha applied within 24 hrs of sowing and 1250 g/ha at 3 days after sowing (DAS), pyrazosulfuron ethyl (10WP) 25 g/ha, bensulfuron methyl + pretilachlor (66G) 600 g/ha and pretilachlor + safenor (30% EC) 300 g/ha applied at 3 DAS and control. The experiment was laid out in a randomized complete block design with three replications. The soil type was red sandy loam with neutral pH (6.12), normal EC (0.108 d S/m), low to medium in organic carbon (0.50%) and available N of 298 kg/ha, $P_2O_5$ of 28 kg/ha and $K_2O$ of 212 kg/ha. The major weed flora observed in the experimental site were *Fimbrstylis miliacea*, *Cyperus difformis* (among sedges), *Echinochloa colona, Panicum tripheron, panicum dilatatums* (among grasses), *Glinus oppossitifolium, Spilanthus acmella* and *Eclipta alba* (among broad leaved weeds). The mean of three seasons results revealed that, pre- emergence application of pretilachlor + safenor 300 g/ha, bensulfuron methyl + pretilachlor 600 g/ha, pyrozosulfuron ethyl 25 g/ha and butachlor 1250 g/ha at 3 DAS recorded lower visual phytotoxicity and higher weed control ratings (0.19 to 0.50 and 9.44 to 9.48 , 0.01 to 0.29 and 8.78 to 9.28 and 0.01 to 0.23 and 8.91 to 9.43, respectively) at 7, 15, 21 DAS, respectively as compared to use of butachlor applied within 24 hrs of sowing in both the doses. Similarly, the above chemicals applied at 3 DAS lowered the density of weed (12.0 to 33.0/$m^2$) and recorded higher weed control efficiency (76.3 to 92.8%) at 21 DAS as compared to un-sprayed control (233.3/$m^2$). The cost of weed control in the above chemicals was ranging from Rs. 136 to 235/ 750 $m^2$ of rice nursery which was used to transplant one hectare area.

## P - 50 Establishment techniques and weed management practices on weed control efficiency and yield of puddled lowland rice

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Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif* 2008 and *rabi* 2008-09. Four crop establishment techniques *viz.,* system of rice intensification (SRI), transplanting, direct planting system (DPS) and drum seeding and four weed management practices *viz.,* pre-emergence pyrazosulfuron ethyl 30 g/ha at 3 DAT/8 DAS+weeding with finger type double row rotary weeder at 40 DAT/S, weeding with conoweeder twice at 20 and 40 DAT/S, two hand weeding at 20 and 40 DAT/S and un-weeded control were taken for the experiments. Among the crop establishment techniques, weed control efficiency was higher in system of rice intensification at 60 DAT/S in both the seasons was mainly because of the reason that in SRI, besides weeding treatment, conoweeder was operated from 20 DAT at 10 days interval till the stage of panicle initiation. Among weed management practices, pre-emergence application of pyrazosulfuron-ethyl 30 g/ha+ weeding with finger type double row rotary weeder at 40 DAT/S recorded higher weed control efficiency at 60 DAT/S in both the seasons. Among crop establishment techniques, yield components and yield was significantly higher under system of rice intensification and among weed management practices, conoweeder twice at 20 and 40 DAT/S gave better crop yield components and yield.

## P - 51 Management of weedy rice menace in rice through integrated management techniques in Palakkad district of Kerala

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Rice cultivation in Palakkad district of Kerala is seriously constrained with the spread of weedy rice in major rice growing tracts. Weedy rice, a weedy form of cultivated rice (*Oryza sativa*) is difficult to identify before panicle emergence and competes aggressively with the crop leading to drastic yield reduction in addition to contaminating the harvest and field. Considering the severity of the problem, an effort was made to develop an effective management strategy for weedy rice management through integrated approach in a heavily weedy rice infested farmers' field during *kharif* season of 2009-10 and 2010-11. The treatment consisted of use of a germination stimulatory rice crop, stale seed bed technique coupled with use of herbicides or ploughing followed by sowing. Use of stimulatory rice crop was included under the belief of farmers that presence of rice seeds in the field stimulates germination of weedy rice. The land was ploughed and rice seeds sown 25 kg/ha and irrigated to stimulate weedy rice seeds. This was followed by incorporation of all the sprouted plants either by ploughing or spraying of total weed killers like paraquat and glyphosate. The study revealed that sowing of rice seeds have no significant influence in stimulating germination of weedy rice and there was 33.42% reduction in wild rice count/$m^2$ in stale seedbed coupled with glyphosate applied plots. Stale seed bed coupled with glyphosate application followed by flooding the field without ploughing and wet seeding recorded the lowest weedy rice population and highest rice yield. Stale seed bed coupled with ploughing repeated thrice followed by wet seeding without disturbing the field was effective in bringing down the weedy rice population below the economic threshold.

## P - 52 Efficient weed management in system of rice intensification (SRI)

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An experiment was conducted to assess the performance of different weed management practices under the system of rice intensification (SRI) in comparison with the conventional system of rice cultivation. The field studies were carried out during the *rabi* seasons of 2007 and 2008 in the lateritic sandy clay loam soils of RARS, Pattambi, Palakkad district in Kerala, having pH 5.00 and medium fertility. The experiment was laid out in randomized block design with 16 treatments replicated thrice. The density and dry weight of weeds at 45 and 60 days after transplanting (DAT) were higher in all the SRI treatments especially when weed control was done through repeated cono weeding, while they were lower in the conventional system. Conventional system with cono weeding at 10 DAT followed by hand weeding at 30 DAT as well as use of post emergence herbicides could reduce the weed dry weight and nutrient removal by the weeds and reduced the weed index significantly. Moreover, the gross return, net return and B:C ratio were the highest in the conventional system with post emergence herbicides treatment. In the SRI fields the weed density and dry weight were the lowest with pre emergence herbicide followed by hand weeding at 30 DAT as well as cono weeding at 10 DAT followed by post emergence herbicides, and the use of post emergence herbicides showed higher B:C ratio. Thus, considering the acute shortage and high wage rate for the labourers in Kerala, weed management through post emergence herbicides will be the preferable option for the farmers in both conventional and SRI systems of rice cultivation.

## P - 53 Effect of pre and post emergent herbicides on nutrient uptake and yield in aerobic rice

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A field experiment was conducted on sandy loam soil during *kharif* 2010 at Main Research Station, Hebbal, UAS, Bangalore to investigate the effect of pre and post emergent herbicides on nutrient uptake and yield of aerobic rice. The predominant weed flora observed in the experimental field were *Echinochloa colonum, Digitaria marginata, Chloris barbata, Cynadon dactylon, Ageratum conyzoides, Spilanthus acmella, Celosia argentia* and *Cyperus rotundus*. The results revealed that higher grain and straw yield (4100 and 4961 kg/ha, respectively) was recorded with bensulfuron methyl 60g + pretilachlor 600 g/ha as pre emergent spray which was at par with two hand weedings at 20 and 40 DAS ( 4074 and 4928 kg/ha, respectively) and oxyfluorfen 90 g/ha as pre-emergent spray + 2, 4-DEE as post emergent spray 500 g/ha at 25 DAS (3876 and 4730 kg/ha respectively). This increase in yield was mainly attributed to better expression of growth and yield components as a result of effective control of weeds during early stages of crop growth and it helped the crop to utilize available resources i.e. nutrients, moisture, space and light to the full extent. Further bensulfuron methyl 60 g/ha +pretilachlor 600 g/ha as pre-emergent spray recorded significantly higher uptake of nutrients (79.3, 13.9 and 58.4 kg NPK/ha, respectively) which was at par with two hand weeding at 20 and 40 DAS (77.8, 13.2 and 57.3 kg NPK/ha, respectively) and oxyfluorfen 90 g/ha as pre-emergent spray + 2, 4-DEE as post emergent spray 500 g/ha at 25 DAS (73.8, 12.5 and 54.6 kg NPK/ha, respectively). Higher nutrient uptake by weeds was recorded in unweeded check (54.7, 18.9 and 46.1, kg NPK/ha, respectively).

## P - 54 Evaluation of pre and post-emergent herbicides in aerobic rice

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Aerobic rice is a new method of cultivating rice that requires less water compared to low land rice. It entails the growing of rice in aerobic soil, with the use of external inputs such as supplementary irrigation, fertilizers besides saving of 50 to 60 per cent of irrigation water. A field trial was conducted during *karif* 2010 at Main Research Station, Hebbal, UAS, Bangalore to evaluate performance of pre and post emergent herbicides in aerobic rice. The experiment consisted of 12 treatments laid out in RCBD with three replications consisting of five pre-emergent herbicides, two post emergent herbicides, two combination of pre and post-emergent herbicides, passing of cycle hoe at 15, 30 and 45 DAS and compared with two hand weedings at 20 and 40 DAS and unweeded check. The major weed flora observed in the experimental field was *Echinochloa colonum, Digitaria marginata, Chloris barbata, Cynadon dactylon, Ageratum conyzoides, Spilanthus acmella, Celosia argentia* and *Cyperus rotundus*. Results revealed that the yield reduction in aerobic rice due to critical period of crop weed competition was 91.7%. Among different herbicide treatments pre emergent application of bensulfuron methyl 60 g + pretilachlor 600 g/ha recorded significantly higher grain and straw yield (4100 and 4917 kg/ha respectively) followed by two hand weedings at 20 and 40 DAS (4074 and 4928 kg/ha, respectively) and oxyfluorfen 90 g/ha as pre-emergent spray *fb* 2, 4-DEE as post emergent spray 500 g/ha at 25 DAS (3876 and 4730 kg/ha, respectively) which were at par with each other. Unweeded check registered significantly lower grain and straw yield (339 and 462 kg/ha, respectively). Maximum net returns and B:C ratio was obtained with the pre emergent application of bensulfuron methyl 60 g + pretilachlor 600 g/ha (Rs. 27754/ha and 2.69, respectively) as compared to other treatments.

## P - 55 Efficacy of herbicides for controlling weeds in direct seeded rice

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The field experiments were conducted during *kharif* 2010 and 2011 to know the performance of weed management practices in direct seeded rice under upland condition at the Main Research Station, Hebbal, Bengaluru. The soil type was sandy loam with average fertility level. The experiment was laid out in a RCBD design replicated thrice and consisted of pyrazosulfuron ethyl 10 WP at 25g /ha, pretilachlor-S 30 EC at 750 g/ha (as pre-emergence at 3 DAS). Cyhalofop butyl 10 EC at 90 g/ha, fenoxaprop-p-ethyl 9 EC at 60 g/ha, cyhalofop butyl 10 EC at 90 g/ha + chlorimuron + metsulfuron (Almix 20 WP) at 4 g/ha, fenoxaprop 9 EC at 60 g/ha + chlorimuron + metsulfuron (Almix 20 WP) at 4 g/ha, azimsulfuron 50% G at 35 g/ha, bispyribac sodium 10% SC at 25 g/ha, fenoxaprop 9 EC at 60 g/ha + ethoxysulfuron 15 WG at 15 g/ha (all as post-emergence at 20 DAS). Oxyfluorfen 23.5 EC at 300 g/ha (3 DAS) *fb* 2,4,-D Na salt 80 WP at 0.5 kg/ha (30 DAS) in comparision to hand weeding (20 and 45 DAS) and unweeded control. Major weeds were *Cyperus rotundus, Echinochloa colona, Digitaria marginata, Dactyloctenium aegyptium, Cynodon dactylon, Spilanthus acmella, Ocimum canum, Euphorbia hirta, Mullugo cerviana,* and *Digera arvensis.* Among weed management practices, oxyfluorfen 300 g/ha + 2,4-D Na salt 0.5 kg/ha caused toxicity to rice and gave lower yield than all other weed control treatments, as the dosage of oxyfluorfen 300 g/ha is higher. Hand weeding twice gave higher paddy yield (3121 kg/ha) than all herbicide treatments. However, the next best treatments were fenoxaprop-p-ethyl + chlorimuron ethyl + metsulfuron methyl (2616 kg/ha), cyhalofop butyl + chlorimuron ethyl + metsulfuron methyl (2491 kg/ha), fenoxaprop-p-ethyl + ethoxysulfuron (2416 kg/ha), bispyribac sodium (2398 kg/ha).While pre-emergence herbicides – pyrazosulfuron ethyl and pretilachlor - s gave the next best yields (2198 to 2310 kg/ha), owing to good control of weeds during critical period of initial stages. Unweeded control gave the lowest paddy yield (607 kg/ha) owing to severe competition from weeds of all types and had higher weed index of 78%. The cost of herbicides including application cost was cheaper (Rs. 1240 with pyrazosulfuron ethyl to Rs. 2870/ha with cyhalofop butyl + chlorimuron ethyl + metsulfuron methyl) than hand weeding (Rs. 6750/ha). Thus herbicides usage could save weeding cost to an extent of Rs. 3880 to Rs. 5510/ha over hand weeding.

## P - 56 Effect of new herbicide molecules on growth and yield of transplanted rice in coastal Karnataka

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A field experiment was conducted during *kharif* 2010 at Zonal Agricultural Research Station, Brahmavar, Udupi district, Karnataka. The experiment consists of 10 treatments laid out in randomized block design with three replications consisting of four pre- emergence herbicide, three post emergence herbicides, conoweeder at 20 days after transplanting followed by hand weeding at 40 days after transplanting, hand weeding twice at 20 and 40 days after transplanting and control. The predominant weed flora were *Differmis* spp., *Cyperus procerus, Euricolon* spp, *Monocoria vaganalis, Ammania baccifera, Rotala verticilaries, Ludwizia parviflora* and *Marselia quadrifolia.* The results reveled that among the herbicidal treatments, pre-emergence application of bensulfuron methyl10.6% G 60 g/ha + pretilachlor 6% G 600 g/ha at 3 days after transplanting recorded significantly higher grain yield and straw yield (5212 kg/ha and 5858 kg/ha, respectively), lower weed population and their dry weight (23.12 / 0.25 $m^2$ and 4.29 g / 0.25 $m^2$, respectively). The net returns and B:C ratio was also high with the bensulfuran methy + pretilachlor at 3 days after transplanting (Rs 40855.65/ha and 2.93, respectively).

## P - 57 Participatory technology development for control of *Scirpus grossus*– a perennial weed in rice fallows

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The low-lying *Padashekaram* of Puthenchira Panchayath of Vellangallur block of Thrissur district is an area where *Pokkali* cultivation was taken up years before. Now an area of about 150-200 acres is seriously infested by a perennial rhizomatous deep rooted alien weed of Cyperaceae family, *Scirpus grossus,* locally known as *Pottapullu.* A meeting of the farmers of various *Padasekharams*, panchayat representatives and officials was convened. As the farmers were reluctant to go for chemical control it was decided to go for tractor ploughing using rotovator to cut the weeds. A first round of ploughing with cage wheel followed by two rounds of ploughings were given using rotovator and finally leveling. An area of 26 acres in Thekkumkulangara *Padasekharam* was cleared off the weeds and paddy seeds (variety – Uma) were sown in January 2010. A post emergence spray of 2,4 –D 1kg/ha was done on 18 DAS to control further weed growth. This was very effective and the crop was harvested in April. The study could clearly demonstrate the successful control of a perennial troublesome weed. Hence if farmers are willing to take up cultivation, the area can be brought under paddy again. As the technology was developed with farmers' participation

## P - 58 Influence of weed management practices under different rice establishment techniques on productivity and economics of rice

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The field experiments were carried out during *kharif* 2008, 2009, 2010, summer 2009 and 2011 seasons to know the effect of weed management practices under different rice establishment techniques on the rice productivity and economics at the Agricultural Research Station, Kathalagere, The soil type was sandy clay loam with average fertility level. The four crop establishment techniques were $S_1$–System of Rice Intensification, $S_2$–Transplanted rice, $S_3$ - Broadcasting of sprouted rice and $S_4$- Drum seeing of sprouted rice in the main plots. Sub plots comprised of four weed management practices like $W_1$ – Pyrazosulfuron 25 g/ha – 3 DAS/P *fb* mechanical weeding (45 DAP/S), $W_2$ – Cono weeder (15, 25 & 35 DAS/P), $W_3$ –Hand weeding (20 & 45 DAS/P), $W_4$ – Unweeded control. Major weeds were *Cyperus difformis*, *Scirpus* sp, *Fimbristylis miliacea, Echinochloa colona, Panicum tripheron*, *Paspalum dilatatum, Ludwigia parviflora, Eclipta alba, Rotala verticillaris, Gnaphalium polycaulon, Dopatrium junceum, Spilanthus acmella* and *Marselia quadrifoliata.* Averaged over five seasons (2008 to 2011), paddy yield was considerably lower in broadcasting of rice (3279 kg/ha) as compared to other methods of rice establishment. Normal transplanting of rice produced yield (4664 kg/ha) similar to SRI (4367 kg/ha) and these two methods were slightly superior to drum seeding (3922 kg/ha), due to initial weed competition. Among weed management practices, pyrazosulfuron ethyl 25 g/ha *fb* mechanical weeding (45 DAS/P) (4947 kg/ha) and hand weeding twice (20 and 45 DAS/P) (4800 kg/ha) gave similar paddy yields. Passing of conoweeder (15, 35 and 45 DAS/P) resulted in next higher yields (4252 kg/ha). As compared to transplanting, direct seeding of rice either by broadcasting (Rs.3200/ha) and drum seeding (Rs.3075 kg/ha) lowered the cost of cultivation Among weed management practices, use of pyrazosulfuron ethyl fb one hand weeding (45 DAS/P, Rs.2400/ha) and adoption of conoweeder (15, 25, 35 DAS/P, Rs. 2000/ha) were cheaper than hand weeding (Rs. 6200/ha) and thus saved weeding cost by Rs.3800 – 4200/ha.

## P - 59 Weed control studies in chickpea

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An experiment was carried out to evaluate the efficacy of some post emergence herbicide in chickpea at Crop Research Center of S.V. P. University of Agriculture & Technology, Meerut (U.P.) during *rabi* season of 2009-10 and 2010-11. Twelve treatments consisted three dose of quizalopfop ethyl 5 EC (30, 40, 50 and 60 g/ha and imazethapyr 10% SL (50, 75 and 100 g/ha) were compared with pendimethalin 30 EC 1000 g/ha, ioproturon 75 WP 1000 g/ha, clodinafop 15 WP 40 g\ha, two hand weeding and weedy check in randomized block design with three replications. The soil of the experimental field was sandy loam in texture, neutral in reaction, low in organic carbon and nitrogen and medium in phosphorus and potassium. All the herbicide had marked influenced on weed density, dry weight, nutrient uptake by weeds, yield and yield attributes of crop along with growth indicators and quality of chickpea, except the lower dose of quizalopfop ethyl (20 and 40 g/ha). Quizalopfop ethyl 50 and 60 g/ha. and imazethapyr 75 and 100 g/ha were produced significantly higher yield than weedy and it was statistically at par to check pendimithalin 100 g/ha PE as well as two hand weeding. At this dose, these herbicides were more effective against grassy weed as compared to broad leave weeds. These treatment were also expressed superiority in weed reduction, nutrient utilization by crop, gross income, net return and B:C ratio. It can be concluded that post-emergence application of quizalopfop ethyl 50 and 60 g/ha and imazethapyr 75 and 100 g/ha can be used to control weeds in chickpea.

## P - 60 Management options for controlling the weedy rice complex in rice fields of Kerala

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Weedy rice is a complex of *Oryza* morphotypes widely distributed in the commercial rice fields, especially in areas where farmers have switched to direct seeding due to labour shortage and high cost. The present recommendations of chemical weed control in rice are not effective for selective control of weedy rice. The results of the experiment revealed that in already infested fields, the effective strategy was to deplete the weedy rice soil seed bank by adopting stale seed bed technique (destroying the weedy rice seedlings by the application of non selective herbicides followed by flooding for two weeks, draining the field and subsequent sowing). The duration and frequency of various operations in stale seed bed preparation varied in mildly infested (2-3 mature weedy rice plants /$m^2$), moderately infested (5-7 mature weedy rice plants/$m^2$) and heavily infested fields (> 10 mature weedy rice plants/$m^2$). Burning of straw left after the harvest of rice stimulated the germination of dormant weedy rice seeds in the soil. Among the different herbicides tried, pre sowing surface application of oxyfluorfen 0.3 kg/ha three days before sowing, in 5 cm standing water, effectively controlled weedy rice emergence during the initial critical period of 12-15 days after sowing, giving competitive advantage to the crop. Soil incorporation of pre emergence herbicides did not give significant control of weedy rice. Addition of weed seeds to soil from the infested standing crop could be controlled by direct contact application of nonselective herbicides like paraquat, glufosinate or glyphosate 100 ml/l to the each heads of weedy rice using special wick applicator at around 60-70 days after sowing, for selectively drying of the panicles of weedy rice.

## P - 61 Bio-efficacy and phytotoxicity of azimsulfuron as sole and tank mix with metsulfuron methyl on transplanted paddy and effect on follow up zero-till rapeseed

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A field experiment was conducted during 2006-07 and 2007-08 to evaluate the bio-efficacy and phytotoxicity of azimsulfuron alone as sole and tank mix with metsulfuraon methyl (MSM) in transplanted paddy cv. IET 4094 and its residual effect on succeeding zero till rapeseed *cv. B-9*. The trial consisted with eleven treatments (two for phytotoxicity) laid out in randomized block design with three replications. The predominant weed flora observed in the experimental plot were, *Echinochloa crus-galli, E. formosensis, Cyperus difformis, C. iria*, *Alternanthera philoxeroides, Marsilea quadrifolia, Eclipta alba* and *Ludwigia octovallis.* Among the herbicide tested, tank mix application of azim sulfuron 50 DF 40g/ha+MSM 20 WG 2g/ha +0.2 % surfactant at 14 DAT was the best in controlling all types of weed showing WCE of 79.08 % and 88.78% at 30 and 45 DAA, respectively and recorded significantly higher grain (4.76 t/ha) and straw yield (5.76 t/ha). Further net returns and B:C ratio (Rs 1.96) were also high with $T_2$ and the lowest in untreated control. Herbicide azimsulfuron recorded significantly better efficacy for controlling sedge and grassy weeds whereas MSM was found as the best killer of broadleaf weeds. No phytotoxicity was observed in paddy plant even with the double dose of tested herbicide with or without surfactant. In follow up rapeseed crop no significant residual effect of herbicide was found on the germination of rapeseed seed though a distinct variation was found in seed & stover yield.

## P - 62 Studies on bio-efficacy and phytotoxicity of penoxsulam for weed control in direct dry seeded rice

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A field trial was conducted during *kharif* season of 2009 and 2010 at Norman E. Borlaug, Crop Research Centre, Pantnagar. The experiment was laid out in randomized block design with eight treatments replicated four times. The treatment consisted of three doses of penoxsulam 24% SC w/v applied at 20, 22.5 and 25 g/ha, pyrazosulfuron 10 WP 20 g/ha, bispyribac 10 SC. Applied at post emergence however, pendimethalin 30 EC 1000 g/ha at (pre-emergence). The dominant weed flora associated with experimental field were grasses like *Echinochloa colona, E. crusgalli* and *Leptochloa chinensis*; broad leaf weeds like *Ceasulia axillaris* and sedges like *Cyperus rotundus*. All the doses of penoxsulam (20, 22.5 and 25 g/ha) have better control over the grasses and BLW than sedges. *Cyperus rotundus* population in penoxsulam 22.5-25 g /ha was considerably high but significantly lower than other. As the doses of penoxsulam increased from 20 to 25 g/ha caused reduction in the density and biomass of weeds. Among the herbicide application, the highest grain yield of direct seeded rice was recorded with application of penoxsulam 25.0 g/ha followed by the application of same herbicide at its lower dose of 22.5 g/ha during both the years. Penoxsulam 25 g/ha was found significantly superior over the standard check pyrazosulfuron 20 g/ha and pendimethalin 1.0 kg/ha while was at par with bispyribac 25 g/ha in respect to grain yield. No phytotoxicity symptoms were observed with any of the treatments on crop plant during both the years of experimentation. Application of higher dose of penoxsulam 25 g/ha followed by pyrazosulfuron 20 g/ha proved to be most effective in minimizing the density of weed and their dry weight and enhancing the grain yield as compared to its reference herbicides.

## P - 63 Effect of weed management practices on direct seeded dry rice under different sowing dates

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Weeds cause major problem in direct seeded rice production, which result in lower yield. A field experiment was conducted during *kharif* seasons of 2006 and 2007 at Norman E. Borlaug, Crop Research center, G.B. Pant University of Agriculture and Technology, in loamy soil having medium in organic matter (0.67 %), high in available phosphorus (38 kg/ha) and medium in available potassium (181.25 kg/ha) to evaluate the efficacy of different herbicides *viz.,* butachlor 1.5 kg/ha (PE), pendimethalin 1.5 kg/ha (PE), pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha (PE), thiobencarb 1.5 kg/ha (PE), pretilachlor 0.75 kg/ha (PE), fenoxaprop-p-ethyl 0.06 kg/ha (15 DAS) followed by 2,4-D 0.5 kg/ha (30 DAS), anilophos 0.4 kg/ha (10 DAS) and two hand weeding (20 and 40 DAS) along with weed free and weedy check under different sowing dates *viz.* 05 June, 20 June and 05 July. The field experiment was laid out in split-plot design with 3 replications. Rice variety *"Govind"* was sown in lines at 20 cm distance with recommended dose of fertilizer 120 kg N, 80 kg $P_2O_5$ and 60 kg $K_2O$ per hectare. Reduction in grain yield in weedy plots was recorded (70.4%) during 2006 and (67.4 %) during 2007. *Echinochloa colonum* among grasses and *Commelina benghalensis, Caesulia axillaris* among non-grasses and *Cyperus rotundus* among sedges were the predominant weed species in the experimental plot during both the years. Highest grain yield (2489 kg/ha and 2703 kg/ha during 2006 and 2007, repectively) was recorded from 20 June sown rice crop which was significantly higher over rest two dates of sowing (05 June and 05 July). Highest grain yield was recorded in mechanical two weeding at 20 and 40 DAS (3324 kg/ha during 2006 and 3437 kg/ha during 2007) being significantly superior over rest of the treatments. Among the herbicidal treatments, pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha PE produced significantly higher grain yield (3097 kg/ha during 2006 and 3289 kg/ha during 2007) over rest of the treatments. Among the herbicidal treatments, highest net income and B: C ratio were found with pendimethalin 1.0 kg/ha + anilophos 0.4 kg/ha during both the years.

## P - 64 Bio-efficacy and phytotoxicity evaluation of clethodium in soybean and succeeding green gram

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A field experiment was conducted at Zonal Agricultural Research Station. Navile, Shivamogga, University of Agricultural Sciences, Bengaluru during *kharif* 2010 to study the diversity and dynamics of weeds as influenced by clethodim in soybean and its residual effect on succeeding crop. The experiment was laid out in RCBD with three replications. Treatment included clethodium at three doses *viz.,* 36, 48 and 60g/ha in combination with non- ionic surfactant (NIS) and ammonium sulphate (AMS) and clethodium at 48 gm per hectare + NIS and clethodium 48g without surfactant The other treatment were quizalofop ethyl 5% EC 50 g/ha, fenoxaprop-p-ethyl100 g/ha as post emergent, pendimethalin 1000 g/ha as pre emergent. Hand weeding was done at 20 DAS and 40 DAS manually. The major weed flora observed in the experimental plots were *Celosia argentia, Acanthospermum hispidum, Commelina benghalensis, Borreria articularis, Parthenim hystrophorus*, *Cleome viscosa*, *Dactyloctenium aegyptium, Cynodon dactylon, Eleusine indica, Digitria marginata* and *Cyprous rotundus.* The results revealed that clethodim 60g/ha along with NIS+AMS reported significantly lower number of weeds and their dry weight compared to all other treatments along with significantly higher seed yield (2312 kg/ha) .The herbicidal weed control treatments did not show any phytotoxicity symptoms on soybean as well as the succeeding green gram crop.

## P - 65 Evaluation of bispyribac sodium 10% SC on weed control in direct seeded rice

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Tamil Nadu contributes nearly eight per cent of the national production from the area of 2 m ha, with production of 6.58 mt. Continuous efforts are being made to increase the rice production to the tune of 115-120 mt by 2020. Weed competition is one of the prime yield-limiting biotic constraints in direct seeded rice. Hence a field evaluation was carried out for finding the new formulation of bispyribac sodium in direct seeded rice during winter season of 2011 at Tamil Nadu Agricultural University, Coimbatore farm. The soil of the field was clay loam in texture. The treatments consisted of EPOE application of bispyribac sodium 10% SC at 10, 20, 40 g/ha, bispyribac sodium (nominee gold) 20 g/ha on 15 DAS and PE herbicides of butachlor 1.5 kg/ha, anilophos 0.45 kg/ha, pretilachlor 0.45 kg/ha PE on 3 DAS + HW on 40 DAS and power weeder, conoweeder weeding at 20 and 40 DAS, HW twice on 20 and 40 DAS and unweeded control. The experiment was laid out in a randomized block design and replicated thrice. The results envisaged that the application of pretilachlor 0.45 kg/ha PE + HW on 40 DAS registered lower weed density and dry weight at 20 DAS but during the later stages of crop growth EPOE application of bispyribac sodium 40 g/ha recorded lower weed density and dry weight. EPOE application of bispyribac sodium 10% SC 40 g/ha obtained higher weed control efficiency (92.54%) and followed by pretilachlor 0.45 kg/ha + HW on 40 DAS (90.06%) produced grain yield of 5933, 5854 kg/ha and straw yield of 8211, 8167 kg/ha, respectively.

## P - 66 Early post emergence herbicidal weed management in transplanted rice

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Weed competition is one of the major factors that affects rice yield. Greater yield losses can occur at times when weed competition coincides with the critical period of growth of rice. Reduction in grain yield due to unchecked weed infestation in transplanted rice varies between 29 and 63 per cent. The rice herbicides presently used are mainly pre-emergence and weeds coming at later stages of crop growth are not controlled effectively. This situation warrants for initiating research efforts to evaluate and identify suitable post emergence herbicide(s). The field experiment was conducted in wetland farm, Tamil Nadu Agricultural University, Coimbatore during *rabi*, 2011 to evaluate the efficacy of new molecule of early post emergence herbicide in transplanted rice. The experiment was laid out in a randomized complete block design with three replications. The treatments consisted of three doses of new formulation of early post emergence herbicide bispyribac sodium 10% SC at 10, 20 and 40 g/ha on 15 DAT, bispyribac sodium 10% SC (nominee gold) 20 g/ha on 15 DAT and pre emergence application of butachlor 1.5 kg/ha, anilophos 0.45 kg/ha along with HW twice 20 and 40 DAT and unweeded control. From the study, it was observed that application of bispyribac sodium 40 g/ha registered lower weed density and dry weight of weeds and it was followed by bispyribac sodium 20 g/ha. The same treatment also recorded higher weed control efficiency which resulted in higher grain and straw yield of transplanted rice.

## P - 67 Best weed management practices in irrigated maize

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A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif* 2010 to evaluate the different weed management practices in maize. The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of different weed management practices *viz*., oxyfluorfen at 0.2 kg/ha, atrazine 0.5 kg/ha, pendimathalin 0.75 kg/ha, ametryn 0.5 kg/ha, oxyfluorfen 0.2 kg/ha + twin wheel hoe (TWH) on 30 DAS, atrazine 0.5 kg/ha + TWH on 30 DAS, pendimathalin 0.75 kg/ha + TWH on 30 DAS, ametryn 0.5 kg/ha + TWH on 30 DAS, oxyfluorfen 0.2 kg/ha + power weeder (PW) on 30 DAS, atrazine 0.5 kg/ha + PW on 30 DAS, pendimathalin 0.75 kg/ha + PW on 30 DAS, ametryn 0.5 kg/ha + PW on 30 DAS, hand weeding twice on 20 and 40 DAS and unweeded control. From the field experiment, it could be concluded that pre emergence application of oxyfluorfen at 0.2 kg/ha followed by removal of late emerging weeds either by twin wheel hoe or power weeder can keep the weed density and dry weight below the economic threshold level and enhance the yield and monetary returns in irrigated maize. In areas where labour is scarce for timely manual weeding, integrated weed management practice of combining pre emergence herbicides followed by mechanical weeding with the use of weeders may be suggested as an economical weed management practice in maize.

## P - 68 Effect of monsoon and weed management on weed growth and yield of direct (dry) seeded rice

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A field experiment was conducted at G.B. Pant University of Agriculture & Technology, Pantnagar during the *kharif* season of 2008 and 2009 to study the effect of seeding time and six methods of weed control on weed, crop growth and productivity of direct dry seeded rice. The experiment was laid out in split plot design with three replications. The treatment comprised of two seeding time (pre and post monsoon) of direct seeded rice in main plot and six methods of weed control *viz.*, pretilachlor 0.5 kg/ha, butachlor 1.5 kg/ha each as PE, broad casting of sesbania knocked down with application of 2,4-D 0.5 kg/ha at 30 DAS, weedy and weed free. The experimental field was mainly infested with *Echinochloa colona, Eleusine indica* among the grasses, *Celosia argentia* and *Cleome viscosa* among broad leaved weeds and *Cyperus* spp. among sedges. The total weed density and dry weight of weeds was reduced in post monsoon as compared to pre monsoon seeded crop, but the differences were non significant. Highest grain yield of rice in 2008 was recorded with post monsoon, while in 2009, it was in pre monsoon seeded crop. Among the weed control treatments, butachlor 1.5 kg/ha in year 2008 and broadcasting of *Sesbania* knockdown by application of 2,4-D at 30 DAS in 2009 proved to be most effective in minimizing the weed dry weight. Pre emergence application of butachlor 1.5 kg/ha yielded highest followed by the application of pretilachlor 0.5 kg/ha and broadcasting of *Sesbania* knockdown with 2,4-D 0.5 kg/ha at 30 DAS.

## P - 69 Impact of time of sowing on weed management in direct wet seeded rice

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Weeds are dynamic and the composition and competition by weeds is dependent on soil, climate, cropping and management factors. Monsoon plays a major role in the intensity and spectrum of weed flora. Weeds are responsible for heavy rice yield losses, to the extent of complete crop loss under extreme conditions. A field experiment was conducted in wetland farm of TNAU, Coimbatore during *rabi,* 2010-11 and *kharif,* 2011, to find out the suitable time of sowing and weed control methods in direct seeded rice. The experiments were laid out in split plot design with three replications. The main plot treatments consists of time of sowing ie. before onset on monsoon (BOM), after onset of monsoon (AOM) and weed control methods *viz.,* pretilachlor - 0.5 kg/ha PE, butachlor 1.5 kg /ha + HW on 30 DAS, fenoxaprop 60 g /ha PO or almix 4 g/ha or tank mix of both, Sesbania (broadcast) + 2,4-D 0.5 kg/ha at 30 DAS, unweeded control (weedy) and HW twice (weed free) in sub plots. Among the different time of sowing, AOM recorded lower density of sedges, grasses and BLW than BOM at 30 DAS during both the seasons. In the different weed control methods, the total weed density was lower with the application of butachlor 1.5 kg/ha + one hand weeding *fb*. hand weeding twice and application of pretilachlor S 0.5 kg/ha PE at 30 days stage of crop. AOM produced significantly higher number of productive tillers, grain yield (4797and 5720 kg/ha) and straw yield (5206 and 6219 kg/ha) during *rabi,* 2010-11 and *kharif,* 2011 respectively as compared to BOM. Application of butachlor 1.5 kg/ha + one HW recorded higher number of productive tillers, grain(5259 and 5834 Kg/ha) and straw yield (5612 and 6740 kg /ha) during *rabi,* 2010-11 and *kharif,* 2011 respectively in the different weed control methods practised during both the seasons, which was followed by HW twice and preemergence application of pretilachlor S 0.5 kg/ha.

## P - 70 Efficiency of pyrazosulfuron ethyl against complex weed flora and grain yield of transplanted rice

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Rice production is plagued by several constraints of which, weed competition inflict heavy losses. Pyrazosulfuron ethyl is one of the new rice herbicide under sulfonylurea group. A field experiment was carried out to evaluate the new formulation of pyrazosulfuron ethyl in transplanted rice. The experiment was laid out in randomized block design with three replication. Treatments were pyrazosulfuron ethyl 10% WP at 5, 10,15, 20, 30 g/ha, pyrazosulfuron ethyl 10% WP at 10, 15 g/ha, pretilachlor at 0.75 kg/ha *fb.* HW on 45DAT, HW twice on 15 and 30 DAT and Weedy check. At 25 DAT, HW on 15 and 30 DAT recorded significantly lower total weed density (3.16 no/$m^2$) which was on par with pyrazosulfuron ethyl at 20 g/ha PE + HW (3.45 no/$m^2$) and pyrazosulfuron ethyl at 30 g/ha PE + HW (3.55 no/$m^2$). At 45 DAT, PE pyrazosulfuron ethyl at 20 g/ha + HW recorded significantly lower total weed density and was on par with HW on 15 and 30 DAT. At 25 DAT, pyrazosulfuron ethyl at 20 g/ha+ HW recorded significantly lower total weed dry weight and was on par with pyrazosulfuron ethyl at 15, 30 g/ha+ HW and pyrazosulfuron ethyl at 15 g/ha + HW and hand weeding on 15 and 30 DAT. HW twice at 15 and 30 DAT recorded higher WCE of 85.27, 83.63 and 88.97 per cent at 25, 45 and 75 DAT, respectively. Pyrazosulfuron ethyl at 5 g/ha+ HW recorded lower WCE (40.86 per cent). In grain yield, application of pyrazosulfuron ethyl at 20 g /ha + HW recorded higher grain and straw yield (6930 and 9606 Kg/ha), respectively.

## P - 71 Effect of weed management practices under different rice establishment techniques

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Rice is one of the important staple crops in India. Major constraint that limits the production and productivity is weed infestation. The present study was undertaken to identify the efficient weed management method under different rice establishment techniques. Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *rabi*, 2010-11 and *kharif*, 2011. The experiment was laid out in split plot design with three replications. The main plot treatments comprised of different establishment methods *viz.,* system of rice intensification (SRI), transplanted rice, direct seeded rice (sprouted and broadcast), drum seeded rice (sprouted) and sub plot treatments comprised of different weed management methods *viz.,* PE herbicide pyrazosulfuron 10% WP 30 g/ha on 3 DAT and 8 DAS + finger type double row rotary weeder at 40 DAT/S, Cono weeding at 20 and 40 DAT/S, Two Hand weeding at 20 and 40 DAT/S and Unweeded control. The results revealed that the different establishment methods have no significant effect on total weed density during *rabi*, 2011 at 30 DAT/S. System of rice intensification, transplanted rice and direct seeded rice have registered significantly lesser total weed density over drum seeded rice. Among the weed management practices, pre-emergence application of pyrazosulfuron ethyl at 30 g/ha + finger type double row rotary weeder weeding at 40 DAT/S has registered lower total weed density. For the given establishment methods, significantly higher grain yield was obtained 5568 kg/ha during *rabi* 2010-11 and 5521 kg/ha during *kharif* 2011 with SRI. The SRI and pre emergence application of pyrazosulfuron ethyl at 30 g/ha + finger type double row rotary weeder weeding at 40 DAT/S recorded lower weed density and higher grain and straw yields with better economic returns during both the seasons of study.

## P - 72 Long term herbicidal weed and nitrogen management in transplanted rice-rice cropping system of Tamil Nadu

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Herbicide use for the control of weeds, especially in intensive rice-rice cropping system is at higher rates as cost and demand for manual labour is increasing. Nitrogen use is likely to change the crop-weed ecology as well as herbicide activity and residue in the soil. Hence, with the objective to evaluate long-term herbicide application integrated with nitrogen management a field experiment were conducted from 2001 to 2011 with hand weeding twice, PE butachlor 0.75 or pretilachlor 0.75 kg/ha or in rotation + POE 2-4, D, 0.4 kg/ha along with inorganic and organic N at 75 and 25 percent in RBD with four replication. Analysis of SDR of weeds showed that the grass weed density decreased from 53.0 to 33.5% from first to XXIII rice. *Echinochloa colona* , *Leptochloa chinensis* and *Marselia quadrifoliata* which were present in first crop was absent in XXII and in XXIII rice. Among the sedges, *Cyperus iria* was recorded in first crop, was absent during XXII and XXIII crops. Shift in weed species from *Echinochloa colona* to *Panicum distachyon* and absence of *Eclipta alba* was observed. Improvement in soil microflora was observed with herbicides application. Residues of butachlor, pretilachlor and 2, 4-D were BDL in soil and crop. BLW density was lower in XXII and XXIII rice crops compared to first rice and the effect was more under rotational herbicides (butachlor + 2,4-D (*kharif*) and pretilachlor + 2,4-D (*rabi*)) and integration of N. Integration of weed control by butachlor + 2,4-DEE with 100% inorganic nitrogen recorded higher grain yield during *rabi,* 2010-11 and *kharif,* 2011 and it was on par with butachlor + 2,4-DEE followed by pretilachlor 0.75 + 2,4-DEE 0.4 kg/ha during both the seasons.

## P - 73 Bio-efficacy and phytotoxicity of clodinofop-propargyl on weed control in wheat crop

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A field experiment was conducted during winter season of 2009-10 at JNKVV, Jabalpur to assess the efficacy of clodinofop-propargyl as post-emergence in wheat. Clodinafop-propargyl 120 g/ha significantly reduced the density and dry weight of *Phalaris minor*, but could not combat the problem of broad-leaved weeds, *viz., Cichorium intybus*, *Chenopodium album*, *Medicago denticulata*, *Physalis minima*. Clodinafop-propargyl (standard check) 60 g/ha did not cause significantly reduction in the density and dry weight of broad-leaved weeds, but significantly reduced the problem of *Phalaris minor*. Clodinafop-propargyl 120 g/ha produced higher grain yield (4683 kg/ha) and net returns of Rs 44272/ha than standard check herbicide.

## P - 74 Evaluation of early post emergence herbicide in transplanted rice

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Rice herbicides presently used are mainly pre-emergence and weeds coming at later stages of crop growth are not controlled as effectively as at emergence stage. This situation warrants for initiating research efforts to evaluate and identify suitable post emergence herbicide (s). Among several sulfonylurea herbicides, bispyribac sodium is a new post emergence rice herbicide. A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif,* 2011. The experiment was laid out in randomized block design with three replications. The treatments comprised of different herbicides *viz*., bispyribac sodium (RIL 029/F1 - 10% SC) applied at 20, 35, 50, 100, 200 g/ha, bispyribac sodium (Nominee Gold 10% SC) at 20 g/ha, butachlor 1.0 kg/ha, pretilachlor 1.0 kg/ha (3 DAT), hand weeding twice and unweeded control. Results revealed that, the post emergence application of bispyribac sodium (RIL 029/F1 - 10% SC) at 200 g/ha recorded lower weed density and dry weight. The post emergence application of bispyribac sodium (RIL 029/F1 10% SC) 50 g/ha registered higher grain yield and it was on par with bispyribac sodium (RIL 029/F1 10% SC) 35 g/ha.

## P - 75 Evaluation of post emergence pre- sowing herbicidal weed control in irrigated maize

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Maize is one of the important cereal crops in the world's agricultural economy both as food for men and feed for animals. Maize is very sensitive to weed competition during the first 3 to 4 weeks after sowing due to initial slow growth. Uncontrolled weed growth causes yield loss of 40 to 60%. Protecting maize from weeds is essential for avoiding heavy losses in yield and quality of grain. Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore, during *rabi* - 2011 to study the role of glyphosate for the control of established weeds and their carryover effect on re-growth of weeds in the succeeding maize. The experiment was conducted in a split plot design with three replications. The treatment consisted of different dosage of glyphosate. Pre-plant weed control treatments were glyphosate at 900, 1350, 1800, 2700 and 3600g/ha. The study revealed that the application of glyphosate at 3600 g/ha recorded lower percentage of weed density and dry matter with higher weed control efficiency at initial stage followed by glyphosate at 2700 g/ha at 45 and 60 DAS.

## P - 76 Effect of time of sowing and weed control methods in direct seeded rice

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Weeds inflict major losses in upland rice sometimes resulting in total crop failures. Direct seeding of rice will only be successful if there is good crop establishment as well as adequate weed control measures to keep the crop free from weeds. In rainfed areas of Himachal Pradesh, the time of sowing is primarily controlled by the onset of monsoons. When sowing is delayed, with a few exceptions most of the varieties suffer to a large extent. The rice herbicides presently used are mainly pre emergence and weeds coming at later stages of crop growth are not controlled effectively. To find out the effect of date of sowing and weed control methods in direct seeded upland rice, a field experiment was conducted during *kharif* 2010 and 2011 in split plot design with three replications. Combinations of two dates of sowing, *viz.,* before onset of monsoon (31.5.10 and 7.6.11) and after onset of monsoon (16.6.10 and 24.6.11) in main plots and seven weed control methods, *viz.,* Pretilachlor-S 0.5 kg/ha as pre-emergence, azimsulfuron 40 g/ha as post-emergence, fenoxaprop 60 g/ha or chlorimuron + metsulfuron 4 g/ha or tank mix of both as post-emergence, cyhalofop-p butyl 90 g/ha fb 2, 4-D 0.5 kg/ha 30 DAS, butachlor 1.5 kg/ha as pre-emergence + 1 hand weeding, weedy and weed free were tested in sub plots. The major weeds of the experimental field were *Echinochloa colona, Ageratum conyzoides, Panicum dichotomiflorum, Cyperus iria* and *Commelina benghalensis. Digitaria sanguinalis, Setaria glauca, Polygonum alatum, Eleusine indica, Aeschynomene indica* were also recorded in small numbers. Azimsulfuron, chlorimuron and cyhalofop butyl also proved as effective as weed free in respect of total weed population. All herbicides were equally effective as weed free in reducing total weed dry weight at harvest. All the weed control treatments including weed free remaining at par resulted in significantly higher paddy grain yield over weedy check.

## P - 77 Performance of different herbicides on productivity of rice

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A field experiment was conducted at Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut during *kharif* 2010 and 2011 to study the effect of different herbicides on productivity of rice. The soil of experimental site was sandy loam in texture low in organic carbon, medium in available phosphorus and potassium with pH 7.9. The experiment was laid out in randomized block design with three replications. Ten treatments consisting of weedycheck, hand weeding, fenaxoprop ethyl 0.07 kg/ha, bensulfuron methyl 0.05 kg/ha, almix 4 g/ha, bispyribac sodium 20 g/ha, pretilachlor 0.75 kg/ha, anilofos 0.5 kg/ha, oxidiagon 0.7 kg/ha and metsulfuron methyl 6 g/ha. *Echinochloa crusgalli, Echinochloa colona, Parthanium hyterophorus, Cynodon dactylon, Digra arvensis* and *Cyprus rotundus* were the major weed species in the experiment site. *"Pusa basmati-1"* was transplanted in the first week of July. Other packages of practices were adopted as per recommendation for the crop. All the weed control measures lead to significant reduction in weed population and dry matter accumulation as compared to weedy check.Among different herbicides maximum rice yield was recorded with the application of bispyribac sodium 20 g/ha. However fenoxyprop ethyl 0.07 kg/ha was found at par.

## P - 78 Integrated weed management in maize

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To study the integrated effect of different herbicides with mechanical weeding against weeds in maize and on its yield, a field experiment was conducted during *kharif* of 2010 and 2011 at the Research Farm of Department of Agronomy, Forages and grassland management, CSKHPKVV, Palampur. The experimental soil was silty clay loam in texture, acidic in reaction, medium in available nitrogen, phosphorus and high in available potassium. The treatments consisted of oxyfluorfen 0.2 kg/ha PE on 3 DAS, atrazine 1.0 kg/ha PE on 3 DAS, pendimethalin 0.75 kg/ha PE on 3 DAS, atrazine1.0 kg/ha early post, oxyfluorfen 0.2 kg/ha PE on 3 DAS + mechanical weeding 30 DAS, atrazine 1.0 kg/ha PE on 3 DAS + mechanical weeding 30 DAS, pendimethalin 0.75 kg/ha PE on 3 DAS + mechanical weeding 30 DAS, atrazine 1.0 kg/ha early post + mechanical weeding 30 DAS, hand weeding twice on 20 and 40 DAS and weedy check was laid out in randomized block design with replicated thrice. Maize variety Kanchan KH-101 was sown on 5.06.2010 and 4.06.2011 with recommended package of practices except treatments. Herbicides were applied with knapsack power sprayer using 600 L water per hectare. Data on density and dry weight of weeds was recorded at 90 DAS and at harvest. The major weeds of the experimental field were *Echinochloa colona, Digitaria sanguinalis, Panicum dichotomiflorum, Commelina benghalensis, Cyperus iria, Ageratum conyzoides, Polygonum* sp., *Eleusine indica* and *Brachiaria ramosa*. All the weed control treatments recorded significantly lower total weed count and total weed dry weight at all the stages of observations as compared to unweeded check. Integration of one mechanical weeding with different herbicides behaving statistically similar with hand weeding twice resulted in significantly lower total weed count and total weed dry weight. Weeds in unweeded check reduced the grain yield of maize by 46.5 per cent over the best treatment i.e. atrazine 1.0 kg/ha PE + mechanical weeding at 30 DAS. However, atrazine 1.0 kg/ha PE + mechanical weeding at 30 DAS behaved statistically alike with all the weed control treatments in which one mechanical weeding at 30 DAS was executed and hand weeding twice treatment, resulted in significantly higher grain yield of maize by effective control of weeds.

## P - 79 Integrated weed management in direct wet seeded rice

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Weeds are the major biotic constraints and compete with rice for moisture, nutrients and light. Weed infestation due to poor management of irrigation water is one of the major constraints in direct seeded rice. A field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during *kharif* 2010 (July-November) to evaluate the performance of different herbicides in direct wet seeded rice. The experiment was laid out in randomized block design with three replications. The treatments comprised of different weed management practices *viz*., PE pyrazosulfuron 25 g/ha, PE pretilachlor-S 750 g/ha, EPOE cyhalofop-butyl 90 g/ha, EPOE azimsulfuron 35 g/ha, EPOE bispyribac sodium 25 g/ha, POE fenoxaprop 60 g/ha, POE cyhalofop-butyl 90 g/ha + Almix (chlorimuron + metsulfuron) 20 g/ha, POE fenoxaprop 60 g/ha + Almix 20 g/ha, POE fenoxaprop 60 g/ha + ethoxysulfuron 15 g/ha, PE oxyfluorfen 300 g/ha + POE 2,4-D 750 g/ha with one hand weeding at 45 DAS for all the above treatments, hand weeding twice at 25 and 45 DAS and unweeded control. The experimental results revealed that the pre-emergence application of pyrazosulfuron 25 g/ha followed by one hand weeding on 45 DAS can keep the weed density and dry weight below the economic threshold level and increase the yield and net return under direct wet seeded rice without any phytotoxicity to the crop.

## P - 80 Effect of dormancy breaker supplemented with sequential herbicide applications on weed management in wheat

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An experiment comprising of two dormancy breaker treatments such as $KNO_3$ 0.6 M (6%) and no $KNO_3$ treatments in the main plots supplemented with seven weed control treatments such as unweeded control, clodinafop 60 g/ha *fb* metsulfuron 6 g/ha as PO, pendimethalin 0.75 kg/ha + carfentrazone 30 g/ha PE, clodinafop 60 g/ha *fb* carfentrazone 30 g/ha PO, pinoxaden 50 g/ha *fb* carfentrazone 30 g/ha PO, isoproturon 0.75 kg/ha PO, and weed-free check in the sub-plots was laid out in a split plot design with three replications in the field for two years. There was no appreciable positive effect on wheat yield due to application of dormancy breaker $KNO_3$, although, there was slight reduction in weed (grass, broad-leaved and total weed) growth. All sequential applications controlled weeds effectively. The post-emergence application of clodinafop 60 g/ha followed by (*fb*) metsulfuron 6 g/ha, clodinafop 60 g/ha *fb* carfentrazone 30 g/ha, pinoxaden 50 g/ha *fb* carfentrazone 30 g/ha resulted in complete weed control and gave higher yields. All weed control treatments gave significantly higher yields than that in weedy check. However, the post-emergence application of clodinafop 60 g/ha *fb* metsulfuron 6 g/ha resulted in significantly higher yield than those in others except clodinafop 60 g/ha *fb* carfentrazone 30 g/ha, pinoxaden 50 g/ha *fb* carfentrazone 30 g/ha, which, in this regard, were comparable with it.

## P - 81 Bio- efficacy and phytotoxicity studies of bispyribac-sodium to control mixed weed flora in direct seeded upland rice

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Several pre-emergence herbicides have been reported to provide a fair degree of weed control in upland rice. But some difficulties are associated with pre-emergence application of herbicides such as their limited application duration. In such situations early post emergence herbicides proved to be better. Hence a new herbicide bispyribac was tested for the post emergence control of weeds along with cyhalofop butyl and butachlor during *kharif* season of 2010 and 2011 at research farm, in randomized block design with 3 replications. The soil experimental field was silty clay loam in texture, acidic in reaction, medium in available nitrogen, phosphorus and high in available potassium. The treatments consisted of three doses of bispyribac PO (20g, 25 g and 30 g/ha) at 25 days after sowing, cyhalofop butyl 90 g/ha (15 DAS) and butachlor 1.5 kg/ha PE both fb. 2, 4-D 1.0 kg/ha PO and metsulfuron methyl 4 g/ha PO at 30 DAS, farmer's practice and unweeded check. Rice variety *HPR-1156* was sown on 25.5.10 & 16.6.11with recommended package of practices except treatments. Herbicides were applied with knapsack power sprayer using 600 l water per hectare. The major weeds of the experimental field were *Echinochloa colona, Commelina benghalensis, Digitaria sanguinalis, Panicum dichotomiflorum, Cyperus iria, Setaria glauca, Polygonum alatum, Aeschynomene indica, Monocoria* and *Ageratum conyzoides* All the control measures recorded significantly lower total weed count and total weed dry weight at both the stages of observations as compared to unweeded check . Bispyribac 30 g/ha being at par with its lower doses resulted significantly lower total weed count and total weed dry weight. Weeds in unweeded check reduced the grain yield of paddy by 49.3 per cent over the best treatment i.e. bispyribac 30 g/ha. However, bispyribac 30 g/ha behaving statistically alike with bispyribac 20 and 25 g/ha, cyhalofop butyl *fb*. metsulfuron methyl and farmer's practice resulted in significantly higher paddy yield.

## P - 82 Bio-efficacy evaluation of trisulfuron against weeds in rice

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A field experiment was conducted during two consecutive season of *kharif* 2009 and 2010 at N.E.B crop research centre, G.B.P.U. A & T, Pantnagar, with nine treatments consisting of trisulfuron at 8, 10 and 12 g/ha. pretilachlor 625 g/ha, pretilachlor 625+ trisulfuron 10 g/ha, ready mix combination of chlorimuron ethyl + metsulfuron methyl at 4 g./ha along with hand weeding at 20 and 45 days after transplanting (DAT), weed free and weedy check and was laid out in randomized block design with three replications. Trisulfuron at different doses and ready mix combination of chlorimuron ethyl + metsulfuron methyl 4 g/ha. were applied at 14 DAT of rice seedling while pretilachlor alone and tank mix combination of pretilachlor + trisulfuron were applied at 3 DAT. The major weeds in the experimental field were *Echinochloa colona* among grasses ; *Ammania baccifera*, *Eclipta alba*, *Caesulia axillaris* and *Commelina diffusa* among broad leaved weeds; *Cyperus iria and C. difformis* among sedges. All the weed control measures caused significant reduction in the density of total weeds over weedy check during both the years. Among herbicidal treatments, the lowest density of weeds was recorded with pretilachlor 625 g + trasulfuron 10 g/haover rest of the treatments. Trisulfuron 12 g/ha effectively reduces the weed density and found significantly superior over other rates of its application during both the years. Triasulfuron at 10 or 12 g./ha. and chlorimuron ethyl + metsulfuron methyl 4 g./ha effectively controlled the broad leaved weeds *viz., Ammania baccifera, Commelina diffusa* and *Caesulia axillaris* and sedges *viz., Cyperus iria* and *C.difformis.* On the basis of two years experimentation it can be concluded that tank mix combination of pretilachlor 625 g + trisulfuron 10 g/ha, applied at 3 days after transplanting was found effective for the control of grasses, sedges and broad leaved weeds.

## P - 83 Efficacy of different herbicides in irrigated wheat on farmers' fields

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The major constraints of wheat under irrigated condition in Datia district of Bundelkhand agro climatic zone of Madhya Pradesh is severe crop weed competition in early stage due to non adoption of appropriate weed management practices. Farmers participatory On Farm trials of wheat were conducted at different villages of Datia district under irrigated condition. Five cultivator of high skill were selected through PRA in each year and large size fields of 0.4 ha each were finalized. The large size fields was further divided into two sub plots at each farmers level. In sub plots treatments *viz.,* farmers practices, isoproturan 1.0 kg/ha + 2,4-D 0.75 kg/ha, sulfosulfuron 35 g/ha, metribuzin 175 g/ha and carfentrazone 60g/ha at 30 days after sowing (DAS) were evaluated against farmer's practices during 2007-08, 2008-09, 2009-10 and 2010-11, respectively. The dominant weeds in the experimental field were *Chenopodium album, Vicia hirsuta, Fumaria parsiflora, Melilotus indica, Medicago denticulata, Anagalis arvensis, Vicia sativa, Lathyrus sativa, Cynodon dactylon, Convolvulus arvensis, Phalaris minor* and *Avena fatua etc.,* The dry matter accumulation of weeds was considerably decreased due to different herbicidal treatments as compared to farmers practice. However, amongst different post emergence herbicides, application of isoproturan 1.0 kg/ha + 2,4-D 0.75 kg/ha at 30 DAS was found most effective in minimizing dry matter production of weeds followed by sulfosulfuron 35 g/ha. Grain yield of wheat was considerably increased due to application of different herbicides over farmers practices. There was an increase of 22.8, 22.44, 24.28 and 17.50% in yield due to post emergence application of of isoproturan 1.0 kg/ha + 2,4-D 0.75 kg/ha, sulfosulfuron 35 g/ha, metribuzin 175 g/ha and carfentrazone 60g/ha at 30 DAS during 2007-08, 2008-09, 2009-10 and 2010-11 respectively. The additional net income due to different herbicides ranged from 4760 to 8298 Rs/ha with mean net income of Rs 5310/ha.

## P - 84 On-farm assessment of herbicides for control of hardy weeds in wheat

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Wheat is the major *rabi* season cereal crop of Punjab and several grassy and broadleaf seeds compete with the crop during its growing period. Herbicides are the most important weed control tool for reducing the infestation of weeds and getting higher yield in wheat. Experiments at farmers' fields at ten different locations were conducted during *rabi* 2010-11 to evaluate the effect of recommended chemical weed management in wheat grown in irrigated subtropical zone of Ropar district of Punjab. The weed control treatments thus replicated at different locations encompassed $T_1$ - recommended practice (clodinafop 60 g *fb* carfentrazone 20 g/ha), farmers practice (unrecommended herbicides/brands), metribuzin 175 g/ha and unweeded control to investigate their effect on yield, yield attributes, weed density and economics. The results revealed that grain yield was significantly higher (4562 kg/ha) with the recommended practice of clodinafop followed by carfentrazone-ethyl than other treatments. There was 14.4, 3.38 and 3% increase in grain yield with recommended practice over control, metribuzin and farmers practice, respectively. The population of grassy weeds was minimum with metribuzin 175 g/ha treatment which was statistically at par with recommended practice but significantly better than other two treatments whereas the number of broad leaf weeds was significantly lower in recommended treatment. There was slight phytotoxicity observed with metribuzin which resulted in significant reduction in effective tillers than other herbicidal treatments. Highest B: C ratio (2.45) was found with recommended practice.

## P - 85 Efficacy of herbicides for controlling weeds in direct seeded rice

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In Bihar, rice is cultivated around 3.36 m/ha with a production of 4.99 million tonnes and productivity of 1486 kg/ha. Among various depressing factors, weed infestation is the most crucial factor particularly under direct seeded upland conditions. Repeated hand weeding is uneconomical and becoming difficult day by day due to non availability of labours. Therefore, a field experiment was carried out at the agricultural research farm, Rajendra Agricultural University, Pusa, Samastipur, Bihar (India) during *kharif* season of 2010 and 2011. The soil of the experimental field was calcareous (clay- loam) with pH 8.10. It was moderately fertile being low in organic carbon (0.39%), available nitrogen (201.20 kg N/ha), phosphorus (19.0 kg $P_2O_5$ /ha) and potassium (100.7 kg $K_2O$/ ha). Treatments comprised of 12 herbicidal treatments on direct seeded rice *viz.,* pyrazosulfuron 25 g /ha at 3-7 DAS, pretilachlor-s 750 g /ha at 0-5 DAS, cyhalofop-butyl 90 g /ha at 25 DAS, fenoxaprop 60 g /ha at 30 DAS, cyhalofop-butyl + (chlorimuron + metsulfuron) at 90 + 20 g /ha at 25-30 DAS, fenoxaprop + (chlorimuron+metsulfuron) at 60 + 20 g /ha at 25-30 DAS, azimsulfuron 35 g /ha at 20 DAS, bispyribac-sodium 25 g/ha at 20 DAS, fenoxaprop + ethoxysulfuron at 60 + 15 g/ha at 25-30 DAS, oxyfluorfenPE + 2,4-D PO 300 + 500 g/ha, two hand weeding at 20 and 40 DAS, weedy check. Azimsulfuron 35 g/ha had registered the maximum growth, yield attributes and yield of direct seeded rice, which was comparable to fenoxaprop + (chlorimuron+metsulfuron) at 60 + 20 g/ha, cyhalofop-butyl + (chlorimuron + metsulfuron) at 90 + 20 g/ha and bispyribac sodium 25 g/ha. Maximum weed control efficiency and weed control index were recorded under treatment azimsulfuron 35 g/ha which gave highest net return.

## P - 86 Effect of plant density and weed management on weed dynamics and yield of rice

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A field experiment was carried out at Rajendra Agricultural University, Bihar (Pusa) during *kharif* of 2009 to study the effect of plant density and weed management on weed dynamics and yield of rice. The field experiment consisted three plant density (15 x 15, 20 x 15 and 20 x 20 cm) and six weed control measures (weedy check, hand weeding, (25 and 50 DAT), butachlor 1.5 kg/ha (PE), butachlor 1.5 kg/ha (PE) + pyrazosulfuron 40 gm/ha (PoE), pretilachlor 0.5 kg/ha (PE) and pretilachlor 0.5 kg/ha (PE) + pyrazosulfuron 40 gm/ha) (PoE). were laid out in split plot design with 3 replications. Among the three tested plant density, spacing 15 x 15 cm was found to be superior over 20 x 15 cm and 20 x 20 cm in respect of number of tillers/$m^2$, dry weight of plant (g/$m^2$), LAI, CGR (g/day/$m^2$), weed population/$m^2$, weed dry weight (g/$m^2$) and number of panicle/$m^2$. Whereas, plant height at harvest, length of panicle (cm) and number of grains/panicle were recorded highest in spacing 20 x 20 cm. Statistical analysis revealed that spacing 15 x 15 cm showed superiority over 20 x 15 cm and 20 x 20 cm in respect of grain and straw yield (q/ha) and grain: straw ratio. Simultaneously, closer plant spacing recorded significantly highest gross and net return as well as B : C ratio than wider spacing. Amongst various weed control measures, hand weeding and chemical weedicides recorded significantly higher number of tillers/$m^2$, dry weight (g/$m^2$), LAI, CGR (g/day/$m^2$), weed parameters, number of tillers/$m^2$, length of panicle (cm), number of grains/panicle, 1000-grain weight, grain and straw yield and harvest index than weedy check. However, chemical weed control practices fetched significantly higher and at par net return and B : C ratio as compared to hand weeding (twice) treatment in the experimentation.

## P - 87 Sequential herbicide application for effective weed management in irrigated rice

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Rice is the staple food crop of 65% population in India. Weeds are a major deterrent in increasing the rice production and productivity. Chemical weed control is effective and one of the most labour saving innovations in view of increasing problems of shortage of labour, timely availability, cost of labour, skill in weeding, shift in weed flora, increasing weed intensity. In order to identify the effective combination and sequentially applied herbicides and also to assess the changes in weed flora due to continuous application of herbicides, an experimental trial was conducted during *kharif* season of 2008, 2009 and 2010 under transplanted conditions. The herbicidal treatments comprised, glyphosate 0.75 kg/ha applied 15 days before transplanting (DBT), butachlor 1.50/ha applied at 0–5 days after transplanting (DAT), bensulfuron-methyl + pretilachlor (0.06 + 0.60 kg/ha) (8 – 15 DAT), butachlor + Almix 1.0 + 0.004 kg/ha (5–10 DAT); and sequential application of herbicides glyphosate (at 15 DBT) followed by butachlor at 0 – 5 DAT; and glyphosate (15 DBT) *fb*., bensulfuron-methyl + pretilachlor at 8–15 DAT; were tested against mechanical weeding using conoweeder, hand weeding twice and non-weeded control treatments. Sequentially applied herbicides i.e., pre-planting application of glyphosate followed by post planting application of bensulfuron-methyl + pretilachlor, recorded lower number of weeds, lower dry weight, higher weed control rating and higher grain yields and proved successful in weed management.

## P - 88 Tembotrione: a new post-emergence herbicide for control of complex weed flora in maize

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A new post-emergence herbicide, tembotrione 42% SC, was evaluated for post-emergence control of mixed weed flora in maize in a field experiment conducted at CCS Haryana Agricultural University Regional Research Station, Karnal. The treatments included tembotrione 100, 110 and 120 g/ha each with 1000 ml /ha surfactant or without surfactant applied at 2-4 leaf stage, atrazine 750 and 1000 g/ha applied as pre-emergence at 0-3 days after sowing (DAS), 2,4-D-Na 800 g/ha at 3 weeks after sowing, along with hand weeding twice (20 and 40 DAS) and weedy check. The treatments were laid out in randomized block design with three replications. Weed flora of the field consisted of mainly *Dactyloctenium aegyptium, Brachiaria reptans, Digitaria sanguinalis, Leptochloa chinensis, Echinochloa colonum* among grasses and *Euphorbia hirta* and *Amaranthus viridis* among broadleaf weeds, and *Cyperus rotundus* among sedges. Tembotrione with surfactant 120 g/ha + surfactants 1000 ml/ha provided effective control of all type of weeds with maximum efficacy. Tembotrione 120 g/ha + S was superior to lower doses in respect of grassy weeds and sedges but at par in respect of broadleaf weeds. Tembotrione 120 g/ha + S was at par with atrazine 1000 g/ha during 2009 but superior during 2010 in respect of density and dry weight of grassy weeds, whereas it was superior to atrazine 750 g/ha during both the years. Its provided the maximum grain yield (3767 kg/ha during 2009 and 4439 kg/ha during 2010) and was superior to all other herbicidal treatments. There was no crop phyto-toxicity of tembotrione on maize at any of its growth stage.

## P - 89 Phytotoxicity of new herbicide molecule UPH 110 on wheat and its residual effect on succeeding sorghum

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To study the phyto-toxic effect of this new herbicide molecule on wheat crop, an experiment was conducted during *rabi* 2010-11 at agronomy research area of CCS HAU Hisar. Visual rating on 0-10 scale for different treatments of UPH 110 was made as per CIB guide lines and compared with untreated check. To assess the residual effect of UPH 110 applied in wheat on succeeding crop, sorghum var. *"Harachara"* was planted on 11.5.2011 within 2 weeks of wheat harvest without disturbing the original layout. Adverse effect on crop growth, if any in treatment of UPH 110 + surfactant at 400-1000 g/ha and sulfosulfuron at 25 g/ha treatments was recorded for number of plants germinated, number of leaves per plant, plant height and fodder yield at 30 days after sowing. UPH 110 at 400, 500 and 600 g/ha did not cause any injury to wheat crop as is evident from parameters recorded on leaf chlorosis, stunting and necrosis. Higher dose of UPH110 at 1000 g/ha caused chlorosis and yellowing of wheat leaves which remained visible up to 30 DAT but at 60 DAT, these injury symptoms vanished without any yield penalty. Residues of UPH-110 applied in wheat even at 1000 g/ha (product) did not cause any adverse effect on crop growth and germination of succeeding sorghum crop. Plant height of sorghum, number of plants/$m^2$, number of leaves per plant and green fodder yield was statistically similar in UPH- 110 treated plots as well as untreated control.

## P - 90 Effect of integrated weed management on weed indices in SRI

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Rice production has to be increased in India with limited resources to meet the burgeoning population which is predicted to cross 1.5 billion by 2020. In order to study the effect of different weed management practices in SRI, two field experiments were conducted at Annamalai University during 2009-10 Thaladi and Kuruvai seasons in factorial randomized block design with two factors *viz*., age of the seedling ($M_1$ –10 days old seedlings and $M_2$ – 15 days old seedlings) and weed management practices ($S_1$ – two times cono weeding, $S_2$ – cono weeding four times, $S_3$ – butachlor 1.5 kg/ha + handweeding on 35 DAT and $S_4$ – un-weeded control) and replicated thrice. Cono weeding four times practiced in 15 days old seedlings resulted in 55.13 per cent reduction in weed count recorded at 60 DAT and ranked first. This was followed by butachlor application 1.5 kg/ha + hand weeding on 35 DAT. Un-weeded control resulted in higher density. The weed control efficiency recorded due to various treatments ranged from 58.51 to 7933 in *Thaladi* season and 59.78 to 82.03 in Kuruvai season. Weed control efficiency was high (75.88 in *Thaladi* and 78.61 in *Kuruvai* seasons) in cono weeding four times but it was comparable with conventional method of butachlor application 1.5 kg/ha + hand weeding on 35 DAT. The least weed DMP of 296.85 and 320.32/kg was recorded during *Thaladi* and *Kuruvai* seasons respectively with cono weeding four times adopted in 15 days old seedlings. Higher weed DMP was recorded in 10 days old seedlings in control plot.

## P - 91 Chemical weed control in dry rice nursery

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The field experiment was conducted in dry rice nursery during Summer 2010 *kharif* 2011 for three consecutive seasons at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bangalore under Cauvery Command area of Karnataka to study the effect of different pre-emergence use of herbicides on weed control and phytotoxicity in dry rice nursery. The treatment details consisted of application of butachlor (50% EC) 625 and 1250 g/ha applied within 24 hrs of sowing and 1250 g/ha at 3 days after sowing (DAS), pyrazosulfuron ethyl (10WP) 25 g/ha, bensulfuron methyl + pretilachlor (66G) 600 g/ha and pretilachlor + safenor (30% EC) 300 g/ha applied at 3 DAS and control. The experiment was laid out in a randomized complete block design with three replications.The soil type was red sandy loam with neutral pH (6.12), normal EC (0.108 d S/m), low to medium in organic carbon (0.50%) and available N of 298 kg/ha, $P_2O_5$ of 28 kg/ha and $K_2O$ of 212 kg/ha. The major weed flora observed in the experimental site were *Cyperus rotundus* (sedge)*, Echinochloa colona, Panicum tripheron, Digitaria marginata* (grasses)*, Spilanthus acmella, Ageratum conyzoides, Portulaca oleraceae* (broad leaved weeds). The mean of 3 seasons results revealed that, pre- emergence application of pretilachlor + safenor 300 g/ha, pyrozosulfuron ethyl 25 g/ha and butachlor 1250 g/ha applied at 3 DAS recorded lower visual phytotoxicity and higher weed control ratings (0.03 to 0.59 and 7.77 to 7.92, 0.15 to 0.31 and 7.43 to 8.62 and 0.00 to 0.08 and 8.87 to 9.22, respectively) at 7, 15, 21 DAS, respectively as compared to use of butachlor applied within 24 hrs of sowing in both the doses and bensulfuron methyl + pretilachlor 600 g/ha at 3 DAS.

## P - 92 Effect of intercropping on maize and associated weeds in maize-intercropping system

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Weeds in maize result in an average of 30-70% yield loss. Vegetable pulses as intercropping components in maize often prove more remunerative. Hence, an experiment was conducted to investigate the possibility of intercropping early maturing vegetable pulses in maize on weed suppression and resultant yield of maize. The trial was laid out with nineteen treatments i.e., four vegetable pulses *viz.,* garden pea, french bean, field bean and soybean were included each at 1:1, 1:2 and 1:3 row proportion with maize palnted in normal planting (60 x 30cm), paired row planting (45/90 x 30 and 30/120 x 30cm), sole maize and sole vegetable pulses replicated thrice in a RCBD design. Inclusion of intercrops with maize gave significantly higher maize-equivalent yield compared to sole cropping of maize. The major weeds were *Cynodon dactylon*, *Cperus rotundus*, *Amaranthus viridis*, *Phyllanthus niruri*, *Setaria glauca* and *Euphorbia hirta*. Intercropping of garden pea in maize significantly reduced the weed density (208/$m^2$) than maize + soybean intercropping system (298/$m^2$) and sole cropping of maize (474/$m^2$). It may be attributed to shading effect and competition stress created by the canopy of intercrops resulting in suppressive effect on associated weeds. Maize + garden pea showed the highest MEY (1,8237kg/ha) and maize + garden pea (1:3, 1:2 and 1:1) recorded the lowest weed density, weed dry weight and highest control efficiency thereby serving as a better smother crop for effective control of weeds.

## P - 93 Weed management in dry direct seeded rice

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The dry sown system of rice cultivation, constitutes more than 60% area under rice during *kharif* in Kerala. In this system, the early growth of rice for 30-40 days is in a dry soil environment and weeds cause serious problems affecting its productivity adversely. A field experiment was conducted in the sandy loam soil at the Regional Agricultural Research Station, Pattambi, Kerala during *kharif* 2011 to develop suitable weed management practice for dry direct seeded rice. The experiment was laid out in randomised block design with ten treatments and three replications. The herbicides pretilachlor 50 EC ) 0.75 kg/ha and butachlor 50 EC 1.5 kg/ha at 4-6 days after effective rainfall and metamifop10 EC 0.1kg/ha at 2-3 leaf stage of grasses, either followed by hand weeding or by spraying of almix 20 WP (0.004 kg/ha) at 20-25 DAS were tested against mechanical weeding thrice, hand weeding twice and rice-green manure-cultural practice and control. Spraying of metamifop followed by hand weeding gave a higher percentage of reduction in weed population. The observations taken on weed count at 50 per cent flowering further showed that *Sacciolepis interrupta* , the most important weed of semi-dry rice in Kerala was effectively controlled by metamifop followed hand weeding (6.7 weeds/$m^2$) as against 78.7/$m^2$ in unweeded check. The study proved that application of metamifop 10 EC 0.1kg/ha at 2-3 leaf stage of grasses or pretilachlor50 EC 0.75 kg/ha 4-6 days after effective rainfall followed by hand weeding (20DAS) is a better weed management practice in dry direct seeded rice in Kerala.

## P - 94 Efficacy of pinoxaden (5 EC) alone and in combination with different herbicides in wheat

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To study the effects of pinoxaden alone and in combination with different herbicides on weed population, weed growth, crop growth and grain yield in wheat, an experiment was conducted at Norman E. Borlaug Crop Research Centre, G.B.Pant University of Agriculture and Technology, Pantnagar (Uttrakhand) during *rabi* of 2010-2011. Weed control treatments *viz.* pinoxaden 50 g/ha, metsulfuron-methyl 4.0 g/ha, pinoxaden 50 g/ha + carfentrazone-ethyl 20g/ha, pinoxaden 50g/ha + metsulfuron-methyl 4.0 g/ha, pinoxaden 50 g/ha +2,4-D 500 g/ha, pinoxaden 50 g/ha *fb* carfentrazone-ethyl 20 g/ha, pinoxaden 50 g/ha *fb* metsulfuron-methyl 4.0 g/ha pinoxaden 50 g/ha *fb* 2,4-D 500 g/ha carfentrazone-ethyl 20 g/ha, idosulfuron+mesosulfuron 400 g/ha, 2,4-D 500 g/ha, isoproturon 1250 g/ha, weed free and weedy check were replicated thrice. Wheat cultivar PBW-502 was sown on 22 Nov. 2010 using seed rate of 100 kg/ha and fertilized with 120 kg N, 60 kg $P_2O_5$ and 40 kg $K_2O$/ha. The soil of experimental field was loam in texture and neutral in pH (7.2). Major weed species were *Phalaris minor* (grassy), *Chenopodidum album, Medicago denticulate, Polygonum plebejum* (non-grassy). Remaining weeds i.e. *Rumex acetosella, Melilotus indica, Coronopus didymus, Vicia sativa Anagallis arvensis* and *Cyperus rotundus* were considered as erratic and minor. Highest grain yield was obtained in weed free plots (41.67 q/ha) followed by pinoxaden 50 g/ha +MSM 4.0 g/ha (4127 kg/ha). Yield attributing characters *viz.* spike length, grains per spike and test weight were recorded highest in weed free plot followed by pinoxaden 50g/ha+MSM 4.0 g/ha. Nutrient (N,P and K) uptake by crop was recorded highest (86.13, 25.36 and 56.11 kg/ha, respectively) in weed free plot followed by pinoxaden 50 g/ha +MSM 4.0 g/ha (80.93, 24.42 and 55.01 kg/ha). Nutrient removal by weeds recorded lowest (1.33 kg. N, 0.93 kg P and 1.27 kg K/ha) in pinoxaden 50g/ha +MSM 4.0 g/ha. The reduction in grain yield due to uncontrolled weeds was recorded 41.90%. Pinoxaden 50 g/ha controlled *Phalaris minor* and MSM 4.0 g/ha controlled broadleaf weeds effectively. The combination of these herbicides (Pinoxaden + MSM) provide effective control of grassy as well as non grassy weeds.

## P - 95 Effect of herbicide bispyribac sodium on rice weeds in nursery

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The experiment has carried out during *kharif* of 2007-08 at Agricultural Research Station Gangavathi. The results on bio-efficacy revealed that, at 30 DAS, pre- emergence application of PIH-2023 400 ml/ha was recorded zero population of sedges compared to weedy check which was recorded 19.3 and 45.7 no/$m^2$ of *Cyperus irria* and *Cyperus difformis* respectively. Similarly, the grasses population was lower (0.67 no/$m^2$) with pre emergence application of PIH-2023 400 ml/ha as compared to weedy check (3.33 no/$m^2$). The herbicide at this rate was quite effective against most of the grasses including *E. colonum*, *Panicum repense* and *Fimbristylis miliacea*. Hand weeding recorded significantly lower BLW population (1.33 no/$m^2$) as compared to other treatments. The total weed dry weight was significantly lower in case on PIH-202 400 ml/ha (0.38 g/$m^2$) than weedy check which recorded hither weed dry weight (16.75 g/$m^2$). The treatment is was also found significant to pre emergence application of pretilachlor (2.82 g/$m^2$) or cyhalofop butyl (3.18 g/$m^2$) and remained on par with hand weeding (0.68 g/m2). With reference to Phytotoxicity, all the treatments were found no injury (0 scale).

## P - 96 Integrated weed management in wheat crop

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To Study the effects of integrated weed management treatments on weed population, weed growth, crop growth and grain yield in wheat, an experiment was conducted in randomized block design during *rabi* season of 2007-08 and 2008-09 at Crop Research Centre of G.B.Pant University of Agriculture and Technology, Pantnagar. Weed control treatments *viz.,* isoproturon 1.0 kg/ha, isoproturon 1.0 kg/ha +2,4-D 0.5 kg/ha, isoproturon 1.0 kg/ha + one hand weeding (45 days), isoproturon 1.0 kg/ha + dicamba 240 g/ha, isoproturon 1.0 kg/ha + tribenuron-methyl 22.5 g/ha, clodinafop 60 g/ha, clodinafop 60 g/ha+2,4-D 0.5 kg/ha, metsulfuron-methyl 4.0 g/ha, tribenuron-methyl 22.5 g/ha, dicamba 240 g/ha + clodinafop 60 g/ha, sulfosulfuron 25 g/ha, one hand weeding, weed free and weedy check were replicated thrice. Wheat cultivar PBW 343 was sown on 28th Nov. during 2007 and 25th Nov. during 2008 using seed rate of 100 kg/ha and crop was fertilized with 120 kg N and 60 kg $P_2O_5$. The soil of experimental field was loam in texture and neutral in pH (7.3). Major weeds were *Phalaris minor* and *Polypogon monspeliensis* (grassy) and *Chenopodium album* and *Medicago denticulate* (non-grassy). Remaining weeds i.e. *Vicia sativa, Melilotus indica, Rumex acetosella, Coronopus didymus, Aanagallis arvensis* and *Cyperus rotundus* were considered as "other weeds". Highest grain yield was obtained in weed free plot (43.17 q/ha) followed by isoproturon 1.0 kg/ha (35 days)+one hand weeding at 45 days (41.70 q/ha) during fifteen year. Yield contributing characters *viz.,* spikes/$m^2$, spike length, number of grains spike and test weight were also higher in weed free plot followed by isoproturon 1.0 kg/ha (35 days)+one hand weeding (45 days) over rest of the treatments. Nutrients (N,P and K) uptake by crop was recorded highest (36.14, 4.89 and 24.91 kg/ha, respectively) in weed free plot followed by isoproturon 1.0 kg/ha (35 days)+one hand weeding (45 days). Nutrient removal by weeds recorded lowest (1.33 kg N, 0.93 kg P and 1.27 kg K/ha) in isoproturon 1.0 kg/ha (35 days)+one hand weeding (45 days). Highest net return (Rs. 35182/ha) was found in weed free plot followed by isoproturon 1.0 kg/ha (35 days)+one hand weeding at 45 days (Rs. 35104/ha and isoproturon 1.0 kg/ha + 2,4-D 0.5 kg/ha (Rs. 35029/ha). However, benefit: cost ratio was recorded higher in isoproturon 1.0 kg/ha+2,4-D 0.5 kg/ha at 35 days (1.77) than weed free plot (1:61) and isoproturon 1.0 kg/ha (35 days)+one hand weeding at 45 days (1:73). Lowest net return (Rs. 20432/ha) and benefit cost ratio (1:08) was obtained from weedy check plot.

## P - 97 Bioefficacy of pre-emergent herbicides on weed management in maize

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Field investigations were carried out during *kharif* 2010 at UAS, Dharwad (Karnataka) to evaluate the bioefficacy of pre-emergent herbicides on weed management in maize. The experiment consisted of 10 treatments involving four pre-emergent herbicides *viz*., pretilachlor (1.00 and 1.5 kg/ha), oxyfluorfen (0.10 and 0.15 kg/ha), pendimethalin CS (0.675 and 1.00 kg/ha) and atrazine (1.25 kg/ha) in conjunction with one intercultivation (IC) at 30 DAS and one hand weeding at 45 DAS, farmers practice (2 HW +2 IC), weed free check (3 IC + 2 HW) and weedy check. Results of the experiment revealed that pre-emergence application of oxyfluorfen either 0.10 or 0.15 kg/ha and atrazine 1.25 kg/ha significantly reduced the weed dry weight (1.74, 1.47 and 1.80 g) at 30 DAS. Weed Control Index (WCI) was significantly higher in these treatments (84.09, 89.54 and 82.88) compared to rest of the treatments except weed free check at 30 DAS. Grain yield was significantly higher with the application of oxyfluorfen 0.10 (10,523 kg/ha) and 0.15 kg/ha (10,827 kg/ha) and atrazine 1.25 kg/ha (10,436 kg/ha). Net returns were significantly higher with the application of oxyfluorfen 0.15 kg/ha (Rs.59,572/ha), which was at par with oxyfluorfen 0.10 kg/ha (Rs.57,423/ha ) and atrazine 1.25 kg/ha (Rs. 56,845/ha).

## P - 98 Effect of clodinafop-propargyl on soil microflora of wheat crop

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A field experiment was conducted during winter season of 2009-10 at Jabalpur to assess the effect of clodinofop-propargyl on soil microorganism. Five treatments consisted with three herbicidal treatments (post-emergence application of clodinofop-propargyl 60 g/ha($T_1$), clodinofop-propargyl at 120g/ha ($T_2$), standard check-clodinofop-propargyl 60g/ha ($T_3$) alongwith a weedy check ($T_5$) and hand weeding ($T_4$) were tested in randomized block design with four replication. The rhizospheric soil sample for the microbial analysis was drawn from the research field by "soil sample technique''. Laminar flow cabinets with U-V light and disinfectants can achieve complete sterility to handle microbiological procedures like-serial dilution and plating under aseptic conditions. There were some nutrient agar media for isolation of microorganism from soil such as Jensen's agar media for Azotobacter, Asparagine mannitol agar media for total bacteria and Rose-bengal agar media for fungi, Kenknight and Munaier's agar media for Actinomycetes .On the basis of microbial analysis, the overall influence of different treatments a colony forming units of Azotobacter at different stages of crop growth, no definite trend could be observed but the population was maximum at harvest stage of the wheat crop. Total bacterial counts also did not reflect any definite trends whereas a similar trend was found in fungi as well as actinomycetes.

## P - 99 Bioefficacy of herbicides for control of weeds in irrigated wheat

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In view of developing resitance by isoproturan, alternative herbicides were tested against the weeds of wheat. A field experiment was conducted at Research Farm, College of Agriculture, Gwalior during *rabi* 2006-07 and 2007-08. The soil was sandy loam with pH 7.8. The available N, P and K content in the soil was 189.71, 14.46 and 275.24 kg/ha, respectively. The experiment was laid out in randomized block design with four replications, consisted of four herbicides with two doses of each, hand weeding twice (ping resistance oat 30 and 60 DAS) and weedy check. All herbicide treatments were applied at 25 – 30 DAS with 600 liter water/ha. Wheat variety M.P. 4010 using seed rate of 120 kg/ha was sown on third week of November during both the years. The recommended package of practices was follow except weed management practices. The dominant weeds were *Chenopodium album, Anagallis arvensis, Convolvulus arvensis, Melilotus indica* and *Spergula arvensis* were the broad leaf weeds and *Phalaris minor, Cynodon dactylon* and *Cyperus rotundus* were the grassy weeds. The lowest weed density (2.76 /$m^2$) and total dry matter production (63 kg/ha) of weeds were recorded under isoproturon and sulfosulfuron, respectively. Application of isoproturon reduced weed population and weed dry weight to the maximum extent and it was at par with sulfosulfuron and clodinafop. Whereas sulfosulfuron 25 g/ha recorded highest weed control efficiency (95.2%) followed by weed free (94.0%) and sulfosulfuron 50 g/ha (93.0%). The net return and benefit cost ratio was also higher in sulfosulfuron 50 g/ha followed by weed free and sulfosulfuron 25 g/ha. It is concluded that sulfosulfuron is more remunerative and effective control of both the broad and narrow leaves weeds in wheat.

## P - 100 Efficacy of herbicides for controlling weeds in direct seeded rice (aerobic)

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An experiment was conducted in aerobic rice using sprouted seeds. Weed control treatments significantly reduced the total weed density and total weed dry matter production at 60 DAS. Among the various treatments the post-emergence mixture of fenoxaprop + (chlorimuron + metsulfuron) on 30 DAS ($T_6$) significantly lowered the total weed density (32.51) and the total weed dry matter production to 72 kg/ha. Unweeded control ($T_{12}$) recorded higher total weed density (316.8) and total weed dry matter production of 1062 kg/ha. The weed flora mainly consisted of *Echinochloa colonum, Panicum javanicum, Chloris barbata, Dactyloctenium aegyptium* and *Panicum repens* under grasses, *Cyperus iria, Cyperus difformis* under sedges and *Cleome viscosa, Corchorus olitorius, Euphorbia hirta, Merremia emarginata, Portulaca oleracea* and *Trianthema protulacastrum* under broad leaved weeds. Post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) registered higher plant height. But this treatment ($T_9$) was comparable with post-emergence bispyribac sodium alone on 20 DAS ($T_8$) and $T_7$. At flowering stage, post emergence application of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) registered higher LAI, which was comparable with post-emergence bispyribac sodium alone on 20 DAS ($T_8$). Post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) registered significantly higher rice dry matter production at harvest stage. It was followed by bispyribac sodium ($T_8$) in all growth attributes. Number of panicles $m^2$ was significantly improved by weed control treatments. Among different treatments, post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) registered more number of panicles/$m^2$ (431.03). But it was comparable with post-emergence bispyribac sodium alone on 20 DAS ($T_8$). Similarly, post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) registered higher number of filled grains panicle$^{-1}$ (138.56). Among different treatments, post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) recorded significantly higher test grain weight. All yield attributes were next in bispyribac sodium ($T_8$). Grain yield was significantly improved by weed control treatments. Among different treatments, post emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) recorded significantly higher grain yield (6051 kg/ha). It was followed by bispyribac sodium ($T_8$). Unweeded control ($T_{12}$) recorded very low grain yield (2232 kg/ha). Similarly fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) recorded significantly higher straw yield (7480 kg/ha). The investigation conclusively proved that post-emergence mixture of fenoxaprop + ethoxysulfuron on 30 DAS ($T_9$) in aerobic rice is the appropriate weed management practice to control broad spectrum of weeds and to achieve higher productivity in aerobic rice.

## P - 101 Influence of integrated weed management practices on weed competition for nutrients in aerobic rice

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A field trail was carried out in red sandy loam soil during *kharif* 2009 at zonal agricultural research station, V.C. farm, Mandya to investigate the influence of integrated weed management practices on weed competition for nutrients in aerobic rice. Results revealed that pre-emergent application of bensulfuron methyl + pretilachlor 0.06 + 0.60 kg/ha + one intercultivation at 40 DAS recorded significantly lower weed population (17.0/0.25 $m^2$), weed dry weight (2.32g / 0.25 $m^2$), higher grain yield (4804 kg/ha) and straw yield (5470 kg/ha). Nutrient uptake by rice was higher in bensulfuron methyl + pretilachlor 0.06 + 0.60 kg/ha + one intercultivation at 40 days after sowing (107.70 N, 19.28 P and 77.71 K, kg/ha, respectively). Whereas, unweeded check recorded lower nutrient uptake by crops (28.1 N, 3.99 P and 15.86 K kg/ha, respectively). There was a significant positive correlation between grain yield and total uptake of nitrogen, phosphorus and potassium by crop.

## P - 102 Effect of rice establishment techniques under different weed management practice

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The different rice establishment methods significantly influenced the distribution of weeds. The experimental field was dominated by grass weeds at all the stages of the crop. Broadcasting ($M_4$) and drum sowing ($M_3$) methods recorded significantly higher weed density throughout the crop growth stages. SRI method of rice establishment ($M_1$) recorded significantly lower weed density. Among the weed management methods, unweeded check ($W_4$) recorded higher weed density throughout the crop growth stages. Cono weeding ($W_2$) recorded significantly lower weed density. SRI method of establishment recorded weed dry matter of 55g/$m^2$ during harvest stage of the crop whereas broadcasting method recorded 85.9g/$m^2$. Unweeded check ($W_4$) recorded significantly higher weed dry matter of 156.8g/$m^2$, while cono weeding ($W_2$) recorded significantly lower weed dry matter of 45.9g/$m^2$ at harvest stage. The different rice establishment methods and weed management practices significantly influenced the growth and yield attributes of rice. The growth attributes like plant height, LAI, dry matter production were higher under SRI ($M_1$) and transplanted Rice ($M_2$). Plant height was significantly higher under SRI ($M_1$) followed by transplanted rice ($M_2$) whereas broadcasting method recorded lower plant height. LAI and number of panicles were higher under transplanted rice ($M_2$). drum sowing ($M_3$) recorded significantly lower LAI and dry matter production. Cono weeding ($W_2$) recorded significantly higher growth attributes of rice. It was followed by pre-emergence application of pyrazosulfuron ethyl + mechanical weeding ($W_1$) and hand weeding twice ($W_3$). The yield attributes like panicles/$m^2$, total grains and filled grains/ panicle were significantly higher under SRI and transplanted rice. Filled grains / panicle were higher (115) in SRI. Higher grain and straw yield of 6386 kg/ha and 7607 kg/ha, respectively were recorded under SRI ($M_1$). It was followed by transplanted rice ($M_2$). But broadcasting method recorded lower grain and straw yield of 2459 kg/ha and 4183 kg/ha, respectively. Among the weed management practices, cono weeding ($W_2$) recorded significantly higher grain and straw yield of 6833 kg/ha and 8167 kg/ha, respectively. It was followed by pre-emergence application of pyrazosulfuron ethyl + mechanical weeding ($W_1$) and hand weeding twice ($W_3$). Unweeded check recorded lower grain and straw yield of 1816 kg/ha and 4527 kg/ha, respectively. Among the establishment methods, SRI performed better than other methods of establishment followed by transplanted rice. Cono weeding was found to be effective in managing weeds. It was followed by pre-emergence application of pyrazosulfuron ethyl + mechanical weeding ($W_1$).

## P - 103 Herbicidal weed management in transplanted rice

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A field experiment was conducted during *rabi*, 2011 in the wetland farm, Tamil Nadu Agricultural University, Coimbatore to study of pre-plant and pre-emergence herbicidal weed management in transplanted rice. The experiment was laid out in a factorial randomized block design with two factors *viz*., glyphosate at 0.75 kg/ha and non glyphosate application. Each factor was divided into six treatments *viz.*, butachlor 1.25 kg/ha, pretilachlor 0.75 kg/ha, almix 20 g/ha on 3 DAT followed by hand weeding HW at 40 DAT and bensulfuron methyl + pretilachlor 0.06+0.60 kg/ha on 10 DAT along with HW at 20 and 40 DAT and unweeded control with three replications. The results revealed that all the weed treatments significantly influence the grain yield. Among the different treatments application of bensulfuron methyl + pretilachlor 0.06 + 0.60 kg/ha recorded significantly higher weed control efficiency, weed dry weight, grain yield and straw yield followed by pretilachlor at 0.75 kg/ha + HW at 40 DAT. Shift in the weed flora was observed in the pre-plant application treatments. In this treatment, *Marsilea quadrifoliata* dominated the weed flora by excluding the *Hibiscus vitifolia.*

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## Weed management studies in wheat

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A field experiment was conducted at Agronomy Research Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during *rabi* season of 2010-11 with an objective to find out the effect of weed control treatments on wheat and associated weeds. The soil of the experimental field was silt loam, having pH 7.9, organic carbon 0.32, available N, P and K 180 kg/ha, 80 kg/ha and 210 kg/ha, respectively. Field trial was laid out in RBD with three replication, having ten number of treatments *viz.* metribuzin 175g, clodinafop 60g, sulfosulfuron 25g, pinoxadan 50g, metribuzin + clodinafop 105 + 60 g, metribuzin + clodinafop122.5 +60g, metribuzin + sulfosulfuron 105+ 25g, sulfosulfuron + pinoxadan 25 + 50g, weed free and weedy check. The herbicide treatment were executed at 35 DAS with the help of manually operated knapsack sprayer fitted with flat fan nozzle using 600 litres of water/ha. The crop was sown on 23rd December, 2010. The density of BLWs, narrow leaved weeds as well as total weeds and total weeds dry weight were recorded significantly less with matribuzin + clodinafop 122.5 + 60.0 g/ha as compared to rest of the herbicidal treatments. All the growth and yield contributing characters *viz.* plant height, dry matter accumulation, LAI, length of spike, test weight as well as grain and straw yield were significantly higher in weed free *fb* metribuzin + clodinafop 122.5 + 60.0 g/ha. Higher dose of metribuzin (175 g/ha) showed the toxicity symptom on crop for 10-12 days only. With respect to economics (net return and B:C ratio) metribuzin + clodinafop 122.5 + 60.0 g/ha recorded maximum net return (Rs. 48586) and B:C ratio (Rs. 2.26). It can be concluded that matribuzin + clodinafop 122.5 + 60.0 g/ha proved superior with respect to weed control and crop yield fb metribuzin + Sulfosulfuron 105 + 25 g/ha.

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## Effect of planting techniques and different weed management practices on weed density and yield of maize

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Maize is one of the important cereal crops next only to wheat, rice in the world. Weed create acute problem in rainy season crop, as they compete for nutrient, moisture light and space and ultimately affect the growth and the yield of crops. Field experiment was conducted at crop research center, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut (U.P.) during *'kharif'* season of 2011. The soil of the experimental field was sandy loam in texture; pH 8.0 low in available N, medium in phosphorus and potash. The experiment consist of 3 planting techniques (flat bed, broad bed and narrow bed planting) in main plot and 6 weed management treatments (weedy check, pendimethalin 1.0 kg/ha, metolachlor 1.0 kg/ha, atrazine 1.0 kg/ha, green manure *fb* 2,4-D 0.75 kg/ha., atrazin 0.5 kg. + metolachlor 0.5 kg/ha. in sub plot. These treatments were evaluated under split plot design with three replications. Among different planting technique narrow bed planting system recorded significantly less weed population and dry weight and higher yield of maize as compare to flat bed and Broad bed planting system. Use of different weed management practices significant by reduced the weed population compare to weedy check. Application of atrazin 0.5 + metolachlor 0.5 kg/ha as pre emergence proved significantly superior to other practices.

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## Weed management in wheat

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An experiment was undertaken during *rabi* 2004-05 at Instructional farm, MPKV, Rahuri (Maharashtra) in randomized block design and replicated three times. The treatments consisted of T1: weedy check, T2: weed free plot, T3: pendimethalin 1.0 kg/ha PE, T4: pendimethalin 1.0 kg/ha PE+ one hand weeding at 40 DAS, T5: pendimethalin 0.75 kg/ha PE+ one hand weeding at 40 DAS, T6: 2,4-D 1.0 kg/ ha POE at 40 DAS, T7: hand weeding at 20 DAS+ 2,4D 1.0 kg/ ha POE at 40 DAS, T8: hand weeding at 20 DAS + 2,4-D 0.75 kg/ha POE at 40 DAS, T9: metsulfuran methyl 4 g/ha POE at 40 DAS, T10: hand weeding at 20 DAS + metsulfuran methyl 4g/ ha POE at 40 DAS and T11: hand weeding at 20 DAS+ metsulfuran methyl 3g/ha POE at 40 DAS. Weed intensity and dry matter of weeds at harvest were significantly lower in WF, pendimethalin PE 1.0 kg/ha + HW, pendimethalin PE 0.75 kg/ha + HW. Maximum drymatter and weed intensity was observed in WC. The growth of wheat measured in terms of height, number of functional leaves, number of tillers per plant and dry matter accumulation per plant was influenced by WF and followed by pendimethalin PE 1.0 kg/ ha + HW. Maximum values for yield attributing characters were observed in weed free upto 60 DAS followed by pendimethalin 1.0 kg/ha as pre-emergence and one hand weeding at 40 DAS. The grain (42.50 q/ha) and straw yield (52.54 q/ha) of wheat was maximum in WF followed by pendimethalin PE 1.0 kg/ha + HW. The total uptake of N, P and K (96.57, 20.78 and 74.38 kg/ha, respectively) was maximum in treatment in WF followed by pendimethalin PE 1.0 kg/ha + HW. The gross monetary returns were maximum in weed free up to 60 DAS (Rs. 39801/ ha) followed by pendimethalin PE 1.0 kg/ha + HW (Rs. 39041/ha). Maximum net monetary returns were obtained due to pendimethalin PE 1.0 kg/ha + HW (Rs. 22284/ha) followed by pendimethalin PE 0.75 kg/ha + HW (RS. 20990/ ha) and WF (Rs. 20875/ha). Benefit: Cost ratio was maximum in pendimethalin PE 1.0 kg/ha + HW.

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## System of rice intensification (SRI) as influenced by weed management practices

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The present investigation carried out at Research cum-Instructional Farm, IGKV, Raipur (C.G.) during *kharif* season of 2009 in RBD with three replications. The weed flora of the rice field comprised *Alternanthera triendra, Echinocloa colona, Fimbristylis miliacea* and *Cyperus iria* throughout the crop season. Results revealed that post-emergence application of fenoxaprop-p-ethyl 60 g/ha+ethoxysulfuron 15 g/ha at 20 and 35 DAT was statistically at par with hand weeding (twice) at 20 and 40 DAT for controlling weeds effectively in system of rice intensification method of rice and the grain yield and straw yield were also comparable and it was closely followed by fenoxaprop-p-ethyl 60 g/ha + ethoxysulfuron 15 g/ha at 20 DAT + MW performed on two ways at 35 DAT. All the treatments gave significantly higher seed yield than control. The highest gross return and B:C ratio was obtained from fenoxaprop-p-ethyl 60 g/ha + ethoxysulfuron 15 g/ha at 20 and 35 DAT followed by hand weeding.

## P - 108 Statistical models for the estimation of yield loss due to *Scciolepis interrupta* in rice

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A study was undertaken at Kerala Agricultural University, Thrissur to identify suitable statistical models for the estimation of yield loss due to the weed S*acciolepis interrupta* at varying densities on the yield of rice crop. The data required for the study were taken from the trial conducted on crop-weed competition of *Sacciolepis* on rice under AICRP on Weed Control, College of Horticulture, Vellanikkara. *Sacciolepis* is a major grass weed seen in the dry seed (upland) rice field during *kharif* season. The weed characters like number of productive tillers, weed count, height of the weed, weed dry matter *etc.* were taken for the study. Multivariate techniques such as multiple linear regression analysis, stepwise regression analysis, and principal component analysis were used along with univariate techniques for the prediction of yield and yield loss. The study undoubtedly revealed the importance of the weed in suppressing the potential yield of rice. Among the morphological traits, height of the weed showed maximum negative correlation with the crop yield. The hyperbola, cauchy function, parabola and normal equation were the most promising univariate functional models in describing the yield-weed relationship. However, the estimate of loss due to weed density obtained from the function was very low when compared to that from multivariate techniques. The study showed the importance of nonlinear models in response studies. In general nonlinear models were superior to linear models in predicting the nature of response irrespective of the type of the independent variable. The multiple linear regression equation explained 82% of the variation in the grain yield of rice. The total yield loss by weed infestation using multiple linear regression analysis was found to be 56.54%. Stepwise regression analysis disclosed the importance of WDM as the single best predictor of yield loss in rice contributing to about 65% of total variability. The selected prediction equation was of the form, Y= 477.375-103.821** X1, where Y is yield and X1 is WDM. The estimated loss from this equation was found to be 41.8 Multivariate regression models were more powerful in predicting crop yield than univariate models. In these cases, the fitted statistical models described the relationship with satisfactorily high degree of precision.

## P - 109 Herbicides residue studies in soil applied in *rabi* maize under rice-*rabi* maize cropping system

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Field trials were laid out during *rabi* 2009 and 2010 in a randomized block design with four replications at Agronomy Research Farm as well as in Weed Science Laboratory of Department of Agronomy, N.D.U.A.T., Kumarganj, Faizabad. Application of atrazine1.5 and 3.0 kg/ha, pendimethalin 1.0 and 2.0 kg/ha and isoproturon 1.0 and 2.0 kg/ha at pre-emergence applied in *rabi* maize did not cause significant differences in germination, plant height and dry matter production of cucumber grown in sampled soil taken after the harvest of *rabi* maize. Therefore, the results revealed that herbicides namely atrazine 1.5 and 3.0 kg/ha, pendimethalin 1.0 and 2.0 kg/ha and isoproturon 1.0 and 2.0 kg/ha applied at pre-emergence to control the weeds in randomize did not leave their harmful toxic level of residues in soil after the harvest of *rabi* maize.

## P - 110 Management options for controlling the weedy rice complex in rice fields of Kerala

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Weedy rice is a complex of *Oryza* morphotypes widely distributed in the commercial rice fields, especially in areas where farmers have switched to direct seeding due to labour shortage and high cost. The present recommendations of chemical weed control in rice are not effective for selective control of weedy rice. Hence, a trial was conducted for formulating a package for the management of weedy rice by tackling the problem at different phases of the crop. The results of the experiment revealed that in already infested fields, the effective strategy is to deplete the weedy rice soil seed bank by adopting stale seed bed technique (destroying the weedy rice seedlings by the application of non selective herbicides followed by flooding for two weeks, draining the field and subsequent sowing). Burning of straw left after the harvest of rice stimulated the germination of dormant weedy rice seeds in the soil. Among the different herbicides tried, pre sowing surface application of oxyfluorfen 0.3 kg/ha three days before sowing, in 5 cm standing water, effectively controlled weedy rice emergence during the initial critical period of 12-15 days after sowing, giving competitive advantage to the crop. Soil incorporation of pre emergence herbicides did not give significant control of weedy rice. Addition of weed seeds to soil from the infested standing crop could be controlled by direct contact application of nonselective herbicides like paraquat, glufosinate or glyphosate 100 ml/l, to the each heads of weedy rice using special wick applicator at around 60-70 days after sowing, for selectively drying of the panicles of weedy rice.

## P - 111 Emergence pattern of *Sacciolepis interrupta*, a problem grass weed of semi-dry rice

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*Sacciolepis interrupta* (Willd.) Stapf, locally called 'Polla', is reported as a serious weed of semi-dry rice in Kerala. The problem of *Sacciolepis interrupta* assumes significance as more and more farmers resort to dry seeding to avoid the hassles of transplanting. The present experiment was undertaken to study the emergence pattern of *Sacciolepis interrupta* in relation to the receipt of rainfall and its behaviour with ploughing. After land preparation, three strips of size 5.0m x 1.5 m were left unsown. On each strip, three micro plots of size $0.25m^2$ (0.5mX0.5m) each were marked and the emergence of *Sacciolepis* at weekly intervals was noted from the first receipt of rains. Rings of different colours were given for different flushes of weeds. During the first week after the receipt of rains, 51.4 per cent of the *Sacciolepis* emerged. During the second, third, and fourth weeks, emergence percentages were 35.7, 7.1, and 5.7 respectively. After four weeks, there was no further emergence of the weed It could be noted that majority of the weeds (87.1%) emerged during the first two weeks after the receipt of pre-monsoon showers. Observations on survival revealed that 77.7% *Saccilolepis* emerged during the first week survived at maturity. However, the survival percentages of those emerged during the second, third, and fourth week were in the order of 64, 60, and 50. Mortality percentages were lower for the early-emerged seedlings but much higher for those appeared at the end of the emergence period. The results support the possibility of delaying sowing date as a method of control, which can reduce potential infestation of *Sacciolepis interruta.*

## P - 112 Weed management studies in late sown wheat

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Field experiment was conducted during *rabi* season of 2009-2010 at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) to study the weed management in late sown wheat. The soil of the experiment field was silt loam in texture, low in organic carbon and nitrogen and medium in available phosphorus and potassium having pH 8.4 and EC 0.32/dSm. The experiment consisted of 10 treatments (carfentrazone 15 g *fb* pinoxaden 30 g/ha Carfentrazone 20 g *fb* pinoxaden 35 g/ha; carfentrazone 25 g *fb* pinoxaden 45 g/ha; pinoxaden 30 g *fb* carfentrazone 15 g/ha; pinoxaden 35 g *fb* carfentrazone 20 g/ha, penoxaden 40 g *fb* carfentrazone 25 g/ha; carfentrazone 25 g/ha, pinoxaden 40 g/ha, weed free and weedy check) was laid out in randomized block design with three replications. The wheat variety UP 2425 was sown on 20$^{th}$ December 2009. Nitrogen, phosphorus and potassium were applied uniformly 120, 60 and 40 kg/ha, respectively, through urea, di-ammonium phosphate and murate of potash. The major weed flora observed during the investigation were *P.minor, Cyperus rotundus, Chenopodium album, Convolvulus arvensis* and *Melilotus alba.* Post emergence application of pinoxaden 40 g/ha (35 DAS) followed by carfentrazone 25 g/ha (42 DAS) reduced significantly the density and dry weight of weeds as compared to other treatments and was found at par with weed free and carfentrazone 25 g *fb* pinoxaden 40 g/ha. All the growth and yield contributing characters *viz.,* plant height, dry matter accumulation, 1000-grain weight as well as grain and straw yield were significantly higher with weed free and the values were at par with post emergence application of pinoxaden 40 g *fb* carfentrazone 25 g/ha. Thus, it was concluded that PE application of pinoxaden 40 g/ha applied at 35 DAS fb carfentrazone 25 g/ha applied at 42 DAS was found most effective in controlling the weedy and recorded higher production of late sown wheat.

## P - 113 Study of herbicide combinations and its effect on weeds in rice-rice cropping system

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A field experiment was conducted at R.A.R.S, Pattambi farm of Kerala Agricultural University during *kharif* and *rabi* seasons of 2009 -10 and 2010 - 11 on lateritic soils with acidic pH to study the response of combinations of herbicides on rice weeds. The herbicide treatments consisting of pre-plant application (15 days prior to planting) of lyphosate, pre-emergent (0 to 5 DAT) herbicides butachlor and mixtures of bensulfuron-methyl and pretilachlor (15 DAT) were laid out in randomized block design. Herbicides treatments were compared with mechanical, manual and non-weeded control plots. The results revealed that the sequentially applied herbicides were found to be effective in controlling weeds and increasing the grain yield of rice. Among herbicides, the combination herbicide bensulfuron-methyl + pretilachlor (post planting) when applied in conjunction with glyphosate (pre-planting) was found to be effective followed by butachlor (post-planting) + glyphosate (pre-planting), which was significantly superior to other weed control treatments tested in this experiment. The herbicides, being effective against weeds recorded lower number of weeds, lower dry weight of weeds and higher grain yields, which were comparable to hand, weeded treatments. Weeds in the experiments field were grasses *Echinocloa crusgalli, E colona*, *Panicum repens*, sedges *Cyperus iria*, *C difformis*, *Fimbristylis miliaceae* and broad leaved weeds *Eclipta alba*, *Marsilea quadrifoliata*. The perennial grass *Panicum repens* was found to lower in the plots received the herbicides sequentially applied after the glyphosate as pre-plant treatments. The data on weed control and crop toxicity rating indicate that the sequentially applied herbicides exhibited higher weed control rating of 6.00, were found to be safe and non-phytotoxic to rice plant. Mechanical weeding cono-weeder was found to be effective, however little modifications and necessary skill mobilization was needed to popularize this mode of weed control.

## P - 114 Integrated weed management in rice : future prospective

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It was reported that uncontrolled weeds reduce the yield by 96% in dry direct seeded rice, 61% in wet seeded rice and 40% in transplanted rice. Weed control in rice has been mainly carried out by manual weeding but due to increasing labour shortage and high cost during peak period and early crop weed competition makes manual weeding difficult and uneconomic which led farmers to shift towards chemical weed control. Repeated use of single herbicide for many years may results in herbicide resistance among the different weed species and some herbicides if not properly used, may cause problems of phytotoxicity. The only way to avoid these problems is the implementation of Integrated Weed Management (IWM) practices. In India most of the research carried out on IWM in rice is mostly based on herbicide. There is need to step up coordinated extension efforts to educate farmers on judicious use of herbicides in integration with other weed management practices. Herbicides must be made economically and ecologically affordable to farmers by innovatively integrating with other components of IWM. Effective IWM combines preventive, cultural, mechanical, chemical and biological weed control methods in an effective, economical and ecological manner including crop rotation with allelopathic crops and rice cultivars, competitive and herbicide-resistant rice cultivars, weed-smothering with green manure and intercrop etc. The challenge for weed scientists is to develop innovative, effective, economical, and environmentally safe IWM systems that can be integrated into current and future cropping systems to bring a more diverse and integrated approach to weed management in rice.

## P - 115 Bioefficacy of new herbicides against common weeds of rice

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During recent years, a number of new herbicides for rice have come into the market. They include early post emergence herbicides like Pyrazosulfuron ethyl and post emergence herbicides like bispyribac sodium and fenoxaprop - p -butyl. A few other herbicides like penoxsulam, azimsulfuron and metamifop are in the final stage of getting registration of Central Insecticides Board. In this context it was decided to compare the bioefficacy of the new herbicides against the already recommended herbicides (pre emergence – oxyfluorfen, butachlor and pretilachlor, and post emergence – cyhalofop butyl and Almix) with respect to the response of major weeds of rice. The trial was conducted in farmer's field in the kole lands of Thrissur, Kerala, where weed problems are very severe. *Echinochloa crusgalli, E. stagnina* and *Leptochloa chinensis* are the main grass weeds, whereas *Cyperus iria* and *Fimbristylis miliaceae* are the major sedges, and *Ludwigia parviflora* is the major dicot weed. The experiment was laid out in a randomized block design with twelve treatments and four replications during the third crop season (December 2011 to March 2012) in plots of 20 $m^2$. Pre emergence herbicides were sprayed at 6 DAS. Pyrasosulfuron was sprayed at 10 DAS and the other post emergence herbicides were sprayed at 20 DAS. Observations on weed count and dry matter production were recorded on 30 and 60 days after sowing. All herbicides reduced *Echinochloa, Cyperus* and *Fimbristylis.* The most effective herbicides against *Echinochloa* were bispyribac sodium, penoxsulam and cyhalofop butyl. As it was difficult to distinguish leptochloa at 30 DAS, counts were recorded at 60 DAS. All the pre emergence herbicides and cyhalofop butyl, metamifop and fenoxaprop were found effective against leptochloa whereas bispyribac sodium was not effective. *Ludwigia* was controlled by Almix, bispyribac sodium, azimsulfuron and ethoxy sulfuron. Weed dry matter production was significantly reduced by all herbicides. Consistently low dry matter production was recorded by cyhalofop butyl *fb* Almix, azimsulfuron, bispyribac sodium, penoxsulam, pretilachlor and oxyfluorfen.

## P - 116 Bio-efficacy of pinoxaden 5EC in combination with broadleaf herbicides against complex weed flora in wheat

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A field experiment was conducted during *rabi* season 2010-11 under All India Coordinated Research Project on weed control at Students' Instructional Farm of this university to find out bio-efficacy of pinoxaden 5 EC in combination with other herbicides against complex weed flora in wheat. Twelve treatment consisting *viz.,* pinoxaden (50 g/ha), metsulfuron-methyl (4 g/ha), pinoxaden + carfentrazone-ethyl (50+20 g/ha), penoxaden + metsulfuron methyl (50+4 g/ha), pinoxaden + 2,4-D (50+500 g/ha) pinoxaden + metsulfuon ethyl (500+4 g/ha), pinoxaden *fb* 2,4-D (508500 g/ha), carfentrazone ethyl (20g/ha), 2,4-D (500 g/ha), weedy check and weed free plots were assigned in randomized block design replicated thrice. All treatments resulted significant reduction in the total density and dry matter of weed except weedy plot. There was tremendous reduction in the grain yield of wheat due to uncontrolled weeds. The minimum density of weeds and dry weight of grassy weeds was recorded with application of idosulfuron + mesusulfuron (12+2.4g/ha). The minimum density and dry weight of broad leaf weeds were recorded with application of pinoxaden fb metsulfuron ethyl (50 and 4 g/ha). The maximum yield (55.27 q/ha) and net income (Rs 44094/ha) obtained with application idodulfuron + mesosulfuron (12+2.4g/ha) and minimum yield (43.12q/ha) and net income (Rs. 30978/ha) were recorded in weedy plot.

## P - 117 Efficacy of pre and post emergence herbicides in transplanted, medium duration rice under sub-tropical conditions of Jammu

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An investigation on the Efficacy of pre and post emergence herbicides in transplanted, medium duration rice (*Oryza sativa*) under sub-tropical conditions of Jammu was carried out during rainy season (*kharif*) of 2010 and 2011 on sandy loam soil , slightly alkaline in reaction , medium in organic carbon , available nitrogen , phosphorus and potassium at Research Farm of Faculty of Agriculture , Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu , main campus Chatha. *Echinochloa crusgalli* , *Echinochloa colonum* , *Ischaemum rugosum* and *Cynodon dactylon* ; *Cyperus iria* , *Cyperus difformis* , *Cyperus rotundus* and *Fimbristylis milliaceae*; and *Caessulia axillaries* , *Eclipta alba* , *Ammania* and *Commelina* species have been observed to be the major weed flora in the group of grasses , sedges and broad leaf weeds, respectively. All the herbicidal treatments recorded their superiority in enhancing rice grain yield from 29-80% , reducing mean weed population from 29-91% and weed dry weight values to 152.64 - 23.04 g/m$^2$ with weed control efficiency of 26-88% and net return values of Rs. 22231-38144/ha over unweeded check. The pooled grain yield data reveal that the highest yield of rice ( 51.39q/ha) was realized under weed free treatment and was observed to be statistically at par to the rice grain yield as realized under herbicidal treatments penoxulam 22.5 g/ha applied 10 days after transplanting (49.74q/ha) and bispyrebac 30gms/ha applied 30 days after transplanting (48.70q/ha) which in turn were not only found to record statistically similar yields between themselves but even with other doses of these herbicides. Penoxulam 22.5 g/ha and bispyrebac 30gms/ha also registered their superiority in controlling all the categories of weeds (grasses , sedges , and broad leaf weeds) conforming their wide spectrum herbicidal action with their mean weed control efficiency values of 89% and 86% , respectively. Amongst other herbicidal treatments butachlor was followed by pendimethalin and 2,4-D in recording higher grain yield , reduction in weed population and weed dry weight.

## P - 118 Effect of herbicides and nutrient management on nutrient uptake by wheat and associated weeds under irrigated conditions

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A field experiment was conducted during *rabi* 2004-05 and 2005-06 to evaluate the effect of isoproturon, clodinafop and sulfosulfuron alone at 750 g/ha, 60 g/ha and 30 g/ha respectively and tank mixture of isoproturon at 500 g/ha + 2, 4-D at 500 g/ha, isoproturon at 500 g/ha + clodinafop at 30 g/ha and isoproturon at 500 g/ha + sulfosulfuron at 15 g/ha along with nutrient management on NPK uptake by wheat and associated weeds. The highest grain yield (58.00 q/ha) was recorded with tank mixture isoproturon at 500 g/ha + sulfosulfuron at 15 g/ha and it was at par with isoproturon at 500 g/ha + 2, 4-D at 500 g/ha. Uninterrupted weed growth depleted 20.97 kg N/ha, 3.13 kg P/ha and 26.94 kg K/ha, while NPK depletion by weeds was lowest with isoproturon at 500 g /ha + sulfosulfuron at 15 g/ha. Herbicide treatments significantly increased NPK uptake by wheat as compared to weedy check. Maximum uptake of N (150.20 kg/ha), P (41.00 kg/ha) and K (194.14 kg/ha) by wheat crop was in plots treated with tank mixture of isoproturon at 500 g/ha + sulfosulfuron at 15 g/ha while in weedy check plots N, P and K uptake by crop was 87.87, 23.82 and 118.04 kg/ha respectively. Thus with the application of tank mixture of isoproturon at 500 g/ha + sulfosulfuron at 15 g/ha there was saving of 62.33 kg N, 17.18 kg P and 76.10 kg K/ha. Among nutrient management treatments, 75 % RDF + vermicompost at 1.5 t/ha and 50 % RDF + vermicompost at 3.0 t/ha increased NPK uptake by crop significantly over RDF. The increase in chlorophyll and protein contents and grain yield were also significantly higher over RDF with 50 % RDF + vermicompost at 3.0 t/ha (50.17 q/ha) followed by 75 % RDF + vermicompost at 1.5 t /ha (48.90 q/ha).

## P - 119 Effect of weed management practices and establishment techniques on productivity of rice in north-west Himalayan sub-tropical foothills

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A field experiment was conducted in sandy loam soil having slightly alkaline in soil reaction with medium in available phosphorous and potassium and low in available N and organic carbon during the *kharif* seasons of 2006-2007 in factorial randomized block design with three replications. The results revealed the superiority of the treatment with respect to crop productivity where mechanical hoeing using cono-weeder twice was used as weed management practice which was statistically similar to other weed management treatments like fenoxaprop-p-ethyl (Puma super) 0.06 kg/ha *fb* 1HW, metsulfuron methyl + chlorimuron ethyl (Almix) 0.004 kg/ha *fb* 1HW and fenoxaprop-p-ethyl when applied alone whereas the latter two treatments were at par with the treatment metsulfuron methyl + chlorimuron ethyl 0.004 kg/ha . Among the establishment methods of rice, statistically non-significant results were obtained with respect to grain yield, straw yield and harvest index in conventional and SRI methods of rice establishment. However, conventional method of rice showed marginally higher yield values over the SRI method of rice establishment. Mechanical hoeing with cono-weeder practised in rice proved to be superior economically. Higher B:C ratio was observed with the mechanical hoeing using conoweeder twice (1.78) which was closely followed by metsulfuron methyl + chlorimuron ethyl 0.004 kg/ha and fenoxaprop-p-ethyl .

## P - 120 Evaluation of pre emergence mixed herbicide for weed control and yield in transplanted rice

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Normally the loss in yield ranges between 15-20% yet in severe cases the yield losses can be more than 50%, depending upon intensity of weeds. Proper weed management technologies can result in an additional rice production. Thus, field experiments were conducted at wet land farm, Tamil Nadu Agricultural University, Coimbatore during *kharif,* 2010 and 2011. The treatments consisted new formulation of PE pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at different doses 7.5, 10, 12.5 and 20 kg/ha, the application of other pre-emergence herbicides were butachlor 50% EC 2.5 lit/ha, pretilachlor 50% EC 1.2 lit/ha, pyrazosulfuron-ethyl 10% WP 0.6 kg/ha, bensulfuron methyl 0.6% + pretilachlor 6% 10 kg/ha. All the pre-emergence herbicide were followed by one hand weeding at 45 DAT. Among the different pre emergence herbicides the application of pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 20 kg/ha recorded lower weed density, dry weight and higher weed control efficiency, this was followed by pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 12.5 kg/ha controlled the weeds effectively. The pre-emergence application of pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 12.5 kg/ha produced significantly higher yield attributes and grain yield and it was on par with pyrazosulfuron ethyl 0.15% + pretilachlor 6% (UPH 309) at 10 kg/ha. The weedy check produced the lower yield during both the years.

## P - 121 Chemical weed management in direct seeded dry sown rice under lateritic soil of West Bengal

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The investigations were conducted in Faculty Farm of Institute of Agriculture, Visva-Bharati, Sriniketan during early *kharif* seasons of 2010 and 2011 in a RBD with 12 treatments and 3 replications. The treatments included were pyrazosulfuron 25 g/ha at 3 DAS, pretilachlor 750 g/ha at 3 DAS, cyhalofop butyl 90 g/ha at 25 DAS alone and combination with Almix (metsulfuron methyl 10% WP + chlorimuron ethyl 10% WP) 90 g + 20 g/ha at 25 DAS, fenoxaprop 60 g/ha at 30 DAS alone and in combination with Almix 60 + 20 g/ha at 25 DAS and ethoxy sulfuron 60 + 15 g/ha at 25 DAS, azimsulfuron 35 g/ha at 20 DAS, bispyribac sodium 25 g/ha at 20 DAS, oxufluorfen 300 g/ha at 3 DAS followed by 2, 4-D 500 g/ha at 30 DAS. Two hand weeding at 20 and 35 DAS and weedy check were also included. The most pre-dominant weed was *Melochia corchorifolia* followed by *Panicum indicum, Cyperus iria* and *Fimbristylis miliacea.* Post emergence application of cyhalofop butyl either alone or in combination with Almix, fenoxaprop, ethoxysulfuron and bispyribac sodium controlled grassy weeds where as azimsulfuron, oxyfluorfen *fb*. 2, 4-D were effective in controlling broad leaved weeds particularly *Melochia corchorifolia* the most pre-dominant one. Application of pyrazosulfuron as pre-emergence was found to be effective to control the mixed weed flora through out the growth period of direct seeded rice. The highest net return (‘ 22,763/ha) and benefit : cost ratio (1.33) was recorded in pyrazosulfuron ethyl and it was followed by azimsulfuron (‘21,417/ha, 1.16) and cyhalofop butyl (‘ 21,341/ha, 1.15).

**P - 122**

# Occurrence and Management of Major Weeds in Tea

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India has unique distinction of being the largest producer and consumer of tea in the world. Indian tea industry produces about 840 million kg tea from an area of 5.10 lakh ha. Northeast India contributes about 75% of total Indian production. Tea occupies about 2, 28,260 ha area in Assam with an annual production of 4, 25,430 kg of made tea and thus contributes 55% of the country's total tea production. There are about 1000 tea estates in Assam besides having more than 5000 of small tea gardens. Tea industry in India has an annual turn-over of Rs. 6000 crores and provides employment to 1.2 million people of which 50% is woman besides providing indirect employment to millions. India has witnessed many-fold increase in production of tea, which is mainly attributed to effect of integrated agricultural practices including efficient weed management practices. Weeds can reduce the production of tea by 10-50% depending upon the intensity of weeds, weed species and the competitive ability of clones. Besides causing direct yield loss, weeds also led to the adverse effects on tea by:

- Restricting the branching and frame development in young tea
- Harbouring insect/pest
- Reducing the plucking efficiency
- Contaminating plucked shoots
- Reducing water flow in the drains

Being a perennial crop, tea needs appropriate weed management particularly during early stage as weed infestation during this stage may affect frame formation vis-à-vis long-term productivity. In general, weed infestation is severe in young tea and in the years following light to medium pruning and deep skiffing. Grassy weeds reduce the productivity of tea by 21%, while broad leaf weeds accounts for 9-12%. Besides removing substantial amount of nutrients, weeds also increase the incidence of other pest and diseases. Weed flora in tea is highly complex and consists of grasses, broadleaves and sedges. Some of the major weeds species observed in tea plantation are *Mikania micrantha, Melastoma malabatricum, Chromolena odorata, Axonopus compressus, Cynodon dactylon, Imperata cylindrica, Parspallum longifolium etc.*

The critical period of weed competition in tea is from April to September and hence utmost care is needed to control the weed during this period so that the productivity is not affected. Weed control is the second most expensive input in tea. Manual removal/uprooting of weed in the nurseries and young plantation are very much expensive, time consuming and back breaking. These methods require about 75 man days/ha annually for young tea and 35 man days for mature tea while, 15 man days/ha for young tea and 8 man days for mature tea in the first year are required for herbicidal control of weeds excluding the cost of herbicides. Cheeling, mostly followed in young tea, is not only expensive but often lead to greater weed infestation primarily due to exposure of the top soil layer and the weed seed present therein. It also damages the surface roots of young tea. Light pruning, medium pruning and deep skiffing exposes the surface soil layers, which encourage early weed growth.Presently, herbicide worth over 7 crores are being used by tea industry in NE India alone and is expected to increase further in view of acute shortage of laborers in time and escalation of wages of labour. Tea plantations alone use about 20% of total quantity of herbicides used in India. A number of herbicides (pre and post emergence) have been recommended for controlling weeds in tea. However, the choice of herbicides is mainly dependent on the weed flora present, type of herbicides, its availability, age of tea plantations and economic aspects. Herbicidal programmes for young and mature tea are also different due to variation in weed species as well as their intensity of infestation.

Sustainable weed management in tea essentially involves appropriate integration of manual, mechanical as well as chemical methods of weed control. Besides, evaluation of new herbicide molecules, herbicide rotation, use of herbicide mixtures are some of the options which needs due consideration for effective weed control in tea and increasing its productivity in northeast India.

## P - 123 Bio efficacy evaluation of sulfentrazone for weed control in planted sugarcane

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Sugarcane is one of the most important cash crops in India. Weeds pose tough competition to sugarcane crop because of wider spacing, slow germination, heavy fertilization and frequent irrigations. It reduces yield in field, sucrose recovery in the mills and shortened ratoon lives. Field experiments were conducted at Tamil Nadu Agricultural University, Coimbatore during 2010 and 2011 to evaluate the efficiency of sulfentrazone on weeds in sugarcane and its phytotoxicity on sugarcane. The experiment was laid out in randomized block design and replicated thrice. The treatments consists of pre emergence application of sulfentrazone at 720, 840, 960, 1080, 1200, 1320, 2400 g/ha and pre plant incorporation of sulfentrazone at 1080, 1200, 1320, 2400 g/ha, PE-atrazine 1250 g/ha, POE-2,4-DEE 1200 g/ha, HW on 30 DAP and control. Total weed density and dry weight were lower in pre plant incorporation of sulfentrazone when compared to pre emergence application of sulfentrazone. Among the weed management practices, pre plant incorporation of sulfentrazone at 1200 g/ha recorded lower weed density, weed dry weight and higher weed control efficiency which was at par with pre emergence of sulfentrazone at 1200 g/ha. This was followed by pre emergence application of sulfentrazone at 1080, 960 g/ha. Weed control efficiency was lower with unweeded control followed by hand weeding and earthing up on 60 DAP. Yield parameters, cane and sugar yield were higher with pre plant incorporation of sulfentrazone at 1200 g/ha which was on par with pre emergence of sulfentrazone at 1200 g/ha. The effect of sulfentrazone on weed control efficiency, cane yield and sugar yield were higher over the atrazine, hand weeding and control.

## P - 124 Chemical weed control in sugarcane + wheat intercropping system

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Area under sugarcane+ wheat intercropping system is increasing in north India particularly Haryana. Being a new system, a field experiment was conducted at regional research station, CCS HAU Karnal to evaluate the herbicides for control of weeds in sugarcane+ wheat. Recommended of herbicides wheat were evaluated so as to screen their feasibility in this system. The treatments were laid out in randomized block design with three replicates. Sulfosulfuron 25 g/ha, sulfosulfuron+ metsulfuron (ready-mix) 32 g/ha, mesosulfuron+ iodosulfuron 14.4 g/ha, pinoxaden 50 g/ha, pinoxaden+ metsulfuron 50+4 g/ha, pinoxaden+ 2,4-D 50+500, pinoxaden+ carfentrazone 50+20 g/ha provided >80% control of grassy weed i.e. *Phalaris minor.* Sulfosulfuron+ metsulfuron, meso+iodosulfuron, and combination of metsulfuron, 2,4-D and carfentrazone with pinoxaden provided very good control of broadleaf weeds as well. Carfentrazone 20 g/ha was phyto-toxic to the sugarcane crop with necrotic spots appearing on the leaves. All the other herbicide treatments were safe to both the crops. However, slight phyto-toxicity of sulfosulfuron+ metsulfuron (ready-mix) was observed at later stages during 2009-10. Grain yields of wheat under sulfosulfuron, sulfosulfuron+ metsulfuron, mesosulfuron+ iodosulfuron, pinoxaden alone and in combination with metsulfuron, 2,4-D or carfentrazone were as good as weed free check. Similarly the sugarcane yields under these treatments except pinoxaden+ carfentrazone were at par with weed free check.

## P - 125 Studies on bio-efficacy of tembotrione+surfactant against mixed weed complex in maize

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A field experiment was conducted at Norman E. Borlaug Crop Research Center, Pantnagar during rainy season of 2009 and 2010 to evaluate the efficacy of tembotrione a new post-emergence herbicide to control mixed flora of weeds and productivity of maize crop. The experiment was laid out in randomized block design with twelve treatments and replicated thrice. The treatment consisted of three doses of tembotrione *viz.,* 100, 110 and 120 g/ha with and without surfactant (1000 ml/ha), 2,4–D (0.8 kg/ha), atrazine, diuron and pendimethalin (1.0 kg/ha) and twice hand weeding done at (20 and 40 DAS). The experimental plot was uniformly infested with the grassy weeds like *Echinochloa colona*, *Digitaria sanguinalis*, *Brachiaria ramosa* while the BLWs included *Phyllanthus niruri*, *Cleome viscosa* and *Trianthema monogyna* during both the year. Application of tembotrione 120 g/ha + surfactant (1000 ml) showed maximum efficacy in minimizing all types of weed species and proved significantly superior over all the herbicidal treatments. Density of both grassy and non grassy weeds decreased with increasing the doses of tembotrione from 100 to 120 g/ha with or without surfactant. Herbicide tembotrione applied alone were least effective as compared to its sequential application in minimizing the density and dry weight of weeds. The application of tembotrione 120 g/ha along with surfactant recorded highest grain yield during both the years which was at par with its lower dose (110 g/ha + surfactant).

## P - 126 Integration of foliar and soil applied herbicides for efficient reduction of weed seed bank and management of seedling recruitment in plantation

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Unlike seeds of crop mature synchronously in a month, weed seeds mature in different seed lots and sheds as 5 to 18 seed rain episodes, with 2-10% of total seeds/episode. Thus total duration of seeds production extend to 15 days to 90 days depending on biomass of weed plant. Few predominant weed species *viz. Ageratum conyzoides* possess high seed production followed by *Crassocephalum crepidioides, Bidens pilosa, Dactyloctanum aegyptium* and the least seeds produced by *Digitaria marginata*. The average number of seeds/plant were 14609, 8922, 4706, 787 and 463 respectively. Thus soil serve as weed seed bank. Further, use of improperly decomposed farm yard manure will be another source of weed infestation in cropped fields. Out of total seeds deposited in the field, only 1 to 10% seedlings emerged afresh. Top soil (0-2.5 cm layer soil) sample showed had higher seedling emergence than deeper layers (2.5-5.0 and 5-7.5 cm) of soil seed bank. Hence there is a need to target the existing population and destroy the seed bank for effective weed management. Thus directed spray of glyphosate (1.5 kg/ha) on weed foliage in coffee and cardamom plantation killed the existing weeds. After the exposure of soil, pre-emergent herbicides *viz.,* butachlor (1 kg/ha) for coffee and cardamom and alachlor (1.25 kg/ha) for pepper application effectively reduced the seed bank. Butachlor and alachlor do not cause toxicity to plantation crops. At present, glyphosate or paraquat is recommended herbicides for coffee and areca plantation during non windy days. Farmers' opinion was herbicide treatment facility the intact root system which led to less soil erosion and herbicide application before eases the gleaning of coffee and areca fallen fruits has added advantage. Thus, integrated approach is a sustainable weed management practice for plantations.

## P - 127 Bio-efficacy of herbicides for weed control in direct dry seeded rice under tarai-agro climatic region of Uttarakhand

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A field experiment was carried out at N.E. Borlaug Crop Research Centre, GB Pant University of Agriculture and Technology, Pantnagar with objectives to evaluate the bio-efficacy of herbicides applied either alone or in combination to control the weeds in direct seeded rice (dry) under irrigated ecosystem during *kharif* 2010 and 2011. The experiment was laid out in randomized block design consistingh of twelve weed control treatments i.e. pyrazosulfuron 25 g/ha, pretilachlor 750 g/ha, cyhalofopbutyl 90g/ha, fenoxaprop 60g/ha, cyhalofop butyl+(chlorimuron+ metsulfuron) 90+20g/ha, fenoxaprop+(chlorimuron+ metsulfuron) 60+20g/ha, azimsulfuron 35 g/ha, bispyribac sosdium 25g/ha, fenoxaprop+ethoxysulfuron 60+15g/ha, oxyflurofen+2,4-D 300+500g/ha, two hand weeding (20 and 40 DAS) and weedy check. Herbicides were sprayed with flat fan nozzle with 750 liters of water/ha. The major weed species associated with crop were *Echinochloa colona* (44.1%), *E. crusgalli* (6.45%), *Panicum maxicum* (10.8%), *Leptochloa chinensis* (3.28%), *Trianthema monogyna* (1.45%) among the grasses, *Caesulia axillaries*(5.58%) among the BLWs and *Cyperus rotundus* (24.5%) among the sedges. Two hand weeding (20 and 40DAS) recorded lowest average weed dry weight (40 g/$m^2$) followed by the tank mix application of fenoxaprop + ethoxysulfuron fenoxaprop +(chlorimuron+metsulfuron,56.0 g/ha) and bispyribac sodium. Two hand weeding at 20 and 40 DAS showed highest weed control efficiency (90.2%) followed by the application of fenoxaprop+ ethoxysulfuron, fenoxaprop+(chlorimuron+ metsulfuron), azimsulfuron and bispyribac sodium at 60 days growth stage of crop. Combined application of fenoxaprop+ (chlorimuron+ metsulfuron) 60+20 g applied as post -emergence recorded the highest grain yield (3480 kg/ha) followed by application of fenoxaprop+ ethoxysulfuron (3185 kg/ha) and twice hand weeding at 20 and 40 DAS (3134 kg/ha) which was at par with bispyribac sodium (3003 kg/ha). The higher grain yield in these herbicidal treatments may be attributed due to higher number of panicles and grains per panicle.

## P - 128 Impact of weeds and comparative studies of legumes and natural covers in rubber plantations

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Weed management is an important cultural operation in rubber plantations and in India weed control accounts for about one third of the maintenance cost during immature phase. The recommended practice of weed management in immature rubber is establishing legume covers in the interspace and managing the weeds in the platform by manual, chemical or mechanical methods. However, considering the management option of allowing natural flora in the interspace in view of biodiversity in rubber plantations, a field experiment was laid out during 2010 at the Central Experiment Station of Rubber Research Institute of India to study the effect of legume covers and natural flora on growth of rubber, soil physico-chemical and biological properties, biomass and nutrient turnover. The treatments comprised four weed management options *viz*., rubber+ *Mucuna*, rubber + *Pueraria,* rubber + natural cover (maintaining 1 $m^2$ around the plant basin weed free), and rubber + natural cover (maintaining rubber with life saving weeding). The results showed that the growth of rubber plants was affected significantly by allowing natural flora with life saving weeding and the girth increment over a period of six months reduced by 44 to 56 per cent compared to the other three treatments. The weed density and weed dry biomass recorded at different dates after planting rubber were significantly higher in the treatment rubber + natural cover with life saving weeding. The effect of different treatments on nutrient removal is also discussed.

## P - 129 Effect of halosulfuron methyl on the productivity of early planted sugarcane

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High weed infestation and water stress are the key factors to cause great losses in yield of sugarcane. The loss in sugarcane yield varies from 20-40 per cent due to the presence of weed at the initial growth. *Cyperus rotundus* is the challenging weed, complicated to control which cause higher yield failure in sugarcane. Keeping this in view, the present study was undertaken to assess the influence of halosulfuron methyl against *Cyperus rotundus* in sugarcane. Field experiment was conducted at Tamil Nadu Agricultural University, Coimbatore during 2010. The experiment was laid out in a randomized block design with three replications. The treatments consisted of different doses (70, 80, 90, 100 and 200 g/ ha) at 3-4 leaf stage of *Cyperus rotundus* after 30 days of planting and efficacy of new herbicide was compared with the atrazine (pre-emergence) + hand weeding + earthing up and with hand weeding + earthing up. The results revealed that the NMCS did not differ significantly, indicating that halosulfuron methyl did not have any effect on the number of canes. Cane length ranged from 1.61 to 2.20 m in different treatments as against 1.42 m in control. All the treatments except halosulfuron methyl 70 g/ha, recorded significantly more cane length than control. All the treatments recorded significantly more cane yield (82.80 to 102.23 t/ha) in comparison with unweeded control (74.22 t/ha). Amongst the treatments, atrazine + hand weeding + earthing and hand weeding + earthing up recorded significantly more cane yield than the remaining treatments. Halosulfuron methyl at 90, 100 and 200 g/ha recorded significantly more cane yield (100.31 to 100.53 t/ha) than halosulfuron methyl at 70 and 80 g/ha (82.80 to 91.90 t/ha).

## P - 130 Herbicidal management of *Cyperus rotundus* in early planted sugarcane

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Weeds pose tough competition to sugarcane crop because of wide spacing, slow germination and initial growth, heavy fertilization and frequent irrigations. Weed causes more economic loss in sugarcane than all other pests combined. To over come this problem the present evaluation was undertaken to assess the effect of halosulfuron methyl on *Cyperus rotundus* control and on other weed species in sugarcane at Tamil Nadu Agricultural University, Coimbatore during 2010 (Mid season). The experiment was laid out in a randomized complete block design with three replications. Treatments consisted of different doses (70, 80, 90, 100 and 200 g/ha) at 3-4 leaf stage of *Cyperus rotundus* after 30 days of planting and efficacy of new herbicide was compared with the atrazine (pre-emergence) + hand weeding + earthing and hand weeding + earthing up. Results reveled that, the after 60 day of halosulfuron methyl application also, significantly lesser density of *Cyperus rotundus* (2.5 to 3.3/ $m^2$) was recorded in 90,100 and 200 g/ha as against 12.5 to 14.1/ $m^2$ in halosulfuron methyl at 70 and 80 g/ha. In atrazine + hand weeding, hand weeding and unweeded control recorded significantly more of *Cyperus rotundus* (18.0 to 19.0 /$m^2$) in comparison to all the doses of halosulfuron methyl. The data indicated that halosulfuron methyl 75 WG 90, 100 and 200 g/ha are highly effective against *Cyperus rotundus* as these treatments controlled 79.37 to 83.55% of *Cyperus rotundus* over pretreatment population as against an increase of 11.80, 15.15 and 32.03% in atrazine + hand weeding, hand weeding and un-weeded control, respectively.

## P - 131 Weed status in rice based cropping system under shifting cultivation in Dima-Hasao district, Assam

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Dima-Hasao district is the hilly tract mainly of Borail Range between the Brahmaputra valley of Barak valley of Assam. Shifting cultivation (*Jhum*) is the chief agricultural practice which is purely rainfed. Rice based cropping system in *Jhum* of Dima-Hasao district has been surveyed since 1992 to 2011 at an interval of 8 to 10 years. In this district, the cropping period prevailed for 2 to 3 years; however, the *Jhum*-cycle was reduced from nearly 25 years to 7 to 10 years during these years of observation. Study revealed that the rice based cropping system of Dima-Hasao district had a wide range of intercrops, including ginger, turmeric, water melon, mask-melon, maize, colocasia, banana etc. Sesame is commonly cultivated after rice up to the altitude of 600m MSL. Distinct declination of dominance of grasses has been noticed between 1992 to 2011 in the first year of cropping, in contrary, population density of Asteracean weeds, mostly belonging to *Ageratum, Bidens, Crassocephalum, Gynura* and *Mikania* have been increased and rather acutely above 600m MSL altitude. In both the altitudinal regions, *Imperata cylindica* was the only frequently occurred grass species, which havocked the farmers and compelled them to leave the place of cultivation after second and third years of cropping. High altitude weed flora (above 600m) of *Jhum* fields shown rather affinity with the flora of Meghalaya which is adjacent to Dima-Hasao district of Assam; however, it contained nearly 38% species common with lower altitude (below 600m) weed flora of *Jhum* cultivation in this district. Surveillance study revealed a distinct addition of 25 numbers of species to the summer weed flora and elimination of *Biophytum reinwardtii*, *Desmodium gangaticum*, *Mollugo pentaphylla*, *Passiflora foetida*, *Smilax perfoliata* Lour., *Sonchus asper Stephani*a *japonica*. var. *discolor,* besides the grassy weeds, *Digitaria setigera*, *Echinochloa colona* and *Phragmites karka* from the fields of rice based cropping system under shifting cultivation of Dima-Hasao distict.

## P - 132 Integrated weed management in sugarcane intercropping system

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A field experiment was conducted during autumn season of 2010-11 under All India Coordinated Research Project on Weed Control at Students' Instructional Farm of this university to quantify weed flora under various sugarcane based cropping system and its effect on weed growth. Experiment comprising two intercrop *viz.,* sugarcane + wheat (2:4) and sugarcane + mustard (2:2) in main plot and four weed control treatment (weedy, pendimethalin 1.0 kg/ha, trifluraline 1.25 kg/ha and farmers' practices ( two manual weeding *fb* one hoeing) in sub-plot was laid out in split-plot design with three replications. The significantly higher grassy weed population and dry matter observed when sugarcane intercrops with wheat in comparison to sugarcane intercrop with mustard. Maximum sugarcane equivalent yield (825.16q/ha) was observed when sugarcane intercrop with wheat. Among the weed control practices the minimum weed density and its dry weight ware recorded (two manual weeding + one hoeing) followed by with the application of trifluraline (1.25kg/ha). The higher net income (Rs 123443/ha) and B:C ratios (2.44) were obtained when sugarcane intercrop with wheat. Among the weed control the highest net income (Rs 127819/ha) and B:C ratios (2.59) were obtained with application in s trifluraline (1.25kg/ha).

## P - 133 Weed management studies in sugarcane ratoon crop

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To control weeds in sugarcane ratoon an experiment consisting of ten treatments was conducted during 2006-2007 and2007-2008 at Norman E. Borlaug Crop Research Centre of Govind Ballabh Pant University of Agriculture & Technology, Pantnagar. All the ten treatments *viz.,* $T_{1-}$ control (no hoeing, no weedicide was applied} $T_{2}$- three hoeings at 1,4 and 7 week DARI) $T_{3-}$ atrazine 2.0 kg/ha (PE)+2,4-D 1.0 kg/ha (45 DARI); $T_{4-}$ atrzine 2.0 kg/ha (PE)+ 1 hoeing at 45 DARI; $T_5$ – metribuzine 1.0 kg/ha (PE)+2,4-D 1.0 kg/ha (45 DARI); $T_6$ – metribuzine 1.0 kg/ha PE+1 hoeing (45 DARI); $T_7$ –glycel 0.4 kg/ha (3 weeks stage) as directed spray; $T_8$– glycel 0.4 kg/ha (3 weeks stage) as directed spay+one hoeing at 60 DARI; T-9- trash mulcluing in altlernae rows+ hoeing at 1 and 6 weeks after ratoon initiation; $T_{10}$ – trash mulching between all rows were replicated three times in randomized block design. Ratoon was initiated on March 05 during 2007 and in 2008 on February 24. Plant and ratoon crops were raised as per recommended practices. Soil of the experiment was silty loam having the organic carbon (1.12%), 48.8 kg $P_2O_5$ and 243.0 Kg $K_2O$/ha soil was neutral in pH (7.4). Major weed species recorded in the experimental field were C*elosia argentea, Solanum nigrum, Parthenium hysterophorus* among non-grasses*; Cynodon, dectylon. Echinocloa* spp and *Decteloctanium aegypticum* among grasses were dominant. *Cyperus rotundus* was the only sedge. Reduction in cane yield (ratoon) due to weeds 40% during 2007 and 39% during 2008 was recorded. Highest cane yield (110.5 t/ha) during 2007 and 111.3 t/ha during 2008 was recorded in the treatment 3 hoeings (1,4 and 7 week DARI) which was found significantly higher over rest of the treatments except treatment $T_{10}$ during 2007 and over rest of the treatments during 2008. Weed population was highest in control plot during both the years. Weed population was reduced almost in all the treatments significantly as compared to weedy check during both the years. However significantly lowest weed population was recorded in the treatment $T_4$ (atrazine 2 kg/ha (PE)+1 hoeingh at 45 DARI during 2007 and in trash mulching in all rows during 2008 which was found significantly lower over rest of the treatments.

## P - 134 Influence of weed management practices on cane yield, quality and weed intensity of ratoon sugarcane

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Field experiments were conducted at Regional Sugarcane and Jaggery Research Station, Kolhapur during 2007-08 and 2008-09, to evaluate effective method of weed management in ratoon sugarcane. It may be concluded from this study that the pre-emergence application of atrazine 2.0 kg/ha followed by 2,4-D 1.0 kg/ha at 45 days after ratoon initiation (DARI) recorded highest cane yield (94.76 t/ha) over control treatment (no hoeing and no herbicide application) and it was followed by trash mulching in all rows treatment (94.09 and 14.53 t/ha). Highest net returns of Rs. 81,138/ ha) and B:C ratio (3.49) was recorded with pre-emergence application of atrazine 2.0 kg/ha with 2,4-D 1.0 kg/ha at 45 days after ratoon initiation. Trash mulching in all rows also gave highest B: C ratio (3.49) over rest of the weed management practices.

## P - 135 Weed management in newly planted mango and citrus orchards

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Allowing weeds in newly planted orchard ecosystems is a serious concern. Efforts are needed to tackle weeds of various natures intelligently in mango and citrus orchards by using suitable weed management practices for getting maximum returns. Present study on integrated weed management in mango and citrus orchard was conducted to evaluate the economically viable integrated weed management technique. The treatments consisted of intercropping of cowpea-pea-cowpea; intercropping of green gram-pea- green gram; the combination of both the intercropping with fluchloralin/pendimethalin/ fluchloralin in each season; metribuzin 0.5 kg/ha; glyphosate 2.0 kg/ha; two mechanical weedings in each season along with weedy check.

The experimental fields of mango and citrus orchards were mainly infested with *Echinochloa colona, Cyperus rotundus, Physalis minima, Cynodon dactylon, Dinebra* sp. during rainy and summer seasons. While during winter season, *Medicago* hispida, *Chenopodium album, Paspaladium sp., Alternanthera sessilis, Physalis minima, Sida* spp. were dominant weed flora. Results revealed that adoption of cropping system like cowpea-pea-cowpea and green gram-pea-green gram as intercropping combined with herbicide application significantly reduced the weed population and weed dry matter in mango and citrus orchards. Intercropping of green gram-pea-green gram with herbicides (pendimethalin and fluchloralin) was found most effective and remunerative in reducing weed density and their biomass. However, application of glyphosate (2.0 kg/ha) in each season followed by two mechanical weedings resulted significantly the lowest weed density and biomass throughout growing season.

In mango, there was no definite trend on per cent increase in height and girth of plant due to various treatments but in case of citrus, two mechanical weeding and metribuzin 0.5 kg/ha in each season gave higher per cent increase in height and girth of the plant. Growing of intercrops during the year with and without herbicide application also influenced the plant height and girth of citrus plants. A bonus yield of cowpea and green gram ranged between 4-6 q/ha/season (*kharif* and summer) and 6-8 q/ha of pea during rabi season was obtained. It is very clear from the results that growing intercrops like cowpea and green gram during *kharif* and summer seasons and pea during *rabi* season with herbicide application could be utilized as a integrated weed management (IWM) package for effective weed control, reducing of soil weed seed bank and to get additional income during non-fruiting period of orchard crops. Highest free-living diazotrophs, (23.1x104), ammonia oxidizer 18.9x103), nitrite oxidizer (16.3x103) and total bacterial population (28.4x105) were recorded in intercropping of cowpea treatment, at harvesting stage. Among the treatments receiving herbicide metribuzin showed lower population of total bacteria (20.9x105) free living diazotrophs (16.9x104) and nitrite oxidizer (12.3x103) at harvesting stage. Similar effects also recorded during winter season experiment. It is apparent from this study that intercropping using legume crops in mango and citrus orchards were found to be highly favorable to soil microbial population. Detrimental effects of herbicides can be reduced with the integration of crops in case of orchard.

## P - 136 Identification of rice genotypes for weed competitiveness under upland condition

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In most agricultural systems, effective weed control has been one of the major problems. Without weed control, yield losses range from 10-100% depending on the competitive ability of the crop. Weeds are the major constraint to productivity in direct sown upland as well as lowland ecosystem where standing water is not maintained throughout the season. Weed management is one of the key elements of most agricultural systems. This has resulted in the development of strategies for integrated weed management, based on the use of alternative methods for weed control and rationalization of herbicide use, i.e. rather than trying to eradicate weeds from a field, emphasis is on the management of weed populations. The increasing herbicide resistance in weeds, the necessity to reduce cost of inputs and widespread concern about environmental side effects of herbicides have resulted on greater pressure on farmers to reduce the use of herbicides.Twelve judiciously selected rice (*Oryza sativa* L.) genotypes, which included two land races, four widely grown cultivars of this region and six advance breeding material, were evaluated for their performance under weed free and weedy situation, with the objective of identifying high yielding genotypes under both the situation and estimation of variability in weed suppression. The presence of weed overall reduced the yield level from 172.6 to 1024.3g and 52.6-223.3g in weedy and weed free conditions, respectively. The two genotypes identified to be exhibiting weed competitiveness were R 1033-968-2-1 and Kakro. These two genotypes had early seedling vigour more plant height and high yield potential under both the conditions.

## P - 137 Physiological efficiency of $C_4$ weeds and a $C_3$ weedy rice in 'kole' land ecosystem of Kerala

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It was observed that the $C_4$ grasses and $C_3$ weedy rice were responding strongly to increase in temperature than $C_3$ cultivated rice in kole lands, causing serious threat to rice production. Hence physiological efficiency of $C_4$ and $C_3$ weeds in were evaluated in kole land ecosystem. The $C_4$ weed species evaluated were *Echinochloa crussgalli, Echinochloa colona, Echinochloa stagnina* and *Leptochloa chinensis* and the C3 weed was a weedy rice which is dominant in rice field. The field observations were made in directly sown rice field with variety Uma during flowering stage in March, 2011.The observations indicated that weeds with $C_4$ physiology are making them more dominant than $C_3$ as evidenced from their faster growth rate and establishment in field. Surprisingly the weedy rice with $C_3$ physiology also expressed significant physiological efficiency as that of $C_4$ weeds proving its predominance in kole lands. The photosynthetic rate and transpiration rate, which indicate water use efficiency, were higher in both $C_4$ and $C_3$ weed when compared to cultivated rice. The Canopy temperature depression (CTD) values ranged from 10.53°C to 11.2 °C for $C_4$ weeds whereas it was 10.83 °C for $C_3$ weedy rice and 6.97 °C for cultivated rice .The WUE and stomatal conductance were positively related to CTD.The data revealed that all the physiological parameters recorded by $C_3$ weedy rice was within the range of $C_4$ weeds.

## P - 138 Power weeder integration in transplanted rice – rice eco system

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A field experiments was carried out at wet land farm of Tamil Nadu Agricultural University, Coimbatore with power weeder integration in transplanted rice–rice eco system. The experiments were carried out during August to December, 2010 and January to April, 2011 in a completely randomized block design with four replications. The treatment included pre emergence (PE) application of herbicides *viz*., butachlor 1.0 kg/ha for 1st rice and pretilachlor 1 kg/ha for 2nd season rice + hand weeding on 45 DAT for both the crops ($T_1$), PE application of butachlor 1.0 kg/ha for 1st rice and pretilachlor 1.0 kg/ha for 2nd season rice + rotary weeder weeding on 45 DAT for both the crops ($T_2$), PE application of butachlor 1.0 kg/ha for 1st rice and pretilachlor 1 kg/ha for 2nd season rice+cono weeder weeding on 45 DAT for both the crops ($T_3$), PE application of butachlor 1.0 kg/ha for 1st rice and pretilachlor 1 kg/ha for 2nd season rice + motorized weeder weeding on 45 DAT for both the crops ($T_4$), hand weeding (25 and 45 DAT) for both crops ($T_5$) and control ($T_6$). Application of PE herbicides *viz.,* butachlor 1.0 kg/ha for 1st rice and pretilachlor 1 kg/ha for 2nd season rice + motorized weeder weeding on 45 DAT for both the crops ($T_4$) was very effective in controlling the weeds and registered lowest weed density and total weed dry matter production in both the seasons. Among the different weed control treatments, the treatment consisting of PE application of butachlor 1.0 kg/ha for 1st rice and pretilachlor 1 kg/ha for 2nd season rice + motorized weeder weeding on 45 DAT for both the crops ($T_4$) showed the higher number of productive tillers/hill (21.8, 24.5), grain yield (kg/ha) (6172, 6725), straw yield (kg/ha) (9480, 10329), benefit cost ratio (2.02, 2.23) in both the seasons.

## P - 139 Allelopathic potential of some rice genotypes against weeds and the role of elicitor compound methylsalicylate

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Allelopathy refers to the release of chemicals by a living plant which may stimulate or inhibit the growth and development of neighboring plants. Genetic variability in the allelopathic potential of crop cultivars can be a valuable resource for breeding weed suppressive cultivars. In the present study, a field experiment was conducted in the Norman. E. Borlaug Crop Research centre, Pantnagar during the rainy seasons of 2009 and 2010 to assess the allelopathic potential of ten rice genotypes against weeds. The experiment was laid out in a Split-Plot design with two treatments, weedy and weed free in the main plot and rice genotypes in the sub-plot. Data on weed density and dry matter, as well as crop growth parameters and yield were recorded. Profiling of phenolic acids of the rice genotypes was carried out by HPLC to identify potential allelochemicals. Among the genotypes, highest crop weed competitive index was found in the genotypes Govind, UPR 2962-6-2-1, UPR 2919-14-1-1 and Pant Dhan 16. Phenolic acids, detected through HPLC, such as syringic acid, caffeic acid, 8-HQ and salicylic acid were the major acids identified in most of the genotypes. Among the phenolic acids, the levels of syringic acid and caffeic acid could be related to the competitive ability of rice genotypes against weeds. Application of the elicitor compound methyl salicylate at 0.2mM resulted in maximum reduction in weed dry weight. It was found to stimulate the production of phenolics in the competitive cultivars

## P - 140 Allelopathic influence of water cabbage *Limnocharis flava* on germination and growth of rice

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Water cabbage *(Limnocharis flava* (L.) Buchenau), a monocot weed belonging to the family Limnocharitaceae, was first reported in India from a wetland area in Alappuzha, Kerala and now it has invaded paddy fields, coconut groves and other agricultural fields in the state. The weed also clogs irrigation channels and drainage ditches resulting in poor drainage, thereby making lower regions of the cultivated tracks of the flood plains and other low lying areas of Kerala unsuitable for farming. The present study was conducted to determine the allelopathic influence of fresh and decayed plant leachates of the weed at different concentrations (2.5%, 5% and 7.5%) on germination and seedling growth of rice. The results indicated that seed germination of rice was not much influenced by the fresh plant leachate of water cabbage, while there was significant positive influence on the plumule and radicle growth. The seedling dry weight was on par with control at 2.5 and 5% but was superior at higher concentration (7.5%). Vigour index was significantly higher than that of control (distilled water) in all treatments involving fresh leachate and the maximum value was recorded at the highest leachate concentration (7.5%). However, rice seeds when treated with leachate from decayed plant samples, the germination was delayed and the plumule and radicle growth were significantly lower than that of control. The vigour index and seedling dry weight recorded were also significantly lower at all the three concentrations.

## P - 141 Potential of natural enemies for the suppression of *Parthenium hysterophorus* L. in western Uttar Pradesh, India

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Congress grass (*Parthenium hysterophorus* L.), one of the worst weed of the world has now spread throughout India except some extreme deserts of Rajasthan and higher altitudes of Himalayas and posing a serious threat to animal/ human health, crop production, biodiversity of indigenous vegetations and ecotourism. Surveys were conducted during 2003 to 2011 in Western Parts of Uttar Pradesh, to find out the potential of natural enemies and weeds for suppression of this noxious weed. Surveyed area constituted seven representing districts i.e. Bulandshahar, Ghaziabad, Rampur, Bijnor, Meerut, Muzaffarnagar and Moradabad to find out the occurrence of natural enemies (pathogens such as Sclerotinia stem rot, phyllody and leaf curl virus; insects e.g. Mexican beetle, *Zygograma bicolorata*) and suppressive weed species against *P. hysterophorus*. During the survey, it was noticed that the diseases such as Sclerotinia stem rot, phyllody and leaf curl virus were recorded from low to moderate extent with very low potential of Parthenium suppression. The temporal variations were observed with reference to the occurrence of well established insect biological control agent, Mexican beetle (*Zygograma bicolorata*) on *P. hysterophorus*. Maximum relative populations of beetles and *P. hysterophorus* suppression were observed in the month of September followed by August and July. A relatively lower to moderate insect population was observed in rest of the months during all the years. The less disturbed roadside ecosystem was found one of the model habitats for growth of competitive weed species with greater potential for suppression of *P. hysterophorus.* The major weed species with greater Parthenium suppressing ability were *Peristrophe paniculata, Cassia tora* (= *Cassia obtusifolia* L.)*, Achyranthes aspera, Hyptis suaveolens, Setaria verticillata, Urena lobata, Triumfetta rhomboidea, Xanthium strumarium, Justicia adhatoda, Saida acuta, Canabis sativa, Chenopodium ambrosoides, Cassia occidentalis, Desmostachya bipinnata, Clerodendron enermis* etc.

## P - 142 Utilization of weeds as source of green leaf manures on growth, productivity, nutrient uptake and economics in aerobic rice-rice cropping system

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The field experiment was conducted at Agricultural Research Station, Kathalagere, in southern transition zone of Karnataka during *kharif* 2006 and summer 2007. The treatment details consisted of use of three weed green leaf manures at 10 t/ha such as *Parthenium hysterophorus, Chromolaena odorata* and *Cassia sericea* compared with *Glyricidia maculate,* a traditional green leaf manure, FYM, and paddy straw incorporation with 75 and 100% recommended fertilizer dose (RDF, 100-50-50 kg/ha for *kharif* and 125-62.5-62.5 kg/ha for summer, respectively) and absolute control to know the effect of weed green leaf manures on growth, productivity, nutrient uptake and economics in aerobic rice-rice cropping system. The experiment was laid out in a randomized complete block design with three replications. The soil type was sandy clay loam with slightly acidic pH of 5.83,normal electrical conductivity of 0.24 d S/ $m^2$, moderate organic carbon of 0.44 %, available nutrients- 168.0 kg N, 17.1 kg $K_2O$ and 195.2 kg $K_2O$/ha. The results revealed that, incorporation of 10 t/ha green leaf manures of weeds- *Chromolaena or Parthenium* or *Cassia* along with 100% RDF produced taller plants (88.0 to 92.2 and 95.9 to 97.8 cm), more productive tillers (22.4 to 23.8 and 24.1 to 27.1/hill), higher LAI (5.57 to 5.63 and 5.05 to 6.01) and total dry matter accumulation in aerobic rice plant (94.9 to 98.1 and 99.3 to 109.6 g/hill during *kharif* 2006 and summer 2007, respectively) than mere use of fertilizers levels alone and other treatments. Similarly, these treatment produced higher pooled paddy yield (5241 to 5507 kg/ha) than corresponding fertilizer alone which was comparable with that of *Glyricidia* green leaf manure and FYM along with RDF. Further, the use of above weed green leaf manures 10 t/ha along with 100% RDF resulted in mean additional net returns of Rs.2,492 to 4,123/ha over the use of 10 tons of traditional FYM in aerobic rice, in spite of saving Rs.3,800/ha.

## P - 143 Parthenium as bioresource for increasing the production potential of Potato

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Potato is the important agricultural crop grown in India. Parthenium, Chromolaena and Lantana are major problematic invaded weeds found in India. These weeds are observed to have pronounced allelopathic properties and higher plant nutrient content in their biomass. A field experiment was conducted for consecutive two years at Bangalore during 2001-2004 to study the possibility of using the invaded weeds as potential bioresource in increasing the production potential of potato. The bioconverted weed compost and green weed biomass was used to substitute the synthetic nitrogen fertilizer required by the potato in the field experiment. The experimental results indicated that significantly higher potato tuber yield was recorded with Chromolaena, Lantana used as green weed biomass and parthenium used as bioconverted compost. The green weed biomass used under field condition did not influence the growth of diverse spectrum of weeds of potato. Thus, the experimental results indicated that these problematic invaded weeds can be used as potential bioresource for crop production and these weeds can be managed by their effective utilization from the point of environmental perspective.

## P - 144 Effect of organic mulching on yield and nutrients uptake of maize under rainfed condition

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Field experiment was conducted at Regional Research Station, Paiyur to assess the effect of organic mulching on yield, uptake of nutrients by maize changes in soil physical properties and nutrient availability pattern. The treatments included maize straw at 5 and10 t/ha, sugarcane trash at 5 and10 t/ha, raw coirpith at 5 and10 t/ha and dried weeds at 5 and10 t/ha and un-mulched control, which were replicated thrice in a randomized block design. The biometric observation revealed that raw coirpith at 10 t/ha and dried weeds at10 t/ha treatments recorded increased plant height, cob length, number of grain rows per cob, number of grains per row and 100 grain weight. Dry matter production at all stages of crop growth was found to be higher in raw coirpith at 10 t/ha followed by dried weeds at 10 t/ha and dried weeds mulch at 5 t/ha and were on par. Grain yield of maize under raw coirpith mulch at 10 t/ha (4488 kg/ha), dried weeds at 10 t/ha (4472 kg/ha) and dried weeds at 5 t/ha (4452 kg/ha) were on par. These treatments have recorded 73.3, 68.9 and 68.1% increase in yield over control. The same trend was observed in stover yield. The N, P and K contents of the maize grain and stover and uptake of these nutrients by the maize crop were significantly higher in raw coirpith mulch at 10 t/ha and dried weeds mulch at 10 t/ha treatments. Among different treatments, the sugarcane trash at 10 t/ha had reduced weed population and weed DMP which was on par with dried weeds at 10 t/ha. Application of sugarcane trash at 10 t/ha recorded the weed population and weed DMP of 53.7 and 81.5 per cent only as compared to control (100%).

## P - 145 Utility of water hyacinth as organic manure for crop production with special reference to its heavy metal composition.

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Water hyacinth is one among the most productive plants on earth. Its utility as an organic manure source was verified at the Regional Agricultural Research station, Kumarakom during 2010-12 period. The study focused on the heavy metal and micro nutrient composition of water hyacinth and composts produced from it in relation to its efficacy for crop production. Among the micro nutrients and heavy metal content in water hyacinth, Fe contributed major share (33038 ppm). Al (13075ppm), Ca (2234.8ppm), Mn (1850ppm), Mg (1608.3ppm), Zn (153.4ppm), Pb (126.9ppm) Cr (43.47ppm) and Cu (33.38ppm) were the other minerals of importance. As (1466 ppb) and Hg (191.8 ppb) were also seen in lesser proportion. The root portion contained 51-97% of these elements except Ca and Mg which were more in stem and leaf portion respectively. Vermi-compost and ordinary compost produced from water hyacinth compared well with farm yard waste compost in pH (6.75-6.8), EC (0.020-0.021), moisture (13.99-15.30), N (2.85-3.17), organic carbon (37.6-41.41), CN ratio (13.06-14.21) $K_2O$ (1.07-1.57%) and $P_2O_5$ (2.47-2.72). The heavy metal and micro nutrient content in all the three forms of composts were almost similar with very high content of Fe and Al. In a pot culture study the biomass yield of Amaranthus on 20 days after planting was higher for *Eichhornia* ordinary compost (41.3g/pot) which was at par with farm yard waste compost (32.9g/pot). However for the second harvest on 40 days after planting farm yard waste compost (86.8g/pot) gave significantly higher yield than water hyacinth (49.2g/pot). The results indicated that water hyacinth can be utilized as a plant nutrient scavenger from water bodies and the recovered nutrients can be successfully recycled for crop production.

## P - 146 Effect of organic mulching on soil properties of groundnut under rain fed condition in an Alfisol

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Field experiment was conducted at Regional Research Station, Paiyur to assess the effect of organic mulching on yield, uptake of nutrients by groundnut and changes in soil physical properties and nutrient availability pattern. The treatments included maize straw at 5 and10 t/ha, sugarcane trash at 5 and10 t/ha, raw coirpith at 5 and10 t/ha and dried weeds at 5 and10 t/ha and unmulched control, which were replicated thrice in a randomized block design. In groundnut, application of different organic mulches showed insignificant effect on physical properties of soil and numerical variation alone was realized. Moisture content of the soil at two depths was found to be higher in raw coirpith at 10 t/ha with 81.5% increase at 0-15 cm and 87.6% increase at 15-30 cm at harvest stage over control. Temperature of the soil at two depths was again lowered by raw coirpith mulch at 10 t/ha at all stages of crop growth. Different mulches with their levels did not produce any significant differences in the pH, EC and organic carbon status of the soil. Available N, P and K status of soil did not show any significant increase with mulch application and however, fairly higher available nutrient status was reflected at all stages of crop growth under mulched treatments. Application of dried weeds mulch at 10 t/ha had increased the bacteria, fungi and actinomycetes population of the soil. Based on the results it could be inferred that application of raw coirpith mulch at 10 t/ha and dried weeds mulch at 10 t/ha mulches along with N, P and K could improve the soil properties by groundnut and sustain the soil fertility with increase in microbial population and soil moisture in rainfed Alfisol.

## P - 147 Effect of organic mulching on yield and nutrients uptake of groundnut under rainfed condition

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Field experiment was conducted at Regional Research Station, Paiyur to assess the effect of organic mulching on yield, uptake of nutrients by groundnut changes in soil physical properties and nutrient availability pattern. The treatments included maize straw at 5 and10 t/ha, sugarcane trash at 5 and10 t/ha, raw coirpith at 5 and10 t/ha and dried weeds at 5 and10 t/ha and unmulched control, which were replicated thrice in a randomized block design. The biometric observation revealed that raw coirpith at 10 t/ha treatment recorded increased plant height, total number of pods, number of matured pods per plant and 100 kernel weight and reduced the number of immature pods per plant. Dry matter productin at all stages of crop growth was found to be higher under raw coirpith mulch at 10 t/ha followed by dried weeds at 10 t/ha and dried weeds mulch at 5 t/ha and were on par. Pod yield of groundnut under raw coirpith at 10 t/ha (2663 kg/ha), dried weeds at 10 t/ha (2600 kg/ha), dried weeds at 5 t/ha (2530 kg/ha) and raw coirpith at 5 t/ha (2565 kg/ha) were at par. These treatments have recorded 55.9, 52.2, 50.1 and 48.1% increase in yield over control. The same trend was observed for haulm yield. The application of mulches with different levels did not produce any significant impact in the oil content, protein content and shelling percentage groundnut. However marginal increase was observed under mulched treatments over unmulched control. Among the different treatments, sugarcane trash mulch at 10 t/ha had reduced the weed population and weed DMP which was on par with dried weeds at 10 t/ha.

## P - 148 Utilizing *Mikania micrantha* as a forage crop

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*Mikania micrantha* is a serious weed in agricultural and non agricultural areas of Kerala. Many farmers use it as a fodder along with other grasses. However reports are on avoiding of grazing *Mikania* by cattle. A study was conducted at College of Horticulture, Vellanikkara, Kerala Agricultural University, Thrissur during the year 1995-99 with the objectives of assessing the quality of *Mikania* as fodder. The results revealed that *Mikania* contains only 16.68% dry matter. The plant contains 14.63% crude protein, 2.36% fat, 23.21% crude fibre, 48.75% nitrogen free extract, 8.92% ash, 0.87% calcium and 0.42% phosphorus. Average potassium: calcium + magnesium ratio (K/Ca +Mg ratio) of *Mikania* was 2.86. The fibre fractions contain 42.42% neutral detergent fibre (NDF), 33.22% acid detergent fibre (ADF), 0.096% cellulose, 9.20% hemicellulose and 10.84% lignin. Variation between districts was found in the case of crude protein, ether extract, total ash, calcium, NDF and lignin content. Acid insoluble ash was almost negligible in *Mikania*. The anti nutritional factor, hydrocyanic acid also recorded negative result (qualitative test). The results on chemical composition and fibre fractions revealed that *Mikania* as fodder is comparable with common exotic grasses like guinea and setaria used for fodder purpose. Average protein content in *Mikania* was 14.63%, which was much more than guinea grass and setaria grass. The study indicates that *Mikania* is well suited to be utilized as a fodder.

## P - 149 Use of water hyacinth in craft- a nuisance weed made in to a resource

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Kerala has a huge extend of inland water bodies that are gorgeous and are of great help for the people in various ways. Many of these inland water bodies are troubled with the presence of large floating mats of nuisance weeds namely water hyacinth. Excessive growth of water hyacinth causes grave hardship to inland navigation, irrigation, local fishing and domestic drinking and washing. Water hyacinth petiole contains excellent natural fibre which can ideally used in crafts. It is a soft fiber which can be spliced and used in handlooms for making sheets through interlacement of wrap and weft . Thus water hyacinth can be effectively used as weft on strong cotton wrap to achieve range of highly attractive woven sheets that could be significant durable. This sheets is very flexible and virtually anything can be made out of them. Water hyacinth can be blended through weaving by inter changing weft material like screwpine, banana fibre, grass, jute, sisale fibre *etc.* Realizing this, Kottapuram Integrated Development Society (KIDS) facilitated women artisans to make water hyacinth products. The SHGs are grouped in to federations and turned in to large units. Now water hyacinth products are getting good popularisation and marketing platform through different exhibitions and other marketing strategies. The water hyacinth products shall act as a potential alternative to certain plastic products. Introduction of water hyacinth products in the national and international markets will certainly bring better standard of living for the poor rural women. Now KIDS is facilitating the one and only water hyacinth centre supported by ministry of textiles, Government of India.

## P - 150 Study of weed flora and weed control efficiency under diversification and intensification of rice based cropping systems

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A field experiment was conducted on diversification and intensification of cropping system under irrigated production system over existing rice - wheat and rice - chickpea cropping systems during the year 2009-10 in clay loam soils of Jabalpur (M.P.). *Echinochloa crusgalli* was the most dominating weed contributing 37.19% of total weed intensity at most critical period (30 DAT) followed by *Cyperus irria* with relative density of 31.10% at 30 DAT. The infestation of *Echinochloa* spp. and *Cyperus irria* declined at maturity, while density of other weeds increased. During *rabi* season, *Madicago denticulata* was found to be more dominant in almost all crops. Its relative density was 42.3, 38.9, 32.4, 33.2, 42.9, 22.8 and 46.9% in wheat, berseem, onion and garlic, vegetable pea and chickpea, gobhi sarson, potato and marigold, respectively. During summer season, *Portulaca oleracea* was most dominating weed in all crops with relative density 52.6, 43.8, 42.7 and 43.6% in green gram, maize, sesame and groundnut as well as okra, respectively. Different varieties of rice were grown under various crops sequences and the weed biomass ranged from 3.98 to 5.68 q/ha under different crop sequences. During summer season, the weed intensity was maximum (118.0 weeds/$m^2$) in green gram field, which resulted into the highest weed biomass production (3.89 q/ha). In *kharif,* highest weed control efficiency was recorded in rice - potato - maize cob + fodder (29.9%) cropped sequences.

## P - 151 Proper spraying techniques of herbicides for effective control of weeds in wheat

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One of the major problems with respect to weed control is the development of resistance of weeds against the herbicides. The main reason behind this was observed of faulty application of herbicide spray adopted by farmers. This study was conducted in *rabi* 2010-11 to demonstrate the spraying techniques for weed control, its effect on economic output and to educate the farmers about the recommended spraying techniques. Fifteen sites were selected representing alluvial soil type in Ropar and Ajitgarh districts of Punjab. The demonstrations were conducted using PBW550 and DBW17 cultivars and the sowing was completed between 10 to 21 November 2010. The treatments *viz.,* recommended spraying practice comprising application of clodinafop 60 g/ha in 250 litres water at 30-35 days after sowing with flat fan nozzle and overlapping 1/3$^{rd}$ of the spray boom with steady spray lance (T1); farmer practice comprising application of clodinafop 60 g/ha in 188 to 225 litres water at 40-45 days after sowing with cone type or flat fan nozzle and without any overlapping of the spray boom with to and fro movement of spray lance (T2) and unweeded control (T3). Weed population consisted of both grasses as well as broadleaf weeds. The *Phalaris minor* population observed at time of harvest was 0.46, 2.2 and 11.1/$m^2$ in three treatment, respectively. Other grass weeds namely *Avena ludoviciana* and *Polypogon monospeliensis* were 0, 0 and 4 per $m^2$ under. The maximum (49.0 q/ha) grain yield was recorded under T1 which was 2.1% higher than farmer practice (48.0 q/ha) and 22.5% higher than unweeded control (40 q/ha), indicating an additional net profit of Rs 1170/ha simply by following proper spraying technique over the faulty one.

## P - 152 Database of weeds through surveillance in western Maharashtra

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These non-crop plants, which compete with the crops for moisture, light, nutrients and space, have long been known as weeds. Alien invasive weeds present a major current and future problem to India. Several weeds have been introduced into India either by accidentally or through importing of food grains. Globalization may bring new weed problems while importing or exporting agricultural commodities as per the WTO agreement.Keeping the above mentioned points in view, an attempt has been made to develop a national database on weed science. This database will help in retrieving the information on weeds of different districts of the country distributed in varied agro – ecological regions in various crops and cropping systems. The database will help in monitoring of weed flora shift or changes due to crop management systems. The information on weeds with respect to their distribution in different crops and cropping system , non cropped situations, water used for agricultural commodities as per the WTO agreement. Hence the present work on weed survey and surveillance is of vital importance for the Maharashtra state. Directorate of Weed Research, Jabalpur started this project in 10 states of which Maharashtra is one of them. In western Mahatrashtra MPKV, Rahuri has created the database for 10 districts for cropped, noncropped, garbage and aquatic weeds.Since the total weed density did not differ remarkably among different rice varieties, hence weed biomass also did not show remarkable variations between them. During *rabi* season, the weed intensity was minimum (94.4 to 95.4/$m^2$) in onion and garlic crop grown under two different crop-sequences, hence, the lowest weed biomass (1.24 to 2.07 q/ha) was recorded in onion and garlic fields. Both gobhi sarson crop faced almost similar kind of weed-infestation, which were higher as compared to potato, hence, these resulted into production of higher weed biomass (4.84 to 5.29 q/ha).

## P - 153 On the determinants of paddy-weed ecosystem under guava based agri-horticulture practices of agroforestry: a path coefficient approach

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A study was conducted to know the association of growth and yield attributing character of paddy-weed ecosystem under guava based agri-horticulture practice of agroforestry. The experiment was carried out at the Forestry Research Farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during the year 2007-08 and 2008-09 with 15 years old guava orchards planted at a distance of 5m x 5m under randomized block design with three replications. The soil of the experimental field was clay in texture and almost neutral in reaction. The available nitrogen, phosphorus and potash in the soil were 262 (low), 24 (medium) and 253 (medium) kg/ha, respectively. The crop was irrigated as and when there was moisture stress by using dairy waste water during the crop growth period. The mean annual rainfall of Jabalpur is 1250 to 1400 mm. Paddy variety *Kranti* was grown under different weed control treatments. The treatment combination were *viz.* fenoxaprop-p-ethyl (75,100,125 g/ha), fenoxaprop-p-ethyl + 2,4-D (100+500 g/ha), 2,4-D (500 g/ha), hand weeding (twice 20 and 40 DAS), butachlor+ hand weeding (200 g/ha + 20 DAS) and weedy check. The herbicides were used as post emergence. In the present paper, a path coefficient approach has been employed to seek out the determinants of the paddy yield under guava based agri-horticulture practices of agroforestry. The results revealed that out of five factors taken into consideration, number of effective tillers/m row length, number of grains/panicle and crop biomass were found to be important determinants towards the paddy yield.

## P - 154 Long-term fertilization effects on weed composition of rainfed soybean-wheat cropping system in the north-west Himalayas

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The effects of various fertilization levels on weed species composition, aboveground biomass and weed seed bank were investigated in experimental plots of rain fed soybean-wheat cropping system established 38 years ago at Hawalbagh farm, Almora in a sandy loam soil under sub-temperate climatic conditions. Every year, the nutrients were applied to the soybean crop and wheat was grown without addition of any external sources of nutrients (residual wheat). Major dominant weeds were *Cyperus rotundus, Ageratum conyzoides* and *Oxalis latifolia* in soybean. The weed distribution revealed that population of *C. rotundus* in control (22/$m^2$), N+P (38 $m^2$), N+K (52/$m^2$) and N+P+K (77 $m^2$) was higher compare to N+FYM (11 $m^2$) and NPK+FYM (8 $m^2$) at 45 days after sowing. However, *A. conyzoides* population was more in FYM applied plots i.e. N+FYM (16 $m^2$) and NPK+FYM (25/$m^2$) than in control (2/$m^2$). Similar trend was also observed with respect to total weed dry matter. Total weed seedling density was higher in the 0-15 than in 15-30 and 30-45 cm layers. In N+FYM and NPK+FYM, more than 60% of the total seedlings emerged from 0-45 cm, compared with that of other treatments. During winter season, in wheat crop the residual effect of treatments did not influence either weed population or seed bank size, and only had a small influence on major species abundance. The weed seed bank was dominated by *C. rotundus* (>62%) and *A. conyzoides* (33%) which survived even without any addition of nutrients to soil. Maximum yields of soybean (2.87 t/ha) and subsequent wheat (1.95 t/ha) were obtained in the plots under NPK+FYM treatment. Results suggested that integrated nutrient management enhanced the system productivity of soybean-wheat cropping system. However, it changed weed composition, which need to be addressed through integrated weed management.

## P - 155 Evaluation of new formulation of oxyfluorfen (23.5% EC) for weed control efficacy and bulb yield in onion

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Onion (*Allium cepa* var. *aggregatum* L.) is one of the important bulbous vegetable crops of economic importance and widely cultivated all over the world, with particular distribution in the Asian continent and in Europe. Field experiments were conducted at the Agricultural Research Station, Bhavanisagar of Tamil Nadu Agricultural University, during *kharif* season of 2009 and 2010 to evaluate the new formulation of oxyfluorfen (23.5% EC) on weed control efficacy and bulb yield. The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of different weed management practices *viz*., pre-emergence application of already registered oxyfluorfen (goal) at 200 g/ha, new formulation of oxyfluorfen (23.5% EC) at 150, 200, 250, 300 and 400 g/ha, pendimethalin 0.75 kg/ha + hand weeding on 45 DAS, pendimethalin 0.75 kg/ha + rotary weeding on 45 DAS, Hand weeding twice on 25 and 45 DAS and unweeded check. Lower total weed density and dry weight and higher WCE were obtained with pre-emergence application of oxyfluorfen at 400 g/ha which was on par with oxyfluorfen at 300 g/ha during both the years. Significant improvement in growth and yield attributes of onion were obtained with pre-emergence application of oxyfluorfen at 200 g/ha which was comparable with oxyfluorfen at 250 g/ha. During both the years, higher bulb weight (42.56 and 43.87 g/plant) and bulb yield (15.94 and 15.61 t/ha) of onion were obtained with application of oxyfluorfen at 200 g/ha while, uncontrolled weeds reduced the bulb yield upto 50-56%. In onion, higher gross and net returns and return per rupee invested were registered with pre-emergence application of oxyfluorfen at 200 g/ha.

## P - 156 Performance of pre and post emergence herbicides on growth and yield of *kharif* green gram grown under middle Gujarat conditions

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A field experiment was conducted during *kharif s*easons of 2010 at DWSR Anand Centre, Anand to find out most efficient and economical weed management practices in green gram. The soil of the experimental field was sandy loam having pH 7.8 with 228 kg/ha available nitrogen, 89 kg $P_2O_5$/ha and 230 kg $K_2O$/ha. The experiment was laid out in randomized block design with four replications. At 25 DAS, significantly lower weed population and dry weight of monocot weeds were recorded in IC + HW carried out at 20 & 40 DAS which were at par with the post emergence application of quizalofop-ethyl 50 g/ha, quizalofop-ethyl 50 g/ha *fb* HW at 30 DAS, quizalofop-ethyl 100 g/ha and quizalofop-ethyl 100 g/ha *fb* HW at 30 DAS. Significantly the lowest number of total weeds and their dry weight were recorded in IC + HW carried out at 20 & 40 DAS. Maximum weed control efficiency recorded in inter culture and hand weeding treatment at 25 and 50 DAS and at harvest. The treatment of inter culture and hand weeding carried out at 20 and 40 DAS recorded significantly higher dry weight of *Rhizobium* nodule, no. of branches/plant, no. of pods/plant, length of pod, test weight, seed and haulm yield which remained at par with the treatments of pendimethalin 1000 g/ha as PE *fb* HW at 30 DAS, imzathapyr 100 g /ha *fb* HW at 30 DAS, imzathapyr 50 g /ha *fb* HW at 30 DAS and quizalofop-ethyl 100 g/ha *fb* HW at 30 DAS. The protein content was higher under the treatment of inter culture and hand weeding carried out at 20 & 40 DAS through it was non significant. The cost benefit ratio was higher under the treatment of IC and HW carried out at 20 & 40 DAS followed by pre-emergence application of pendimethalin 1000 g /ha *fb* HW at 30 DAS, imazethapyr 50 g/ha as POE *fb* HW at 30 DAS, quizalofop-ethyl 100 g/ha POE *fb* HW at 30 DAS, imazethapyr 100 g/ha as POE HW at 30 DAS, quizalofop-ethyl 50 g/ ha *fb* HW at 30 DAS and imazethapyr 100 g/ha as compare to weedy check.

## P - 157 Economic feasibility of weed management practices in a anise (*Pimpinella anisum*)

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A field experiment was conducted at National Research Centre on Seed Spices, Ajmer (Rajasthan), India, to find out the economic feasibility of weed management practices in terms of weed dynamics, weed control efficiency and the performance of anise (*Pimpinella anisum* L). The experiment comprised nine treatments. The experiment was laid in randomized block design with three replications. Major weed flora were *Chenopodium murale*, *Chenopodium album*, *Amaranthus virdis*, *Cyperus rotundus* and *Phalaris minor.* The results revealed that weed free treatments resulted into significantly maximum vegetative growth and seed yield (8.92q/ha) of anise followed by pre emergence application of oxadiargyl 75 g/ha + one hand weeding at 45 DAS. Among the weed management practices, weed free treatment was most effective in reducing the dry weight of weeds and recorded the highest weed control efficiency (85.94%) followed by pre emergence application of oxadiargyl 75 g/ha + one hand weeding at 45 DAS (78.31%). However, the maximum net returns (74,280/Rs.ha) and highest benefit: cost ratio was obtained in pre emergence application of oxadiargyl 75 g/ha + one hand weeding at 45 DAS among all the treatments including weed free treatments. Thus pre-emergence application of oxadiargyl 75 g/ha. + one hand weeding at 45 DAS was found as the best economically feasible practices to keep weed infestation at minimum level and to ensure higher economic yield in anise.

## P - 158 Performance of pre and post emergence herbicides on growth and yield of soybean under middle Gujarat conditions

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A field experiment was conducted during *kharif s*easons of 2007 and 2008 at DWSR Anand Centre, Anand to find out most efficient and economical weed management practices in soybean. The soil of the experimental field was sandy loam having pH 8.10 with 0.023 % nitrogen, 59 kg $P_2O_5$/ha and 310 kg $K_2O$/ha. The experiment was laid out in randomized block design with four replications. The predominant weeds of soybean were *Dactyloctenium aegyptium*, *Eragrostis major*, *Phyllanthus niruri*, *Commelina benghalensis*, *Cyperus rotundus*, *Molugo nudicuulis*, *Oldenlandia umbellata* and *Digera arvensis*. Significantly lower dry weed biomass was recorded at harvest in twice inter culturing and hand weeding (IC and HW) treatment which was at par with pre-emergence application of fluchloralin 1.00 kg/ha *fb* HW at 30 DAS, pre-emergence application of pendimethalin 0.75 kg/ha *fb* HW at 30 DAS and post emergence application of quizalofop-p-ethyl 50 and 100 g/ha *fb* HW at 30 DAS. Weed control efficiency varied between 52 to 91%. Plant stand of soybean recorded at 15 DAS was non-significantly influenced by weed management practices in soybean. Significantly higher grain yield was recorded in twice IC & HW treatment which was at par with pre-emergence application of fluchloralin 1.00 kg/ha *fb* HW at 30 DAS, pre-emergence application of pendimethalin 0.75 kg/ha *fb* HW at 30 DAS, post emergence application of quizalofop-p-ethyl 50 g/ha *fb* HW at 30 DAS and post emergence application of quizalofop-p-ethyl 100 g/ha alone and *fb* HW at 30 DAS. Plant population recorded at 15 DAS and plant height recorded at 30 DAS of succeeding wheat and sorghum were not significantly influenced by residual effect of herbicides applied in soybean. Post-emergence application of quizalofop-p-ethyl 50 to 100 g/ha *fb* HW at 30 DAS or pre emergence application of fluchloralin 1.00 kg/ha or pendimethalin 0.75 kg/ha *fb* HW at 30 DAS is the substitute of twice IC and HW carried out at 20 and 40 DAS in soybean crop for efficient weed management and better yield.

## P - 159 Survey on quarantine alien invasive weed *Solanum carolinense* in different ecosystems of Tamil Nadu

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A survey of weed flora in different ecosystems (i.e. cropped, non-cropped, waste disposal and derelict areas) during *kharif* and *rabi* seasons (2008 to 2010) was conducted in eigth districts of Tamil Nadu. The focus was to detect new invasive weeds invasions. *Solanum carolinense* L., a listed, quarntine weed, was observed in 88 places of different survey spots in eight districts; *viz.,* Coimbatore, Salem, Dharmapuri, Krishnagiri, Dindugal, Nilgiris, Erode and Vellore of Tamil nadu. Plants found during the survey were about one meter tall, armed, with small spines. *Solanum carolinense*, *s*tems were erect and possessed stellate hairs, greenish to purple in color. Leaves were alternate, typically lance-ovate and lobed, with spines on midrib and veins. The inflorescence, an axiliary raceme with branches, had compact clusters of flowers. The flowers of *Solanum carolinense* were five lobed and corolla was white to lilac or purple in colour. The flower had stellate pubescence externally and was glabrous internally. It contained five stamens filaments, which were yellowish green in colour. Stigma was dark in colour and the superior ovary was glandular, pubescent and whitish in colour. The deeply lobed calyx (five lobes) and tube was purple green in colour. The immature fruit was green in colour, turning orange and yellow. The fruit, a single, globular berry, contained 120 to 240 seeds. Seeds were flattened, roundest with a peak yellowish to orange brown. The semi hard, woody stem had hairs and thorns all over the plant, making it difficult for farmers to remove the plant manually.

## P - 160 Effect of potassium salt based glyphosate on diverse weed flora of winter irrigated cotton

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Cotton being a long duration wide spaced and relatively slow growing crop during early stages, is subjected to severe weed problems. About 30% of the cotton crop losses were due to weeds. Hence, a sound early weed management is essential to get higher yield in cotton crop. With this background, a field experiment was conducted during 2011 at Tamil Nadu Agricultural University, Coimbatore to evaluate Roundup Crop Shield 460 SL (RCS) with the objective of controlling diverse weed flora in irrigated cotton. The test hybrid MRC 7347 BG II was used for the experiment. The experiment was laid out in randomized block design with 10 treatments *viz.,* POE application of RCS (potassium salt based glyphosate) at 1350,1800, 2250 g/ha on 35 and 70 DAS, 1800 g/ha on 35 and 70 DAS + intercultural operations (earthing up) at 45 and 55 DAS (IC), pendimethalin at 750 g/ha PE + IC on 45 and 55 DAS, hand weeding, mechanical weeding, power weeder weeding at 35 and 70 DAS + IC at 45 and 55 DAS, hand weeding at 25 and 45 DAS and unweeded control. The study revealed that PE application of pendimethalin at 750 g/ha + IC at 45 and 55 DAS recorded higher weed control efficiency (WCE) at 25 DAS. Application of Round Crop Shield 460 SL at 1800 g/ha + IC at 45 and 55 DAS lowered the weed density and weed dry weight with higher WCE at later stages of crop growth and it followed by RCS at 2250 g/ha on 35 and 70 DAS. RCS at 1800 g/ha + IC at 45 and 55 DAS recorded significantly higher yield and it was followed by application of pendimethalin at 750 g/ha + IC at 45 and 55 DAS.

## P - 161 Tolerance of canola gobhisarson cultivars to pre-emergence herbicides

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Gobhisarson is an important winter season oil seed crop in Punjab. Canola varieties of gobhisarson have become popular among farmers and are cultivated on a large scale in the state. Gobhisarson plants grow slowly during the initial stages and weedsinfestation adversely affects its seed yield. The tolerance of three canola gobhisarson cultivars *viz.,* GSC 5, GSC 6 and Hyola PAC 401 to pre-emergence herbicides was evaluated for three cropping season of 2007-08, 2009-10 and 2010-11 at Ludhiana. Major weed flora in the field included *Phalaris minor* among grasses and *Medicago denticulata, Coronopusdidymus* and *Rumexdentatus* among broadleaves overthe years. Among canola cultivars, Hyola PAC 401 recorded significantly taller plants and reduced the weed dry matter as compared to GSC 5 and GSC 6; it also recorded higher seed yield than the other two cultivars. Among weed control treatments, pendimethalin 0.5 to 1.0 kg/ha significantly reduced population and dry matter of *Phalaris, Rumex* and *Coronopus* as compared to weedy check plot while trifluralin0.75 kg/ha was effective against *Phalaris, Rumex* and *Chenopodium*. Both pendimethalin and trifluralin did not provide effective control of *Medicago* and *Coronopus*. Pendimethalin caused phyto-toxicity on canola plants during 2010-11 and it increased with every increment of pendimethalin. Hyola 401 was the most sensitive variety. All the weed control treatments recorded significantly higher seed yield as compared to weedy check; however, canola seed yield was significantly reduced at higher levels i.e. 0.75 and 1.0 kg/ha of pendimethalin. It is concluded that trifluralin 0.75 kg/ha can be safely used for controlling weeds in all the three canola gobhisarson cultivars; pendimethalin 0.50 kg/ha can be safely used in GSC 5 and GSC and its used should be avoided in Hyola PAC 401particularly in light textured soils.

## P - 162 Survey of *kharif* weed flora in kutchh district of north-west agro-climatic zone of Gujarat

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Weed survey work was carried out in Kutchh District of north-west agro-climatic zone of Gujarat state during *kharif* 2011. The major crops grown in this zone are cotton, castor, sorghum, sesamum, groundnut, pearl millet, green gram and cluster bean. Survey revealed that cotton crop was infested with 37 weed species in which dominant weed species having higher IVI values consisted of *Eragrostis major*(13.81), *Digera arvensis* (11.53) and *Cyperus rotundus* (21.34). Total 30 weed species were associated with the castor crop. The most dominant weed species in castor having higher IVI values consisted of *Eragrostis major* (21.30), *Phyllanthus niruri* (13.14) and *Cyperus rotundus* (11.67). Thirty three weed species were found infesting the sorghum crop in which *Eragrostis major, Phyllanthus niruri* and *Cyperus rotundus* were found dominant having higher IVI values consisted of 24.88, 11.46 and 10.43, respectively. Among 31 species recorded in sesamum, *Dactyloctenium aegyptium*, *Phyllanthus niruri* and *Cyperus rotundus* were found dominant having higher IVI values consisted of 16.70, 12.61 and 12.72, respectively. Ground nut crop was infested with 33 weed species and dominated by *Eragrostis major, Digera arvensis* and *Cyperus rotundus* with higher IVI values consisted of 18.42, 8.64 and 15.99, respectively. Total 32 weed species were associated with the pearl millet crop. The most dominant weed species having higher IVI values consisted of *Dactyloctenium aegyptium* (19.00), *Digera arvensis* (11.89) and *Cyperus rotundus* (10.68). Green gram crop was infested with 32 weed species and dominated by *Eragrostis major, Phyllanthus niruri* and *Cyperus rotundus* with higher IVI values consisted of 17.44, 10.69 and 17.44, respectively. Twenty four weed species were found infesting the cluster bean crop in which *Eragrostis major, Digera arvensis, Celosia argentea* and *Cyperus rotundus* were found dominant having higher IVI values consisted of 15.86, 14.28, 14.10 and 10.94, respectively.

## P - 163 Effect of integrated weed management in *kharif* groundnut grown under middle Gujarat conditions

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A field experiment was conducted at agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand during *kharif* seasons of 2008 and 2009 to find out effect of weed management practices on weed dynamics, growth and yield of groundnut. The experiment was laid out in randomized block design with four replications. The experimental field was infested with *Digera arvensis, Echinochloa crusgalli, Phyllanthus niruri, Eleusine indica Gaertn., Boerhavia diffusa, Dactyloctenium aegyptium* and *Eragrostis major.* At harvest, significantly lower dry weed weight was recorded in IC+HW carried out at 20 and 40 DAS treatment which was at par with pre emergence application of pendimethalin 750 g/ha *fb* HW at 40 DAS, quizalofop-ethyl 100 g/ha PO *fb* HW at 40 DAS and fenoxaprop-p-ethyl 100 g/haPO *fb* HW at 40 DAS. Plant population recorded at 15 DAS was not significantly affected by weed management treatments. Pod and haulm yield of groundnut were significantly higher in IC+HW carried out at 20 and 40 DAS treatment which was at par with pre emergence application of pendimethalin 750 g/ha *fb* HW at 40 DAS, post emergence application of quizalofop-ethyl 100 g/ha *fb* HW at 40 DAS and fenoxaprop-p ethyl 100 g/ha *fb* HW at 40 DAS during both the years. Maximum additional profit over control (35679 Rs./ha) was recorded in IC+HW at 20 and 40 DAS treatment followed by application of pendimethalin 750 g/ha PE *fb* HW at 40 DAS (34113 Rs./ha), fenoxaprop-p-ethyl 100 g/ha as POE *fb* HW at 40 DAS (32100Rs./ha) and quizalofop-ethyl 100 g/ha as POE *fb* HW at 40 DAS (31170Rs./ha).

## P - 164 Alien invasive weeds in different eco systems of north western zone of Tamil Nadu

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Invasive weed species are non-indigenous that invade the habitats and cause economical, environmental or ecological problems. National Invasive Weed Surveillance (NIWS) project was programmed to identify, to make awareness and to advice technically about the invasive or alien weeds in our country. Invasive weeds intercepted recently in by the quarantine department are *Solanum carolinense*, *Cenchrus tribuloides*, *Cynoglossum officinale*, *Ambrosia trifida* and *Viola arvensis*. Ten samples each from cropped, non-cropped and garbage area covering an area of 1sq.m per place was selected randomly in a village and weeds were observed and counted. During the NIWS programme, in north-western zone of Tamil Nadu *viz.,* Dharmapuri, Krishnagiri and Salem districts have been surveyed covering 973 villages from 38 blocks. *Solanum carolinense* was identified on the road side at Kambainallur village (Dharmapuri district), Kaveripattinam and Jagadab villages (Krishnagiri district) and Therkkunadu, Melnadu, Keelnadu and Sikkampatti villages (Salem district). Generally the weed flora was grouped under broad leaved weeds, sedges and grasses. In Krishnagiri district, *Cyperus rotundus* and *Cyperus difformis* were the two sedges found in the survey area in both cropped and non-cropped area. Among the sedges, the density of *Cyperus rotundus* was higher. Grassey weeds consisted of five species, in which *Cynodon dactylon* was selectively higher than all other grasses. Among the broad leaved weeds, *Euphorbia hirta* (6.76%) and *Parthenium hysterophorus* (16.26%) were relatively higher than other broad leaved weeds in cropped and non-cropped areas. In Salem district, the weed flora constituted mainly of broad leaved weeds, which was composed of more than twenty five species. Among them, *Cleome viscosa* recorded higher relative density (14.45%) than other sspecies. *Cynodon dactylon* registered higher relative density (18.10%) than other grasses weeds. *Cyperus rotundus* and *Cyperus difformis* were the two sedge weeds found in the survey area. Among the sedges relative density of *Cyperus rotundus* was higher (19.31%). *Parthenium hysterophorus* recorded higher relative density of 9.90% and density of 10.46/$m^2$ in cropped ecosystem of Dharmapuri district. *Cynodon dactylon* in grasses, *Cyperus rotundus* in sedges and *Parthenium hysterophorus* in broad leaved weeds were predominantly observed in the different ecosystems of north western zone of Tamil Nadu.

## P - 165 Weed density as influenced by integrated nutrient supply system

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A field experiment was carried out at Agricultural Research Station, Kathalagere of University of Agricultural Sciences, Bangalore during 2009-10, on red sandy clay loam soils with pH 6.4, Ec 0.13, O.C (%) 0.68, available N (277.4 Kg/ha), available P (12.3 Kg/ha) and available K (211.4 Kg/ha). The investigation was carried out in a randomized block design with four replications to know the effect of different integrated nutrient management practices on weed density and total weed population at 35 days after sowing in maize under paddy-maize sequence. The predominant weed floras observed in the experimental field were *Cyperus procerus, Mollugo casviana, Panicum tripheron, Euphorbia hirta, Echinocloa colona, Phyllanthus niruri and Spilanthus accmella.* The study was mainly focussed on sedges, grasses and broad leaved weeds. The results revealed that the maximum weed density (9.0/0.25$m^2$) in terms of sedges was found in 75% NPK application. Similarly, this treatment also recorded the maximum number of grasses (6.6/0.25$m^2$) and broad leaved weeds (28.8/0.25$m^2$). As for as total weed population was concerned, the maximum number of total weeds (44.4/0.25$m^2$) was noticed in $T_4$.

## P - 166 Integrated weed management on pigeonpea under rainfed condition of Bihar

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The field experiment was conducted during *kharif* season of 2009-10 and 2010-11 at Research Farm of Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar. The treatment comprises eight treatment combinations i.e. weedy check, hand weeding twice at 25 and 50 DAS, pendimethalin 0.75 kg/ha as pre-emergence, pendimethalin 0.75 kg/ha as pre-emergence + one hand weeding at 50 DAS, imazathapyor 75 g/ha at 20 DAS, pendimethalin 0.75 kg/ha as pre-emergence + paraquot 0.4 kg/ha at 6 WAS, imazathapyor 75 g/ha at 20 DAS + paraquot 0.4 kg/ha at 6 WAS, weed free plot (hand weeding at 25, 50 and 75 DAS). The pigeonpea variety *'Bahar'* was sown on August 01 and 07 in first and second year respectively and was harvested in last week of April. Weed control treatments significantly reduced weed count, weed dry-biomass than weedy check. Among the weed control treatments imazathapyor 75 g/ha at 20 DAS + paraquot 0.4 kg/ha at 6 WAS recorded lowest weed count, weed dry-biomass and highest weed control efficiency while the highest value of weed control, weed dry-biomass and lowest weed control efficiency were recorded in the plot received pre emergence application of pendimethalin. Post emergence application of imazathapyor 75 g/ha at 20 DAS killed established plant of *Sorghum helepense* highly troublesome perennial weed of this area without any adverse effect on pigeonpea crop. Similarly, weed control treatments also recorded significantly higher grain yield than weedy check. Among the weed control treatments weed free plot although produced higher grain yield but was found at par with hand weeding twice at 25 and 50 DAS, pre emergence application of pendimethalin 0.75 kg/ha followed by one hand weeding at 50 DAS and imazathapyor 75 g/ha followed by paraquot 0.4 kg/ha at 6 WAS and significantly higher than the rest of the weed control treatments in both the years.

## P - 167 Sequential application of pre and post emergence herbicides for effective weed control in green gram

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Green gram is one of the major pulse crops in India. Its initial slow growth results in heavy weed infestation leading to heavy losses in seed yield. Field efficacy of new post emergence herbicide ie imazethapyr alone and in sequence with pendimethalin was evaluated for weed control in green gram for three years from 2009 through 2011 at Ludhiana. Weed flora in the experimental field included *Dactyloctenium aegyptiacum, Eragrostis tennela, Echinochloa crusgalli, Echinochloa colona, Commelina benghalensis, Acrachne racemose, Digitaria ciliaris* among grasses and *Cyperus rotundus* and *Cyperus compressus* among sedges over the years. Pendimethalin 0.75 kg/ha gave effective control of *Acrachne* and *Eleusine* while imazethapyr 50 to 100g/ha PO was more effective against *Commelina* and *Cyperus* sp., however it did not control *Eleusine*. Sequential application of pendimethalin and imazethapyr gave complete control of all the weeds. Imazethapyr was more effective against grasses when applied at 30 days while in case of sedges it was more effective at 20 day stage. Some phyto-toxicity and growth suppression on green gram plants with imazethapyr was recorded when it was applied at 20 days stage during 2011, however, the plants recovered over time. Sequential application of pendimethalin 0.75 kg/ha PE and imazethapyr 75 g/ha PO recorded green gram seed yield at par with two hoeing. It may be concluded from this study that sequential application of pre and post emergence herbicides is desirable for effective weed control in green gram.

## P - 168 Evaluation of oxyflurofen for weed control in Mentha

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An experiment was laid out at Govind Ballabh Pant University of Agriculture and Technology, Pantnagar during the *kharif* season of 2010 and 2011. In randomized block design with three replications. The treatments comprised of four different doses of oxyflurofen at 176, 206, 235 and 412 g/ha, one dose of oxyflurofen (Goal) at 206 g/ha (available in the market) , pendimethalin at 1000 g/ha, two hand weeding (25 and 40 DAP) and weed-free. Oxyflurofen along with standard treatment pendimethalin was sprayed 3 days after the application of first irrigation when the field came in walkable condition. The suckers of "*Kosi*" variety of *Mentha arvensis* were planted on April 13$^{th}$ ,2010 in the first year and March 14$^{th}$ , 2011 during second year and harvested on August 15$^{th}$ ,2010 and Jul 28$^{th}$ , 2011 in respective years of experimentation. The experimental plot was mainly infested with grasses like *Echinochloa colona*, *Eleusine indica* and *Digitaria sanguinalis*; broad leaved weeds like *Trianthema monogyna*, *Celosia argentea* and *Cleome viscosa* and sedges like *Cyperus rotundus*. None of the herbicidal application had better control over the *Cyperus rotundus*. Among the pre-emergence application of herbicides, higher dose of oxyflurofen applied 412 g/ha was found more efficient in controlling the weed density as compared to its lower doses and reference herbicides oxyflurofen and pendimethalin. The results indicated that pre-emergence application of oxyflurofen at 176, 206, 235 and 412 g/ha proved very effective for suppressing weeds and all these treatments were found statistically similar to recommended treatment i.e. pendimethalin at 1000 g/ha. All the doses of oxyflurofen were found similar to two hand weeding treatments with respect to weed control and production of herbage yield and these were found to be significantly superior to unweeded (control) treatment. Highest per cent oil content of mentha was recorded with pendimethalin (1.28 %) in the first year while in the second year it was with oxyflurofen (Goal) (0.91%).

## P - 169 Weed management study in potato in NEH region

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A field experiment was conducted during summer season of 2011 at Central Potato Research Station, Shillong. The trial was laid out in randomized block design, replicated thrice, with 12 treatments *viz.,* weedy check, weed free check through repeated manual weeding, one hand weeding followed by earthling up, farmers practice of weeding, mulching with organic material, metribuzine 1.0 kg/ha, oxyflourofen 0.2 kg/ha, pendimethalin 1.0kg/ha, metribuzin 1.0 kg/ ha followed by one hand weeding at 40 DAP, oxyflourofen 0.2 kg/ ha followed by one hand weeding at 40 DAP, pendimethalin 1.0 kg/ha followed by one hand weeding at 40 DAP and two hand weeding at 20 and 40 DAP. Maximum potato tuber yield of 29 t/ha was recorded in weed free check followed by 28 t/ha in treatment involving metribuzine application 1.0 kg/ha *fb*. 1 hand weeding at 40 DAP. Both the treatments were significantly superior over weedy check and farmers practices but at par with other herbicidal treatments. The difference in yield reduction ranged from 4 to 34%. The herbicidal treatments were at par with each other but were superior to farmers' practices and mulching of organic material. Although maximum yield was obtained in weed free check but the net return was less due to higher cost of cultivation. From economics point of view, metribuzine 1.0 kg/ha + 1 hand weeding at 40 DAP was found to be more effective in controlling the weeds in potato crop.

## P - 170 Effect of weed management practices on seed yield and nutrient uptake in sesame

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A field experiment was conducted during *kharif* season of 2010 at Research Farm, College of Agriculture, Gwalior consisting of trifluralin, pendimethalin each at 0.75 kg /ha, quizalofop 0.05 kg /ha, clodinafop 0.06 kg/ha, integration of each of these herbicides with 1 HW at 30 DAS, weedy check and two hand weeding at 15 and 30 DAS in randomized block design with three replications. Weed flora of the experiment field were *Digera arvensis, Echinochloa crusgalli, Cyperus rotundus, Commelina bengalensis* and *Phyllanthus niruri*. Lowest weed population, biomass and WCE was recorded with two hand weeding followed by trifluralin 0.75 kg/ha + one hand weeding while highest weed population and biomass was recorded under weedy check plots. Among the herbicidal treatments all the herbicides when combined with one hand weeding at 30 DAS had pronounced effect on weeds as compared to their alone application. Highest seed and stalk yield ((1190 and 4861 kg/ha) of sesame was obtained under two hand weeding given at 15 and 30 DAS, which was found at par with trifluralin and quizalofop supplemented with one hand weeding. Lowest seed yield (451kg/ha) was recorded under weedy check. The highest net return of Rs. 42391/ha was registered with two HW at 15 & 30 DAS but highest B:C ratio (4.55) was registered with the application of trifluralin 0.75 kg/ha + one hand weeding at 30 DAS. The highest NPK uptake was recorded with two hand weeding at 15 & 30 DAS which was found at par with trifluralin supplemented with one hand weeding at 30 DAS. So far nutrient depletion is concerned, heavy weed infestation in weedy check removed 45.0 kg nitrogen, 6.9 kg phosphorus and 36.0 kg potassium/ha whereas least depletion of nutrients (3.1 kg N, 0.5 kg P and 2.6 kg k/ha) was recorded under two hand weeding.

## P - 171 A comparative cost analysis of herbicidal weed management practices in onion cultivation in the western agro climatic zone of Tamil Nadu

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In onion cultivation, the most common problem is the control of weeds, particularly during the early stage of crop growth. Uncontrolled weed growth reduces the bulb yield to the tune of 40 to 80%, depending upon the type of weed flora, their intensity and dura-tion of crop-weed competition. Manual weeding is a common practice in onion. Herbicides although may not control weeds as effectively as hand weeding, it frequently offers most practical, effective and economical means of reducing weed problems, crop losses, and production cost. Hence, a study was carried out in the western agro climatic zone with the objective of estimating the cost of cultivation of onion (with and without the use of herbicides), the profitability and the usefulness of technology i.e. herbicidal weed management. The expenditure on labour for weeding in onion production was higher by about 6 per cent in manually weeded farms than the herbicide applied farms. The net returns were Rs.1,93,715 for herbicide applied and Rs.1,28,598 for manually weeded farms. The cost of production was Rs.7.70 per kg in manually weeded farms and Rs.5.98 per kg of onion in herbicide applied farms. The partial budgeting analysis has revealed that the difference in net income between the herbicide applied farms and manually weeded farms was positive indicating the usefulness of the technology. It could be concluded that the average price, gross return, as well as the net return was remunerative and higher to farms with herbicidal weed management than the manually weeded farms.

## P - 172 Effect of imazethapyr on yield, weed density, nutrient uptake by weeds in groundnut

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A field experiment was conducted during rainy *(kharif)* seasons of 2008 and 2009 at Livestock Farm, JNKVV, Jabalpur, to adjudge the efficacy of imazethapyr against weeds in groundnut. Eight treatments comprising of five doses of imazethapyr (50,100,150,200 and 300g/ha alone), combined application of imazethapyr + chlorimuron (100+24 g/ha, hand weeding twice (20 and 40 DAS) including weedy check were laid out in RBD with three replications. The experimental field was infested with monocot weeds like *Cyperus iria* (44.08%) among the sedges and *Echinochloa colona* (30.51%) and *Dinebra retroflexa* (25.39%) among grassy weeds at 40 DAS during both the years. The efficacy of imazethapyr at the lowest rate (50 g/ha) was poor, which improved slightly with the increasing rates from 150 to 300 g/ha. However, combined application of imazethapyr at lower rate 100 g/ha with chlorimuron 24 g/ha paralyzed the weed growth identically (98.12%) to that of hand weeding twice (98.62%) and attained the superior values of yield attributes (pods/plant 13.50, kernels/pod 2.4) as well as higher pod and haulm yields (12.83 and 21.21 q/ha).The latter treatment also found more remunerative as it fetched the maximum values of net monetary returns (Rs 14096/ha) and benefit: cost ratio (1.8) and surpassed recommended practice of weed control *viz.,* hand weeding twice which recorded the inferior values of NMR (Rs 10194.75/ha) and B: C ratio (1.4) due to more cost of weed control. The maximum nutrient uptake by weeds was observed in weedy check followed by treatment imazethapyr (50 g/ha).

## P - 173 Weed management studies in tea

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Tea is one of the main foreign earned and export commodities of India. It covers an area of about 4000 ha in Kangra and Mandi districts of Himachal Pradesh. The reduction in yield due to weeds goes as high as 10 to 60% depending upon the management practices. Thus, weeding is an important practice for efficient management and sustenance of production in tea crop. Manual and mechanical methods do not present themselves a better option because of time, season and expense involved. Hence, chemical control is better option due to their efficiency, cost effectiveness and ease of operation. In view of these, the present investigation was undertaken during *kharif* (summer) 2009 and 2010 at farmers field in randomized block design with three replications. The experiment consisted of 10 treatments *viz.* four doses of BCA AA 10717+ glyphosate (37.5 + 750, 50+1000, 70+1400 and 140+2800) g/ha, BCA AA 10717 (50 g.ha ) , glyphosate 1025 g/ha, paraquat 600 g/ha, diuron + glyphosate (tank mix) (800 + 512.5) g/ha, hand weeding at 30 days interval and untreated control. The experimental soil was silty clay loam in texture, acidic in reaction, medium in available nitrogen and phosphorus and high in available potassium. The dominant weeds of the experimental field consisted of *Erigeron canadensis, Ageratum houstonianum, Ipomea* spp, *Bidens pilosa, Chromolaena adenophorum etc.* The highest weed control efficiency was observed with combination of BCS AA 10717+ glyphosate (at all the doses) at 30, 60, 90 and 120 days after spray. Glyphosate 1025 g/ha resulted in around 84% weed control efficiency till 60 days after spray and thereafter it showed poor efficacy and was not able to control new weed flush. BCS AA 10717 (50 g/ha) PE gave good efficacy till 30 days after spray.

## P - 174 Modification of solarization technique to increase soil temperature to kill purple nutsedge

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Purple nutsedge (*Cyperus rotundus* L.) is a major weed of upland and tubers kept in hot air oven to high temperature of 65$^0$C for 30 min, lost its tuber viability. To raise soil temperature under pot and field conditions attempts were made to modify solarization technique. by irrigating with hot water as a starter along with plastic mulch. The amount of irrigation water required was standardized by using mobile weighing device technique under pot condition. Three different level of soil moisture status were maintained in pots *viz.,* 100, 80 and 60% field capacity (FC). Irrigating technique was standardized by varied treatments *viz.,* one irrigation, two irrigation, with or without polythene mulch, surface irrigation or via inserted PVC pipes having perforation at different depth. With plastic mulch, hot water of 40 liter for one m$^2$ to maximize temperature was required to bring the 60% FC to FC by surface irrigation. In pots, the raise in soil temperature was 41.3, 36.8 and 35.8 $^0$C within 15 min, 30 min and 40 min and maintained at that temperature for one hour from initial soil temperature of 36.2, 33.9, 34.2 $^0$C at 5, 10 and 15cm soil depth, respectively, due surface irrigation with 40 lits/m$^2$ at 65$^0$C hot water with plastic mulch during September month where as under field condition of size one m$^2$, surface irrigation with 40 lits/m$^2$ at 75$^0$C hot water the soil temperature was 51, 43.5, 42.5 at 5, 10 and 15cm soil depth, respectively during October month recorded. Thus raise in soil temperature was 14.8, 9.6 & 8.3 for 5, 10 and 15 cm depths respectively which depends on growth season, temperature of hot water and initial soil temperature. Maximum soil temperature reached was 40.8, 40.0 and 39.0 during April month at 2 PM for Bangalore condition thus estimated raise in temperature may be 55.6, 49.6 and 47.3 $^0$C at 5, 10, 15cm depth respectively. Sufficient soil temperature (65$^0$C) was not reached by hot water with plastic mulch, thus *C. rotundus* tuber sprouting was not effectively controlled.

## P - 175 Integrated weed management in *rabi* irrigated groundnut

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Groundnut is the sixth most important oilseed crop of the world. Losses due to weeds in groundnut have been estimated as high as 24 to 70%. Field experiment was conducted at agricultural research station, Bhavanisagar of Tamil Nadu Agricultural University during *rabi* 2011-12 to evaluate the integrated weed management on weed control in groundnut. The experiment was laid out in randomized block design and replicated thrice. The treatments comprised of different weed management practices *viz.,* PE application of pendimethalin 750 g/ha PE + HW at 20 DAS, pendimethalin 750 g/ha + TWH weeding 20 DAS, pendimethalin 750 g/ha + imazethapyr 100 g/ha. oxyfluorfen 250 g/ha + HW at 20 DAS, oxyfluorfen 250 g/ha + TWH weeding 20 DAS, oxyfluorfen 250 g/ha + imazethapyr 100 g/ha, white polythene mulch 7 micron, maize straw mulch 5t/ha, TWH weeding twice on 20 and 45 DAS, HW twice on 20 and 45 DAS, TWH weeding 20 DAS + HW 45 DAS and Unweeded control. Results revealed that the application of pendimethalin at 750 g/ha followed by EPOE imazethapyr 100 g/ha recorded lower weed density, weed dry weight and higher weed control efficiency at 20 and 45 DAS. Whereas, application of oxyfluorfen 250 g/ha followed by imazethapyr 100 g/ha showed lower weed density, dry weight and higher weed control efficiency at 45 and 60 DAS in irrigated *rabi* groundnut.

## P - 176 Influence of graded levels of nutrients, time of N application and weed management practices on nutrient uptake and quality of onion

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Productivity of onion is very low in Andhra Pradesh, as compared to other states of India. Excessive fertilizers and delayed nitrogen application will hamper the keeping quality of onions. Hence, an adequate and timely supply of nutrients is essential for plant growth, bulb yield and quality. To study the effect of INM practices and nutrient levels on quality of onion and nutrient up take, the present study was under taken. Weight loss (%) of onion bulbs during storage was the lowest with $N_1$ (40-40-30 kg/ha N, $P_2O_5$, $K_2O$) and it was the highest with $N_3$ (120-60-50 kg N, $P_2O_5$, $K_2O$/ha), where as it was not significantly influenced by weed management practices. The lowest neck thickness of onion bulb was recorded with $N_1$, followed by an increase with $N_2$ and $N_3$, with significant disparity between them. Unweeded check recorded the lowest neck thickness, which was distinctly lesser than the other weed management practices. Quality parameters of onion (TSS and ascorbic acid content) were the highest with $N_3$ (14.02% TSS and Ascorbic acid12.58 mg 100/g), which was distinctly higher than with $N_2$ and $N_1$. Weed management practices significantly altered TSS content (13.32%) and the highest ascorbic acid content (12.19 mg 100/g) was recorded with INM treatments and it was comparable with hand weeding twice(13.24% and 12.09mg 100/g). The lowest quality parameters were noticed with unweeded check. Nutrient uptake (nitrogen, phosphorus and potassium) by shoots and bulbs was the highest with N3 (120-60-50 kg N, $P_2O_5$, $K_2O$ /ha), followed by $N_2$ with distinct disparity between them and the lowest was with $N_1$ (40-40-30 kg N, $P_2O_5$, $K_2O$/ha). Similarly highest nutrient uptake was recorded with hand weeding twice, which was however, on par with pre – emergence application of either oxyfluorfen 0.24 kg/ha or pendimethalin 0.75 kg/ha + hand weeding at 40 DAS and the lowest nutrient up take was noticed with unweeded check.

## P - 177 Dry matter partitioning and economics of onion as influenced by graded levels of nutrients, time of N application and weed management practices

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Onion (*Allium cepa* L.) is the second most important vegetable and condiment crop, next to tomato in the tropics. Under suitable agro-climatic conditions, mineral nutrition is the main factor which influences the growth and yield of onion to a large extent, since onion is known as a heavy feeder of minerals. To optimize the agro techniques for higher productivity and better quality of onion, the present study has been undertaken at S.V.Agricultural College, Tirupati for two consecutive *rabi* seasons of 2005-06 and 2006-07. At the time of harvest, higher dry matter production (5224 and 6599 kg/ha, respectively during 2005 and 2006) was recorded with ($N_3$) 120-60-50 kg N, $P_2O_5$, $K_2O$/ha, which was distinctly higher than with other nutrient levels tried and the lowest dry matter production was observed with $N_1$(40-40-30 kg N, $P_2O_5$, $K_2O$/ha). Among the four weed management practices tried, total dry matter production (4706 and 6004 kg/ha, respectively during 2005 and 2006) was recorded with hand weeding twice, which was at par with the application of either oxyfluorfen 0.24 kg/ha or pendimethalin 0.75 kg/ha + hand weeding at 40 DAS. Higher gross returns of Rs.122734/ha and net Rs.88883/ha as well as benefit cost ratio (3.59) were realized with $N_3$120-60-50 kg N, $P_2O_5$, $K_2O$/ha. The highest gross (Rs.110470) and net (Rs.75753) returns as well as benefit cost ratio (3.18) were realized with hand weeding twice, which was comparable with pre – emergence application of either oxyfluorfen 0.24 kg/ha or pendimethalin 0.75 kg/ha + hand weeding at 40 DAS and the lowest economic returns were realized with unweeded check.

## P - 178 Bio-efficacy of imazethapyr against weeds in groundnut and its carry over effect on succeeding wheat crop under groundnut-wheat cropping system

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A field experiments was conducted to evaluate different post emergence herbicides on weed population, weed control efficiency, pod yield, economics and phytotoxicity in groundnut crop under groundnut - wheat cropping system at main agricultural research station, UAS, Dharwad during 2009-10 and 2010-11. The experiment was laid out in randomized block design and replicated thrice with nine treatments imazethapyr 100 g/ha, imazethapyr 150 g/ha, imazethapyr 100 g/ha + MSO adjuvant 2.0 ml/litre of water, imazethapyr 150 g/ha + MSO adjuvant 2.0 ml per litre of water, imazethapyr 150 g/ha + emulan 1.05 ml per litre of water + ammonium sulphate 2.0 g/litre of water, chlorimuron ethyl 9.37 g/ha, fenoxoprop ethyl 67.5 g/ha, Hand weeding and control. Among the chemical weed control methods imazethapyr irrespective of dosages recorded lower weed population and higher weed control efficiency as compared to chlorimuron ethyl and fenoxoprop ethyl. No phytotoxicity symptoms were observed at first day after herbicide application on groundnut. On third day onwards herbicide application in all the herbicidal treatments recorded mild chlorosis except chlorimuron ethyl. The pooled data indicated that imazethapyr 100 g/ha and imazethapyr 100 g/ha with MSO adjuvant recorded significantly higher groundnut pod yield (2263.3 and 2228.3 kg/ha, respectively), net returns (Rs. 37283 / ha and Rs. 36219/ha, respectively) as well as higher cost benefit ratio (2.25 and 2.22, respectively) as compared to other doses of imazethapyr. Imazethapyr at higher concentration i.e., 150 g/ha resulted in phytotoxicity effect on groundnut crop as well as succeeding wheat crop. Chlorimuron ethyl 9.37 g/ha resulted severe phytotoxicity effect on groundnut crops and there by reduced the pod yield to a greater extent.

## P - 179 Bio-efficacy evaluation of paraquat dichloride against weeds in potato crop

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Heavy weed infestation is one of the major constraints limiting the tuber yield of potato crop. A field trial was conducted during winter season of 2008-09 and 2009-10 at Norman E. Borlaug, Crop Research Centre of G.B. Pant University of Agriculture & Technology, Pantnagar, U.S. Nagar, Uttarakhand to evaluate the bio-efficacy of paraquat dichloride against weeds in potato crop. Experiment with 7 treatments *viz.,* paraquat dichloride at 400, 500 and 600 g/ha from new source, paraquat dichloride at 500 g/ha from existing source, metribuzin at 350 g/ha along with weed free and weedy check was laid out in randomized block design with three replications. The experimental field was mainly infested with *Phalaris minor, Melilotus* sp.*, Medicago denticulata, Gnephalium indicum* and *Chenopodium album.* Paraquat dichloride (new) 600 g/ha being at par with metribuzin 350 g/ha and paraquat dichloride 500 g/ha (new and existing molecules) recorded the lowest weed density at 45 days stage of the crop. Almost similar trend was observed in case of weed dry weight at both the stages as reported in case of density of total weeds. Reduction in tuber yield due to uncontrolled weeds in weedy plots was recorded 40.7 per cent during first year and 58.4 percent during second year. The highest tuber yield was recorded with weed free treatment, which was followed by paraquat dichloride 600 g/ ha and metribuzin 350 g/ha. Among the herbicidal treatments, new molecule of paraquat dichloride 600 g/ ha recorded the highest tuber yield which was at par with metribuzin 350 g/ha.

## P - 180 Impact of weed management technologies in changing economic scenario of Tagar Mahagawa village

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Weed is a widespread biological constraint and is responsible for reduction in crop yield as well as quality of produce. Improved weed management techniques must be an important component of crop production strategies to cut down production cost. A village named Tagar-mahagawa under Panagar Block of Jabalpur district in Madhya Pradesh was adopted in the year 2008 with an objective to make the farmers aware about importance of weed management for increasing the crop yield and income level. The action plan of awareness was initiated by conducting few preliminary demonstrations for showing performance, practicability and profitability of improved weed management technologies to the villagers. Due to the efforts made towards the weed free village campaign, the farmers have started adopting weed management technologies in paddy, wheat, soybean, chick-pea and vegetable crops and getting on an average 10-38% higher yield which is giving an additional average profit of Rs.12000-15000 per hectare. With the introduction of improved weed management techniques along with other modern agricultural production technologies, the farmers' have started growing vegetables in commercial scale from last couple of years. Presently the farmers are earning a profit of approximately Rs. 34,000 per hectare by spending only about Rs. 8000-10,000 for cultivation of brinjal, cauliflower, cabbage, tomato and chilli. All these successes have created an environment of diversification in agriculture in this village. The encouraging outcome in the economic front worked as driving force towards rapid adoption of the demonstrated technologies. From a meagre 4-5% prior to adoption, the level of weed management in crops using improved technologies increased to 85% in the given village within a three year time span. There was a visible increase in the area under various crops. It may be pointed out that prior to adoption the farmers' used to keep more than 80% of the agricultural land uncultivated during *rabi* season due to unmanageable weed pressure. Prior to the adoption, the villagers especially the youth used to migrate to town areas due to unprofitable farming and consequent unemployment in this village. The outcome of the technological support gave a confidence and new ardour to them and they are now seriously occupied in agriculture.

## P - 181 Effect of pre-emergence herbicide on weed seed bank in cotton under winter irrigated ecosystems

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Cotton is highly susceptible to weed infestation during the initial period due to its slow growing nature. Field experiment was conducted during winter season of 2008-09 and 2009-10 with cotton variety *MCU-13* and *Thulasi* Bt in eastern block, TNAU, Coimbatore, to evaluate the persistence behavior of new formulation pendimethalin 38.7% EC in the soil. The treatments included pendimethalin 38.7% 1.5, 2.0 and 4.0 kg/ ha and it was compared with pendimethalin 30% EC 1.0 kg/ ha. Soil (0-15 cm and 15- 30 cm depth) samples from treated plots were collected. Weed flora in the soil weed seed bank was predominantly consisted of grassy weeds like *Dactyloctenium aegyptium, Panicum repens, Echinochloa colona* and *Cynodon dactylon* and the broad leaved weeds, *Trianthema portulacastrum, Parthenium hysterophorus* and *Digera arvensis.* Application of pendimethalin at 2.0 kg/ha + HW and pendimethalin at 2.5 kg/ha + HW recorded lesser density of grasses, broad leaved weeds and total weeds, while unweeded control recorded higher density of grasses, sedge and broad leaved weeds and total weeds in both the years. Higher density of grasses and broad leaved weed seeds and total weed seeds were observed at 0-15 cm depth of soil compared to 15-30 cm depth.

## P - 182 Effect of elevated atmosphere $CO_2$ and crop-weed coexistence on soil microbes, soil respiration and enzyme activities

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An experiment was conducted in open top chambers (OTCs) during 2009-10 to study the rhizosphere microbial activity in response to the interactive effect of elevated $CO_2$ and crop-weed competition between maize and associated weeds (*Sorghum halepense* and *Euphorbia geniculata*). Total bacteria and free living diazotroph populations were enumerated, soil respiration and enzymatic activity were determined. Nutrient agar medium was used for total bacterial count and Jensen's $N_2$ free medium was used for free living diazotrophs count. The most probable number technique (MPN) is used to estimate ammonia and nitrite oxidizing bacterial population Enhancement in the soil bacterial and free living diazotroph populations was observed under elevated $CO_2$ compared to ambient $CO_2$ conditions. Free living diazotroph populations were variable among the treatments. However, the populations were higher when the crop and weeds were coexistent. The populations of ammonium oxidizing bacteria have shown significant increase under elevated $CO_2$. Enhancement in the population of ammonium oxidizing bacteria was observed in maize rhizosphere when it was in association with the weeds under elevated $CO_2$. Soil respiration has also shown similar trend and it was significantly higher under elevated $CO_2$ than ambient $CO_2$. Elevated $CO_2$ enhanced the dehydrogenase and phosphatase activities. Due to $CO_2$ enrichment the enhancement in the activity of dehydrogenase was higher than that of phosphatase. When exposed to the conditions produced by elevated $CO_2$, soil microbial communities can change from being C limited to nutrient limited, as nutrients become sequestered in plant biomass and soil organic matter (SOM). Increased nutrient limitation may lead soil microbes to increase the activity of enzymes that release nutrients such as N and P from SOM.

## P - 183 Efficacy of plant protectant application on biochemical properties and soil microflora in wheat

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Diseases pests and weeds reduce crop yield in wheat crop. Different plant protectants *viz.,* fungicides, insecticides, herbicides were applied after sowing of rice in field at DWSR Centre, Marathwada Krishi Vidyapeeth, Parbhani. The experiment was conducted to asses the effect of plant protectant application on physico chemical and biological properties of soil. In present investigation, the rhizospheric soil samples in wheat crop were taken at 30DAS, 50 DAS and at harvest, Results revealed that the physcio-chemical properties of soil like pH, electrical conductivity and organic carbon were not affected by any agrochemical which was used for plant protection. The total bacterial count (TBC) and total fungal count (TFC) were found highest in mechanical weeding (MW) as compared to fungicide used i.e. mancozeb 0.5 % at 30 DAS ;whereas, TBC and TFC were enhanced at harvest. Pesticide i.e. endosulphon 700 ml/ha also reduced the rate of basal soil respiration and nitrogen mineralization at 30 DAS . However, maximum nitrogen mineralization and basal soil respiration were observed in mechanical weeding followed by weedy check (control). Nitrogen mineralization and biomass carbon were found minimum with mancozeb 0.2 % at 30 DAS which was restored at harvest of crop, Total micro flora and biochemical values were found more in treatment with *Azotobacter* 250g/10 kg of seed.

## P - 184 Control of *Poa annua* weed in berseem fodder

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A field experiment was conducted at Punjab Agricultural University, Ludhiana during *rabi* 2007-08 through 2009-10 to study the efficacy of herbicides for the control of *Poa annua* in berseem. The experiment comprised of 12 treatments (pendimethalin 0.375 kg/ha as pre-emergence and one week before sowing, pendimethalin 0.564 kg/ha as pre-emergence and one week before sowing, trifluralin 0.60 kg/ha as pre-emergence and one week before sowing, fluchloralin 0.45 kg/ha as pre-plant, butachlor 1.25 kg/ha as pre-emergence, imazethapyr 0.04 and 0.05 kg/ha as post-emergence, berseem + brassica and weedy check) was conducted in RBD with three replications. The density of *Poa annua* weed was highest (36.2 plants/ 30 $cm^2$) as compared to 3.7 to 12.7 plants/ 30 $cm^2$ in herbicide treatments. Among the herbicides, butachlor 1.25 kg/ha, fluchloralin 0.45 kg/ha and pendimethalin 0.375 one week before sowing effectively controlled the *Poa annua* weed and the weed control efficiency was 87.9, 89.7 and 76.7%, respectively. Whereas, higher dose of pendimethalin (0.564 kg/ha) either as pre-emergence or one week before sowing, trifluralin 0.60 kg/ha as pre emergence and one week before sowing and imazethapyr (0.04 and 0.05 kg/ha) though controlled *Poa annua* but were toxic to the crop. Under late sown conditions, the highest green fodder yield (589.9 q/ha) and dry matter yield (88.4 q/ha) was obtained with butachlor 1.25 kg/ha closely followed by pendimethalin 0.375 kg/ha one week before sowing (576.9 q/ha green fodder and 87.6 q/ha dry matter yield) and fluchloralin 0.45 kg/ha as pre-plant (562.7 q/ha green fodder and 82.6 q/ha dry matter yield). The uptake of nitrogen by the weeds was more in control plot as compared to the plots which received herbicides. The uptake of weeds was lesser with herbicide application due to lower weed population. The crude protein content of berseem fodder improved in all the herbicide treatments than the weedy check because the weeds might have utilized some quantity of the applied nitrogen.

## P - 185 Effect of different doses of pendimethalin on microbial activities and nodulation in chickpea

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Field trial was conducted at research farm of weed science research station, Marathwada Krishi Vidyapeeth, Parbhani, in spilt plot design with three replications with an objective to study the effect of herbicides on biochemical activities and nodulation in chickpea in maize-chickpea cropping system during *kharif* 2010-11. The soil of the experimental field was black cotton soil in type and medium in fertility status with a pH 7.9, EC 0.32 $dsm^{-1}$ and OC 0.57 %. The treatment comprised of four weed control measures (weedy check, mechanical weeding, pendimethalin 1.0 kg/ha. The soil sample were collected from rhizospheric soil from each plot at 30, 50 DAS and at harvest of crop and were analyzed for soil microbial biomass carbon and basal soil respiration and no. of nodule and nodule dry matter. The results reveal that there were non significant variation observed due to various agrochemical treatments in affecting soil physcio-chemical properties of soil i.e. (pH.EC, and OC) at various stages of crop growth. Highest microbial population, microbial biomass carbon and basal soil reparation were recorded in mechanical weeding whereas, lower activities were recorded in herbicide treated plot i.e. pendimethalin 1.0 kg/ha at 30 DAS. However, values were enhanced at harvest. Application of pendimethalin 1.0 kg/ha did not influence nodule count and nodule dry matter significantly.

## P - 186 Integrated weed management with imazethapyr for weed control efficiency and yield of groundnut in red sandy loam soils of western zone of Tamil Nadu

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Groundnut (*Arachis hypogaea* L.), is the sixth most important oilseed crop of the world. Field experiment was conducted at agricultural research station, Bhavanisagar of Tamil Nadu Agricultural University during 2009 and 2010 to evaluate the new formulation of early post-emergence (EPOE) imazethapyr 10% SL on weed control and on the growth and productivity of groundnut. The treatments consisted of five doses of imazethapyr (50, 75, 100, 150 and 200 g/ha) with one hand weeding at 45 days after sowing (DAS) which were compared with the recommended herbicide pendimethalin at 0.75 kg/ha in combination with either a hand weeding or imazethapyr at 50 g/ha or one star weeder weeding or layby application of pendimenthalin at 45 DAS, hand weeding twice at 25 and 45 DAS, unweeded control and a weed free check. Lesser weed dry weight and higher weed control efficiency was recorded with the application of EPOE imazethapyr at 100 and 150 g/ha *fb* hand weeding. It promoted the growth parameters and yield attributes of groundnut which was closely followed by hand weeding twice or pendimethalin 0.75 kg/ha *fb* imazethapyr 50 g/ha. Pod yield of groundnut was higher with the application of imazethapyr at 100 g/ha *fb* hand weeding at 45 DAS during both *kharif* 2009 (1602 kg/ha) and 2010 (1900 kg/ha) followed by EPOE imazethapyr at 150 g/ha + 1hand weeding. The experimental results revealed that application of new formulation of imazethapyr as EPOE application at 100 g/ha, when the weeds are in 2-3 leaf stage, followed by one hand weeding at 45 DAS was found promising in effectively controlling weeds in irrigated groundnut and to attain higher economic yield.

## P - 187 Soybean growth and productivity affected by weed

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Madhya Pradesh is popularly known as the "Soya bowl" of the country due to maximum area and production. Among the various factors responsible for low yield, weeds have been considered of prime importance. Weeds are known to cause an annual lose of 35-75% in yield. In India, soybean is extremely grown during the rainy season from June -September during which the environment is more conducive for excessive weed infestation. Soybean yield was adversely affected by the weeds due to their competition for nutrients and moisture during early growth stages. Among the various weeds *Echinochloa colonum*, *Cyperus roundus, Solanum nigrum, Phyllanthus niruri, Digitaria sanguinalis, Digra arvensis* were the major weeds associated with soybean crop. Two hands weeding (20 and 40 DAS) gave lowest weed dry weight, weed density and highest weed control efficiency. The herbicidal treatments, application of diclosulam 84 WDG 30g/ha as pre emergence were found most effective. This herbicides recorded weed control efficiency of 97.20% at 60 DAS and were effective to control both monocots and dicots. Quizalofop-p-ethyl 5EC 50g/ha was post emergence herbicide which recorded satisfactory weed suppression with fairly low weed shoot biomass and control grassy weeds. Two hand weeding and treatment diclosulam 30g/ha pre emergence enhanced the grain yield by 79.1 % over weed check. The best result of economics was obtained in hand weeding followed by application of diclosulam 30g/ha as pre emergence were found most effective. Higher B: C ratio was found in this treatment.

## P - 188 Effect of organic mulching on soil properties of maize under rain fed condition in an Alfisol

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Field experiment was conducted at Regional Research Station, Paiyur to asses the effect of organic mulching on yield, nutrient uptake of maize and changes in physical properties, nutrient availability pattern and biological properties. The treatments included maize straw at 5 and10 t/ha, sugarcane trash at 5 and10 t/ha, raw coirpith at 5 and10 t/ha and dried weeds at 5 and10 t/ha and unmulched control, which were replicated thrice in randomized block design. Application of different organic mulches had significant effect on bulk density of soil at surface (0-15 cm) and sub surface (15-30 cm). Among different treatments, the treatment which received raw coir pith mulch at 10 t/ha had reduced the bulk density (1.33 $Mg/m^3$) which was on par with raw coir pith at 5 t/ha, dried weeds at 5 t/ha, dried weeds at 10 t/ha and sugarcane trash at 10 t/ha over the control at both depths. The water holding capacity of soil conspicuously increased with various mulch treatments. Among the different mulches, dried weeds at 10 t/ha recorded the highest water holding capacity (11.53 %). The moisture content of the soil at two depths was found to be higher under raw coirpith mulch at 10 t/ha treatment at all stages of crop growth. The tune of increase was found to be to the tune of 71.2%t at 0-15 cm and 41.5%t at 15-30 cm at harvest stage over control. However, the organic carbon status of the soil was comparatively higher in dried weeds at10 t/ha treatment 18.1% increase over control. Available N, P and K status was found to be higher under dried weeds mulch at 10 t/ha at all stages of crop growth. The tune of increase over control was found to be 31.7, 28.4 and 36.2 per cent in available N, P and K respectively. Generally the organic mulch application had conspicuously increased the microbial population. Among different treatments, the raw coirpith mulch at 10 t/ha had increased bacteria and fungi population by 42.0 and 42.9%, respectively in soil. Regarding actinomycetes, the treatment which received dried weeds at 10 t/ha had increased the population by 72.1%.

## P - 189 Weed flora of cultivated fields and non-cropped area of north Gujarat

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A survey of weed flora of *kharif* crops in north Gujarat was conducted during 2009-10 in the districts of Gandhinagar, Ahmedabad, Sabarkantha, Mehsana, Patan and Banaskantha were 600, 630, 780, 480 and 240 spots each in cropped, non-cropped and garbage areas were surveyed respectively, Weed survey carried out in *kharif* revealed that a total of 26 species were found to infest *kharif* crop fields in north Gujarat, out of which eight were grassy, fifteen broad leaf weeds and three sedges. In Gandhinagar district, *Boerhavia repanda* and *Amaranthus viridis* were the most dominant weeds with a relative density of 33.2 and 32.8 $no/m^2$, respectively in *kharif* crops. In Sabarkantha district, *Amaranthus viridis* and *Cyperus rotundus* were the most dominant weeds. *Tridex procumbens* and *Spergula arvensis* were the dominant weeds in Ahmedabad district. *Eragrostis major* and *Digitaria sanguinalis* were the most dominant weeds with a relative density of 15.1 and 14.2 $no/m^2$, respectively in *kharif* crops in Mehsana district. In the Banaskantha district, *Amaranthus viridis* and *Cyperus rotundus* were the most dominant weeds. *Digitaria sanguinalis* and *Dactyloctenium aegyptium* were the most dominant weeds with a relative density of 4.2 and 3.6 $no/m^2$, respectively in *kharif* crops in Patan district. Weed intensity was more observed in the cropped area of Gandhinagar district due to more irrigated area as compared to other districts of North Gujarat.

## P - 190 Efficient weed management techniques in promising intercropping systems with Bt-cotton

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Cotton being a long duration and widely spaced crop having slow growth rate in the initial sages, is ideally suited for intercropping with short duration crops. This gives scope for chemical weed control in the initial stages to avoid weed competition. A field experiment was conducted at Agricultural Research Station, Dharwad during *kharif* seasons of 2010 and 2011 to evaluate efficient weed management technique in promising intercropping systems with Bt-cotton. Pre emergence (PE) application of pendimethalin or alachlor followed by post emergence application of quizalofop ethyl or phenoxy p-ethyl were compared with recommended practice, weed free and unweeded checks in cotton + greengram (1:1) and cotton + beans (1:1) intercropping systems. Among the weed control treatments PE application of pendimethalin 0.75 kg/ha followed by post emergence application of quizalofop ethyl (0.05 kg/ha at 40 DAS) or phenoxy p-ethyl (100 g/ha at 40 DAS) followed by one hand weeding at 70-80 DAS recorded significantly lower weed number and weed dry weight compared to unweeded check and these were comparable with weed free and recommended practice. Weed free check produced significantly higher seed cotton yield (2488 kg/ha) as compared to any other methods. Weed control by pre emergence application of pendimethalin followed by post emergent herbicides (quizalofop ethyl and phenoxy p-ethyl) produced next best seed cotton yield and on par with present recommended practice (PE application of pendimethalin + 2 hand weeding + 2 inter cultivation). Among two intercropping systems cotton + greengram produced significantly higher seed cotton yield as compared to cotton + beans intercropping system. However, both the intercropping systems produced on par cotton equivalent yield. Hence, both the intercropping systems produced on par gross income, net income and B:C ratio. Among weed control treatments pre emergence application of pendimethalin followed by either quizalofop ethyl or phenoxy p-ethyl can be used economically alternative to the present recommended practice.

## P - 191 Influence of organic farming practice on weed density in groundnut-maize system

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A field experiment was carried out at Agricultural Research Station, Kathalagere of University of Agricultural Sciences, Bangalore during 2009-10, on red sandy clay loam soils with pH 5.3, Ec 0.14, O.C (%) 0.52, available N (202.7 Kg/ha), available P (12.0 Kg/ha) and available K (233.6 Kg/ha). The investigation was carried out to know the effect of different organic and inorganic sources of nutrients on weed growth at 35 days after sowing in maize under groundnut-maize sequence. The experiment with eight treatments was laid out with large plots (30 x10m) without replication. The predominant weed flora observed in the experimental field were *Cyperus procerus, Panicum tripheron, Spilanthus accmella, Euphorbia hirta, Digiteria marginata, Echinocloa colona, Phyllanthus niruri* and *Mollugo* spp. The results reveal that the maximum number of sedges (1.0/0.25m$^2$) was found in $T_7$ i.e 100% NPK+ZnSo4 10 Kg/ha application has recorded whereas, $T_1$ has recorded the maximum number of grasses (5 /0.25m$^2$) and broad leaved weeds (4.0/0.25m$^2$). So far the total weed population is concerned, the maximum number of total weeds (9.5/0.25m$^2$) was noticed in $T_1$.

## P - 192 Effect of chemical weed control of imazethapyr in groundnut var. *TG-24*

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An experiment was conducted at during *kharif* season 2008-09 at the Livestock Farm, JNKVV, Jabalpur to study the chemical weed control of imazethapyr against weeds in groundnut var. *TG-24*. The 8 treatments comprising of imazethapyr at different doses of 50, 100, 150, 200 and 300 g/ha as post-emergence and combined application imazethapyr with chlorimuron (100 + 24 g/ha) as post-emergence, hand weeding at 20 and 40 DAS and weedy check, were laid out in randomized block design with three replications. *Cyperus iria* was most rampant, constituting 46.07 and 47.36% relative density of total weeds at 40 DAS and at harvest, respectively, followed by *Echinochloa colona* (27.30 and 24.72%), *Dinebra retroflexa* (26.61 and 27.90%). Among the imazethaypr treatments, application of imazethapyr between 150 to 300 g/ha as post-emergence arrested the weed biomass production remarkably and proved superior to its lower rates (50 and 100 g/ha). Both pod and kernel yields were significantly higher under all the plots receiving weed control measures than weedy check. Hand weeding plots required the maximum investment (Rs 7000/ha) to control weeds while expenditure incurred under imazethapyr at different rates including imazethapyr with chlorimuron ranged between Rs 825 to 3950/ha, indicating that control of weed through hand weeding was more expensive than the use of herbicides (imazethapyr and imazethapyr with chlorimuron) in groundnut. The net monetary return and B:C ratio were the highest under combined application of imazethapyr with chlorimuron (100+24 g/ha).

## P - 193 Efficacy of imazethapyr at different doses and time of application for weed control under mid hill conditions of Himachal Pradesh

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Urdbean is one of the major *kharif* pulse in Himachal Pradesh. Slow initial growth of urdbean coupled with favourable conditions for weed multiplication and a wide spectrum of heterogeneous weed flora become a serious limitation for its low productivity. In this context, imazethapyr which is quite effective on mixed weed flora as post emergence was tested with respect to its time and dose of application. Eexperiment was conducted during *kharif* 2008 in randomized block design at research farm university keeping fourteen treatments. The treatments consisted of four doses of imazethapyr (i.e. 50, 75, 100 and 125 g/ha), three times of application (i.e. at 10, 15 and 20 DAS), standard check-pendimethalin 1.5 kg/ha (pre-emergence) and weedy check. The soil of the experiment site was silty clay loam in texture, acidic in reaction and medium in available nitrogen, phosphorus and potassium. The crop was sown at 30 cm apart rows using 20 kg/ha seed rate and 20,40 and 20 kg N, $P_2O_5$ and $K_2O$/ha. Results revealed that application of imazethapyr 100 g/ha being at par with its higher dose i.e. 125 g/ha both at 10 and 15 DAS produced significantly lower weed dry weight, which ultimately contributed in getting significantly higher seed yield of mash over rest of the treatments. The weed control efficiencies achieved through theses treatments fall in the range of 84.7 to 93.6%. However, at 20 DAS the application of higher dose of imazethapyr at 125 g/ha also behaved statistically similar to theses treatments for getting higher seed yield (WI=2.6%) and lower dry matter having weed control efficiency of 87.2%. Application of imazethapyr 75 g/ha either at 10 or 15 DAS being at par with each other were the next best treatments in recording significantly lower weed dry weight and higher yield over the remaining treatments. Pendimethalin 1.5 kg/ha has controlled only the initial flush of weed flora but fail to control the second flush of weeds effectively and recorded weed control efficiency of 58.5%.

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## Evaluation of doses of fluazifop-p-butyl 13.4 EC (fusilade 12.5 EC) herbicide for management of grassy weeds in irrigated groundnut

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A field study was conducted during *kharif* 2011, on red sandy loam soil of Hebbal, Bengaluru. The study was conducted to know the comparative performance of new graminicide fluazifop-p-butyl 13.4 EC (Fusilade 12.5 EC) in different doses on the growth and yield of groundnut in relation to unsprayed control. The soil type was sandy loam with pH of 6.50 and average fertility status of 0.50% OC, available N of 218.0 kg/ha, available $P_2O_5$ of 28.5 kg/ha and $K_2O$ of 175.0 kg/ha. The treatments consisted of fluazifop-p-butyl 13.4 EC at 100 g, 134 g and 167 g/ha, imazethapyr 10% SL at 125 g/ha (all four treatments applied as post-emergence at 18 DAS), pendimethalin 30 EC at 750 g/ha, alachlor 50 EC 1.0 kg ai/ha (as pre-emergence at 3 DAS), hand weeding (20 and 40 DAS) and unweeded control replicated thrice in a RCBD design. Major grassy weeds were *Echinochloa colona, Digitaria marginata, Eleusine indica, Dactyloctenium aegyptium and Cynodon dactylon.* Use of new herbicide, fluazifop-p-butyl at 134 to 167 g/ha – 18 DAS gave pod yields (1520 to 1620 kg/ha) similar to imazethapyr 10 SL at 125 g/ha – 18 DAS (1570 kg/ha), pendimethalin 30 EC 750 g/ha – 3 DAS (1490 kg/ha) and hand weeding (1760 kg/ha), but slightly superior to the plot treated with alachlor 50 EC at 1.0 kg/ha – 3 DAS (1390 kg/ha). Unweeded control lowered the seed yield by 64% (640 kg/ha) due to severe weed competition from grasses as evident from significantly higher density (55.5/$m^2$) and dry weight (69.2 g/$m^2$) of grasses. The new graminicide fluazifop-p-butyl lowered the density of grasses namely *C. dactylon, D. marginata, D. aegyptium, E. colona* and *E. indica* considerably as compared to unweeded control.

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## Effect of pendimethalin in drip and furrow irrigation system in Bt cotton and non Bt cotton

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Cotton is an important commercial fibre crop of India. Cotton yields were reduced by 50 to 85% with unchecked weed growth or ineffective weed control. Field experiment was carried out during *rabi* – 2010 and 2011 at experimental site of Tamil Nadu Agricultural University, Coimbatore to optimize irrigation and fertigation schedule under drip fertigation system in Bt cotton. The experiment was replicated thrice in split plot design with treatments, with two genotypes Bollgard II *(Mallika Bt-2)* and non-Bt cotton *(Mallika non Bt)* with three different drip irrigation regimes at 75%, 100% and 125% computed water requirement (WRc) of the crop and with three different fertigation at 75%, 100% and 125 % through Water soluble fertilizers (WSF) at the recommended dose of fertilizer (150: 75: 75Kg NPK/ha) and furrow method of irrigation with normal fertilizers. Soil of the experimental site was clay loam with low in available nitrogen, high in available phosphorus and potassium. Pre-emergence application of pendimethalin 1.0 kg/ha was applied on 3 DAS followed by two hand weeding on 25 DAS and 45 DAS in drip irrigated as well as furrow irrigated treatments. The experimental field was dominated with *Cynotis axillaris, Dactyloctenium aegyptium*, *Panicum repens*, under grasses, *Cyperus rotundus, Cyperus iria* under sedges and *Trianthema portulacastrum, Digera arvensis*, *Portulaca oleraceae, Parthenium hysterophorus, Boerhaavia diffusa, Amaranthus viridis* and *Commelina benghalensis* under broad leaved weeds. Among the different treatments furrow irrigated treatments recorded the highest weed density, dry weight and lower weed control efficiency as compared to drip irrigated treatments. The lowest weed density was recorded in drip irrigation at 125 % WRc + fertigation at 100% RDF as WSF.

## P - 196 Effect of doses of fenoxaprop-p-ethyl 9 EC for grassy weed management in irrigated onion

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A field study was conducted during *kharif* 2010 on sandy loam soil of Hebbal, Bengaluru to know the comparative performance of fenoxaprop-p-ethyl 9 EC herbicide on controlling grassy weeds in onion in relation to quizalofop-p-ethyl, another grass killer and pre-emergence herbicides–pendimethalin and oxyfluorfen, crop safety and bulb yield. The soil type was sandy loam with pH of 6.52 and average fertility status of 0.52% OC, available N of 220 kg/ha, available $P_2O_5$ of 25.6 kg/ha and $K_2O$ of 180 kg/ha. The treatments consisted of fenoxaprop-p-ethyl 9 EC at 56.25 g, 67.50 g and 78.75 g/ha, quizalofop-p-ethyl at 37.5 g/ha (all at 15 days after planting), oxyfluorfen 120 g and pendimethalin 0.75 kg/ha (both at 3 DAP), hand weedings (20, 40 and 60 DAP) and unweeded control. The experiment was laid out as RCBD with three replications. Major grassy weeds were*, Echinochloa colona, Digitaria marginata, Eleusine indica, Dactyloctenium aegyptium* and *Cynodon dactylon.* Fenoxaprop-p-ethyl 67.5 to 78.75 g/ha–15 DAP lowered the density and dry weight of grasses and compared similar to quizalofop-p-ethyl 37.5 g/ha– 15 DAP, hand weeding (thrice) and pre-emergence herbicides - oxyfluorfen 120 g ai/ha and pendimethalin 0.75 kg/ha – 3 DAP. Use of fenoxaprop-p-ethyl 67.5 to 78.75 g/ha – 15 DAP gave bulb yields (13.28 to 15.14 t/ha) similar to quizalofop-p-ethyl 37.5 g/ha – 15 DAP (14.97 t/ha), oxyfluorfen 120 g/ha (14.88 t/ha), and hand weeding – thrice (13.89 t/ha), but slightly superior to the plots treated with pendimethalin 750 g/ha (12.58 t/ha). Unweeded control lowered the bulb yield by 43% due to severe weed competition particularly from grasses, as revealed through higher weed index. Fenoxaprop-p-ethyl 78.75 g/ha, quizalofop-p-ethyl at 37.5 g/ha – 15 DAP and oxyfluorfen 120 g/ha – 3 DAP gave negative weed index due to slightly higher bulb yield obtained than hand weeding owing to good control of grasses from 15 DAP onwards. Thus for irrigated onion during *kharif* 2010, new graminicide – fenoxaprop-p-ethyl 67.5 to 78.75 g/ha – 15 DAP can be used safely for control of grasses, as it gave bulb yields similar to another graminicide, quizalofop-p-ethyl 37.5 g/ha – 15 DAP, pre-emergence herbicide – oxyfluorfen 120 g/ha and pendimethalin 750 g/ha – 3 DAP and hand weeding.

## P - 197 Influence of bioinoculant and agrochemicals on germination and biometric characteristics of sorghum

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The effect of different bioinoculants and agrochemicals on germination and biometric characters of sorghum were studied by pot culture method at $10^{th}$ and $20^{th}$ DAS .Evaluation of effect of bioinoculants on growth of sorghum was carried out. Seeds were treated with different bioinoculants and agrochemicals (herbicide spray were taken at 1 DAS ) and were placed (sown) in earthen pot of size 15 x 10 $cm^2$ containing soil and FYM mixture. The experiment was conducted in CRD with seven treatments in sorghum with three replications. The observations on different biometric characters were recorded at $10^{th}$ and $20^{th}$ days after sowing in plot culture method. The different bioinoculants and agrochemicals had significant effect on germination, shoot length, shoot and root biomass. Seed inoculation with *Azotobactor* recorded maximum germination (88%), maximum shoot length 6.42 cm(10 DAS) and 11.93(20DAS),maximum shoot fresh weight 0.172g (10 DAS) and 0.258g (20 DAS), maximum shoot dry weight (0.0210 g) (10 DAS) and 0.0313 g (20 DAS), maximum root length 6.45 cm(10 DAS) and 11.95 cm (20 DAS), Maximum root fresh weight 0.024g (10 DAS) and 0.0360 g (20 DAS ), maximum increase in vigour index 1054.24 (10 DAS) and 2182.4 (20 DAS). Maximum root dry weight 0.070g (10 DAS) and 0.016 g (20 DAS) were observed in *Azotobacter* seed treatment. Germination, shoot length, root length and vigour index were significantly influenced by *Azotobacter.*

## P - 198 Studies on the control of *Ipomea* spp. in spring planted sugarcane

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To control weeds particularly creepers (*Ipomea* spp.) in sugarcane an experiment in randomized block design was conducted at Norman E. Borlaug Crop Research Centre of G.B.Pant university of Ag. & Tech. Pantnagar during two consecutive years of 2009-10 and 2010-11 consisting. ten treatments i.e. control, conventional method (hoeing at 30,60 and 90 DAP), atrazine 2.0 kg/ha (PE) *fb* 2.4-D 1.0 kg/ha (60 DAP), atrazine 2.0 kg/ha after 1st irrigation and hoeing *fb* 2.4-D 1.0 kg/ha (75 DAP), metribuzin 1.25 kg/ha (PE) *fb* 2.4-D 1.0 kg/ha (75 DAP), atrazine 2.0 kg/ha (PE)+ almix 20g/ha (75 DAP), metribuzin 1.25 kg/ha (PE)+ almix 20 g/ha (75 DAP), atrazine 2.0 kg/ha (PE)+ ethoxy sulfuron 50 g/ha (75 DAP), atrazine 2.0 kg/ha +dicamba 350 g/ha (75 DAP) and metribuzin 1.25 kg/ha (75 DAP)+dicamba 350 g/ha (75 DAP). Sugarcane variety *co Pant 90223* was planted on March 4 during 2009 and on Feb. 26 during 2010 at 75 cm row spacing, keeping 3 budded 4 setts per meter row length. All the treatments were replicated three times. Major weed species were *Echinochloa colonum, Dectyloctanium aegyptium, Cynodon dectylon, Eleusine indica* among grasses and *Cirsium arvence, Ipomea* spp*, Phyllanthus niruri, commelina benghalensis, Mollugo pentaphylla* among non-grasses. *Cyperus rotundus* was the only sedge in experimental field. Reduction in cane yield was recorded 23.5% during 2009-10 and 20.3% during 2010-11. Total weed density (148.0/$m^2$ during 2010-11) and dry matter was highest in control treatment (214.6 g/$m^2$ during 2009-10 and 178.0 g/$m^2$ during 2010-11. Complete control of *Ipomea* was recorded in the treatment metribuzin 1.25 kg/ha (PE) + Almix 20 g/ha applied at 75 DAP during both the years. Highest cane yield 8.7 t/ha during 2009-10 and 9.73 t/ha during 2010-11 was recorded in the treatment metribuzin 1.25 kg/ha (PE)+ dicarmba 3.50 t/ha applied at 75 DAS which was found significantly higher over rest of the treatment. Weed control efficiency was found highest 44.8% during 2009-10 and 35% during 2010-11 CCS yield was also found significantly higher in the treatment metribuzin 1.25 kg/ha (PE)+ cidcamba 3.50 g/ha (75 DAP) during both the years. B: C ratio 2.8 during 2009-10 and 1.8 during 2010-11 was also found highest in same treatment which was significantly higher over rest of the treatments.

## P - 199 Efficacy of post emergence herbicides at different levels of available soil moisture against weeds in irrigated wheat

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A field experiment was conducted during 2008-09 and 2009-10 at Live Stock Farm, JNKVV, Jabalpur to study the effect of post emergence herbicides (isoproturon 1 kg/ha, clodinafop 0.06 kg/ha, clodinanafop followed by 2,4-D 0.5 kg/ha and weedy check) against weeds in irrigated wheat as affected by available soil moisture content (100, 95, 90, 85 and 80%) on weeds, nutrient depletion by weeds and uptake by crop and the grain yield and economics of wheat. 100 per cent available soil moisture at the time of herbicidal application had significantly the lowest weed density and total dry weight of weeds during both the years and hence lowered the nutrient depletion by weeds and increased the uptake by the crop. The presence of 100 per cent ASM registered significantly higher grain yield of wheat (59.99 and 61.95 q/ha) and proved significantly superior over 85 and 80 % ASM. Post emergence application of clodinafop *fb* 2,4-D had significantly the lowest total weed density (8.46 and 7.14/$m^2$) and dry weight (5.57 and 4.69 g/$m^2$) which resulted in higher grain yield as well as net monetary returns over isoproturon, clodinafop and weedy check. However,maximum benefit-cost ratio was obtained with the application of isoproturon at 100 % available soil moisture.

## P - 200 Yield gap analysis of wheat and pea through front line demonstration

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The results clearly shows that the positive effects of FLD over farmer practices towards enhancing the yield of wheat and pea crops. In monetary term, the benefit cost ratio was recorded to be higher under demonstration against farmer practice or traditional practices. The extension gap ranging between 1.52 to 2.86 q/ha. It was observed that due to improve weed management (application of chemical herbicides) good quality of produce was obtained due to healthy crop. Less weed crop competition and high nutrient use efficiency consequently, resulted higher return. Contrary to that farmer practices resulted poor quality of grain produce due to mixer of weed seed and obtained less return. The present investigation was carried out during *rabi* 2010-11 at different villages of Gwalior, Bhind and Morena districts. The crops covered i.e. wheat and peas in front line demonstration with the objectives of determination of yield extension gap. The trails were conducted at 10 and 6 locations. The data collected from each plots at farmers field with respect of use of quality seeds of improved variety, line sowing, timely weeding, balance dose of fertilizers irrigation and chemical herbicides. The traditional practices of farmers kept as level checks. The analyzed data indicated that the field of wheat and peas with improved recommendation practices were higher i.e. 20.31 and 11.69% respectively than the field obtained in famer practices.

## P - 201 Integrated weed management in soybean

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The field experiment entitled was conducted at Crop Research Centre of G.B.Pant University of Agriculture and Technology, Pantnagar during '*kharif'* 2007 and 2008. Fourteen treatments i.e. weedy check, one hand weeding (30 DAS), two hand weeding (25 and 45 DAS), weed free, alachlor 2.0 kg/ha as pre-emergence, alachlor 2.0 kg/ha (PE) + one hand weeding 30 DAS, chlorimuron-ethyl 9.0 g/ha (POE) 30 DAS, fenoxaprop-p-ethyl 70 g/ha (POE) 30 DAS, UPH-706 2.0 kg/ha (POE) 30 DAS chlorimuron-ethyl+ fenoxaprop-p-ethyl (9+70 g/ha (POE 30 DAS, chlorimuron ethyl+UPH-706 (9+2000 g/ha) (POE) 30 DAS, metribuzin 0.5 kg/ha (PE), metribuzin 0.5 kg/ha (PE)+one hand weeding 30 DAS and pendimethalin 1.5 kg/ha as pre-emergence were laid down in randomized block design. All the treatments were replicated three times. Soybean cv. *'PS-1368'* was sown on 9th July 2007 and 2005 July 2008 at 60 cm apart row to row using 75 kg seed/ha. Soil of the experimental plot was clay loam, rich in organic carbon (0.68%) available $P_2O_5$ (61.6 kg/ha) and $K_2O$ (268 kg/ha). The soil was neutral in pH (7.3). Highest grain yield (18.36 q/ha) of soybean was recorded in two hand weeding given at 25 and 45 DAS which was at par with the integrated treatment of metribuzin 0.5 kg/ha (PE)+one hand weeding given at 30 DAS which proved superior in seed yield, yield attributes, net return and B.C. ratio over either pre-emergence or post-emergence herbicides applied alone except pendimethalin applied 1.5 kg/ha as pre-emergence. Higher grain yield in these treatments was the cumulative effect of higher yield attributes i.e. higher number of pods per plant, grain per pod and 1000 grain weight. Net return was recorded highest (Rs. 44,855.0) from weed free treatment followed by two hand weeding (25 and 45 DAS) Rs. 42045.0 and Rs. 40,742.0 from metribuzin 0.5 kg/ha, respectively. Losses caused in grain yield of soybean due to weeds were highest (70.11% in weedy check. Significantly higher oil content (21.0%) was recorded from weed free treatment which was at par with two hand weeding (25 and 45 DAS) and metribuzin 0.5 kg/ha (PE)+one hand-weeding (30 DAS).

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## Integrated weed management in sesame

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Sesame is one of the important oil seed crop of Madhya Pradesh grown in rainy season but its productivity is low. Inadequate weed management and poor fertility management appear to be main constraints for low yield. A field experiment was conducted during the rainy season of 2009 and 2010 at Research Farm College of Agriculture, Gwalior. The experiments comprising 12 weed control treatments *viz.* T1- trifluralin 0.75 kg/ha as PPI, T2- pendimethalin 0.75 kg/ha as PE, T3- quizalofop ethyl 0.05 kg/ha as POE (20 DAS), T4- clodinofop 0.06 kg/ha as POE, T5- T1 + one hand weeding at 30 DAS, T6- T2 + one hand weeding at 30 DAS, T7- T3 + one hand weeding at 30 DAS, T8- T4 + one hand weeding at 30 DAS, T9- T1 + one hoeing at 30 DAS, T11- weed free (2 hand weeding at 15 and 30 DAS) and T12- weedy check. These were tried in RBD design with three replication. Sesamum variety *JT-S-8* was sown in 30 cm rows using a seed rate of 4 kg/ha on 25$^{th}$ July, 2009 and 29$^{th}$ July, 2010and harvested on 22$^{th}$ October, 2009 and 21$^{th}$ October, 2010 respectively. The major weeds were *Cyperus rotundus, Echinochloa crusgalli, Commelina benghalensis, Digera arvensis, Phylanthus niruri* and *Celosia argentia.* The minimum values of weed biomass (473 kg/ha) and higher weed control efficiency (89.23 %) was recorded in weed free treatment (2 hand weeding at 15 & 30 DAS) followed by quizalofop 0.05 kg/ha as POE (84.43 %), trifluralin 0.75 kg/ha as PPI (81.45 %), and pendimethalin 0.75 kg/ha as PE (79.33 %) with one hand weeding at 30 DAS. The higher seed yield of 994 kg/ha was recorded with weed free (2 hand weeding at 15 and 30 DAS) which was significantly superior to other weed control treatments. Quizalofop ethyl 0.05 kg/ha + 1 HW at 30 DAS recorded the highest net return (Rs. 11734 /ha) and benefit cost ratio (2.02) after weed free treatment. It was concluded that application of quizalofop ethyl 0.05 kg/ha as POE or trifluralin 0.75 kg/ha as PPI or pendimethalin 0.75 kg/ha as PE alone or in combination with one hand weeding at 30 DAS may be used for effective control of weeds, getting higher yield and net return.

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## Effect of weed management practices on soil health in chickpea-rice cropping system

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The field experiment was conducted during *rabi* season of 2009-2010 at Agronomy Research Farm of Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) to study the effect of herbicide on soil health in chickpea. The soil at the test site was silt loam with pH 8.12, EC 0.23 $dSm_{-1}$, OC 0.32%, bulk density 1.45 g/cc, available NPK 180.4, 17.5 and 262 kg/ha, respectively. The experiment was laid out in split plot design keeping *kharif* season treatments (weedy check, 2 HW, butachlor1.5 kg/ha + 1 HW and anilophos 0.5 kg/ha + 1 HW) in main plot and rabi season (weedy check, 2 HW, pendimethalin 0.75 kg/ha +1 HW and pendimethalin 1.0 kg/ha alone) in sub-plot. The rhizospheric soil samples were collected randomly from each plot at 30 DAS and at harvest stage and analyzed for various microbial parameters as influenced by various treatments. Results revealed that during *rabi* season at 30 and 50 DAS on microbiological parameters viz., free living bacteria, P-solubilizers, soil biomass carbon, acid-P, alkaline P and dehydrogenase activity significant variation were observed between the treatments. However at harvest stage variation were non significant. Maximum observation were observed under two hand weeding treated plot at various growth stages. Pendimethalin applied in chickpea did not leave any residual harmful effect on soil health.

## P - 204 Effect of weed management practices in cowpea

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Out of the total area under pulse cultivation in Kerala, more than 75% area is occupied by cowpea. Weed competition is the major menace faced by the cowpea growers. Hence an experiment was conducted at RARS, Pattambi during *rabi* 2010 using the variety *Kanakamony* to identify the economically viable weed management techniques. The treatments consisted of stale seed bed technique, application of pre emergent herbicides pendimethalin 0.75 Kg/ha, pretilachlor 0.75 Kg/ha, pendimethalin 0.75 Kg/ha followed by one hoeing at 20-25 days after sowing(DAS) , pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS, one hand hoeing at 20-25 DAS, two hoeing ( one at 20-25 DAS and second at 35-40 DAS) , weed free up to 40 days and weedy check. The pre emergence application of pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS reduced the total weed population to the tune of 76% at 40 DAS. Among treatments the lowest weed dry matter production was observed in pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS. The weed dry matter production at 20 DAS and 40 DAS was significantly lower by application of pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS (4.05 g/m2) and were on par with two hoeing and weed free up to 40 days(1.15 g/m2). The maximum grain yield (4.947 q/ha) was recorded in the application of pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS which was on par with two hoeing ( 4.290 q/ha )and weed free up to 40 DAS(4.219 q/ha). In comparison to the weedy check 57.86% increase in grain yield was observed due to the application of pretilachlor 0.75 Kg/ha followed by one hoeing at 20-25 DAS.

## P - 205 Integrated weed management studies in onion

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Yield loss due to weed infestation in onion were as higher as 82.2%. The conventional method of weed control is laborious expensive and insufficient hence integration of chemical with one hand weeding offers economically suitable alternative. A field experiment was conducted during *rabi* seasons of 2008-09 and 2009-10 at Research Farm College of Agriculture, Gwalior. Nine treatments consisted with different chemical, chemical + cultural and cultural weed management practices including a weedy check were tested in randomized block design with 3 replications. Seven week old age seedling of variety N-53 was planted in November II$^{nd}$ week during both the years recommended package of practices were adopted except weed management practices to raise healthy crop. The major weeds of the experimental field were *Cyperus rotundus, Chemopodium album, Medicago hispida, Phalaris minor, Fumaria parviflora, Parthenium hysterophorus, Convolvulus arvensis, Cynodon dactylon* and *Spergula arvensis.* All the weed control measures caused significant reduction in weed density and dry weight of weed over weedy check. Significantly lower weed density, and weed biomass were recorded with three hand weeding at 30, 45 and 60 DAT (weed free) treatment which was at par with oxadiargyl 0.09 kg/ha as PE + one hand weeding at 45 DAT during both the seasons. Higher bulb yield on onion was 96.03% compared to the yield of obtained in weedy check. Among the herbicide treatment maximum bulb yield (191.2 kg/ha) was recorded with oxadiargyl at 0.09 kg/ha which was at par with oxyfluorfen at 0.25 kg/ha as PE application. Maximum weed control efficiency was also recorded with weed free (3, hand weeding at 30, 45 and 60 DAT) closely followed by oxadiargyl 0.09 kg/ha as PE + one hand weeding at 45 DAT and sequential application of pendimethalin 0.75 kg/ha PE followed by pendimethalin 0.75 kg/ha sand mix broad cast at 30 day after transplants. Higher net return of Rs. 64734/ha was obtained with weed free (hand weeding at 30, 45 and 60 DAT) with benefit cost ratio 3.62 followed by oxadiargyl 0.09 kg/ha + 1 hand weeding at 45 DAT (Rs. 60110/ha) and oxyfluorfen 0.25 kg/ha + 1 HW (Rs. 58269 /ha) with BCR values of 3.58 and 3.50, respectively.

## P - 206 Resource use efficiency as influenced by weed management practices in cumin under arid region of Rajasthan

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Cumin (*Cuminum cyminum* Linn.) occupies prime position among the major seed spices crops of the country. It is mainly grown in the arid and semi arid regions of Rajasthan and Gujarat. Arid region of Rajasthan contributes about 26% to the total cumin production of the country and is highest cumin producing region next to Gujarat. But in cumin, weed infestation is one of the major constraint in its cultivation. Keeping this point in view, a field experiment was conducted at Central Arid Zone Research Institute Jodhpur during *rabi* season of 2007-8 and 2008-9. Experiment consisting 15 different weed management treatments including pre-emergence (linuron), preplant incorporation (fuchloralin) and post emergence (oxadiagryl) herbicides alone and in combination with mechanical and hand weeding were tested in a randomized block design with three replications. The crop was sown in the IInd week of November during both the years. All the recommended package of practices was followed for raising the cumin crop. The experimental field dominated by *Chenopodium murale* (34.7%), *Asphodelus tenuifolius* (24.75%), *Helitropium oralifolium* (14.6%), *C. album.* (10.5%), *Melilotus indica* .(5.95%), *Rumex dentatus.*(4.45%) and *Amaranthus blitum* (5.05%) in the weedy check condition. Highest mean weed control efficiency (88.63%) was recorded with two hand weeding closely followed by fluchloralin 0.50 kg/ha+ oxadiagryl 50 gm/ha and fluchloralin 0.50 kg/ha+ one hand weeding at 25 DAS. Weed free gave highest mean seed yield, which was 5.56, 12.58 and 51.7% higher over the application of fluchloralin 0.50 kg +oxadiagryl 50gm/ha, two hand weedings and weedy check, respectively. But owing to higher cost of weeding in maintaining season long weed free check, net return was lower than the application of fluchloralin +oxadiagryl. However the highest net returns of Rs. 22844/ha was realized with the application of fluchloralin 0.50 kg +oxadiagryl 50gm/ha. Highest mean water use efficiency (1.22 kg/ha-mm) and nutrient use efficiency (8.78 kg seed/ kg N & 11.71 kg seed/kg P applied) were recorded with weed free check but remained at par with two hand weeding and fluchloralin 0.50 kg +oxadiagryl 50gm/ha . The lowest water use efficiency (0.56 kg/ha-mm) and nutrient use efficiency (4.24 kg seed/kg N and 5.65 kg seed/kg P applied) were recorded in weedy checks.

## P - 207 Economics of different weed control options in maize + sunflower intercropping system

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Two field experiments were conducted during July to October 2003 and January to April 2004 at Annamalai University in randomized block design with eight treatments and three replications to find out the economics of different weed control options in maize (CoH (M) - 4) + sunflower (Co-4) intercropping system. The experimental soil was clayey loam in texture, low in available nitrogen (215 kg/ha), medium in available phosphorus (21kg/ha) and high in potassium (332.5 kg/ha). The treatments comprised of control, twice hand weeding at 15 and 30 DAS, three herbicides each at three doses *viz.,* alachlor (2 and 3kg/ha), pendimethain (1 and 1.5 kg/ha) and fluchloralin 1and1.5 kg/ha) followed by one hard weeding on 30 DAS. The additional cost of cultivation incurred due to various treatments ranged from Rs. 1600 to 3725. A mean net income of Rs. 20375.25 and mean BCR of 2.20 was recorded in twice hand weeding. Among the various treatments, the highest mean net income (Rs.33662.63) and mean BCR (2.97) was recorded in application of alachlor 3 kg/ha coupled with one hand weeding on 30 DAS.

## P - 208 Effect of vermi-compost and herbicides on the soil microflora and fertility applied in late sown wheat

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A field experiment was conducted during *rabi* season of 2009-10 at Instructional Farm of N.D. University of Agriculture and Technology, Kumarganj, Faizabad to study the effect of vermicompost and herbicides on soil fertility and health as applied in wheat. Soil of the test site was silt loam with medium fertility status. The experiment was laid out in RBD with three replications. The sowing was done on December 16, 2010. The experiment comprised four doses of vermin-compost (0, 0.8, 1.0 and 1.2 t/ha) in main plot and three herbicides (isoproturon, sulfosulfuron and 2,4-D 750 g, 25 g and 500 g/ha, respectively) in sub plot. The wheat variety NV-2036 was used as test crop. Results revealed that growth and yield of wheat increased, with the application of vermicompost. Vermicompost applied 1.2 t N/ha and isoproturon 750 g/ha was found more effective in increasing the yield and yield contributing characters of late sown wheat physico-chemical and biological properties of soil and improved more when vermicompost applied 1.2 t N/ha. Among various herbicides, isoproturon was found less toxic on microbial population. Further results revealed that all the herbicides applied into soil did not show any toxic residual effect on soil health. The use of vermi-compost and herbicides is economically feasible in wheat cultivation. Maximum net return per rupee invested (Rs. 41897.50) was obtained in the treatment ($OM_3 + H_1$) having benefit cost ratio 1:1.94.

## P - 209 Evaluation of pendimethalin 38.7% CS for weed control in cotton

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Cotton farmers generally control weeds by repeated intercultivation and hand weeding. However, under irrigated and heavy rainfall areas these methods workout costlier and requires more manpower. Besides, the soil condition will not permit for repeated intercultivation and hand weeding. Therefore, a field experiment was conducted at Agricultural Research Station, Dharwad during 2008 and 2009 to evaluate weedicide pendimethalin 38.7% CS for weed control in cotton. Pre emergence application of 0.48, 0.58, 0.68, 1.35 and 1.93 kg/ha of pendimethalin 38.7% CS were compared with pre emergence application of trifluralin 48 % EC 0.26 kg/ha, fluchloralin 45 % EC 1.125 kg/ha, diuron 80 WP 1.0 kg/ha, pendimethalin 30% EC 0.75 kg/ha, recommended practice, weed free and un weeded checks. Weed free and un weeded checks recorded significantly lower and higher weed dry weights, respectively. Among the weed control treatments application of pendimethalin 38.7% 0.68kg/ha recorded significantly lower weed dry weight at 60 DAS (87.6 g/$m^2$) and at harvest (30.5 g/$m^2$). At 60 DAS pre emergence application of pendimethalin 38.7% CS 1.35 kg/ha recorded significantly higher weed control efficiency and it was on par with 0.68 and 1.93 kg/ha. All weed control treatments recorded significantly superior seed cotton yield over unweeded check. Among weed control treatments seed cotton yield was significantly increased with application of pendimethalin 38.7% CS 0.68 kg/ha (1870 kg/ha) as compared to other treatments. However, it was on par with all other treatments except pendimethalin 0.48 kg/ha, fluchloralin 1.125 kg/ha, and trifluralin 0.26 kg/ha. Therefore, pendimethalin 0.68 kg/ha can be economically used for weed control in cotton.

## P - 210 Integrated weed management in pigeonpea

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An experiment was undertaken during *kharif* season of 2003at Agronomy Farm, PGI, Instructional farm, MPKV, Rahuri (Maharashtra). The experiment was laid out in randomized block design and replicated three times with nine treatments. The treatments consisted of T1: weedy check, T2: weed free up to 90 DAS, T3: two hand weeding (at 20 and 45 DAS), T4: pendimethalin pre-emergence 1.5 kg/ha, T5: pendimethalin PE 1.0 kg/ha + one hand weeding at 45 DAS, T6: fluchloralin PPI 1.5 kg/ha + one hand weeding at 45 DAS, T8: pendimethalin PE 1.0 kg/ha + glyphosate 1.0 kg/ha at 45 DAS and T9: pendimethalin PE 1.0 kg/ha + paraquat 1.0 kg/ha at 45 DAS. Weed intensity and weed dry matter at harvest was significantly less in weed free treatment. Whereas, weed intensity and weed dry matter was maximum in weedy check treatment (206.57/$m^2$ and 12.22 q/ha respectively). The growth attributes of pigeonpea were significantly more in weed free treatment. This was followed by pendimethalin PE 1.0 kg/ha plus hand weeding at 45 DAS, two hand weeding at 20 and 40 DAS and pedimethalin PE 1.0 kg/ha plus glyphosate 1.0 kg/ha at 45 DAS. Maximum values of yield attributes were observed in, pendimethalin PE 1.0 kg/ha plus hand weeding at 45 DAS, two hand weeding at 20 and 45 DAS and pendimethalin PE 1.0 kg/ha plus hand weeding at 45 DAS. The loss of nutrient through weed was significantly lower (3.79 kg N, 0.49 kg P2O5, 3.73 kg K2O/ ha) in weed free treatment as compared to that of weedy check (22.10 kg N, 3.54 kg P2O5 and 17.09 kg K2O/ha). Further, weed free treatment exhibit significantly higher content of nitrogen, phosphorus and potassium in seed as well as in stick as compared to rest of the treatments. In economic studies, the gross monetary returns was significantly higher in weed free treatment (Rs. 34620/ ha) followed by IWM treatments. The benefit cost ratio was maximum in pendimethalin 1.0 kg/ ha plus hand weeding at 45 DAS (2.23) due to higher value of pigeonpea and less cost of cultivation.

## P - 211 The efficacy of different herbicides against weeds in onion

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A field experiment was conducted during the *rabi* season of 2009-10 and 2010-11 in JNKVV, M.P. Treatments of herbicides with one weedy check had been employed in RCBD with three replication. The analysis of variance for all characters *viz.,* morphological (plant height, number of leaves and collar thickness) and yield attributes characters (polar diameter, equatorial diameter and average bulb weight) was done. Among the weed management practices, T2 -oxyflurofen 23.5% EC application before planting + quizalofop ethyl (Targa Super) application at 30 days after transplanting, T3- combined spray of oxyflurofen and quizalofop ethyl at the time of planting and second application at 30 days after transplanting, T5- pendimethalin 30% EC application before planting + quizalofop wthyl application at 30 days after transplanting and T6- combined spray of pendimethalin + quizalofop ethyl at the time of planting and second application at 30 days after transplanting, were at par. The treatment T2 significantly reduced the density and dry weight of weeds over other treatments and significantly increased yield attributes of onion resulting in higher marketable bulb yield (298.65 q/ha). Further, higher weed control efficiency (91.43%) and lower weed biomass (6.03 g/$m^2$) was observed in treatment T8. *Chenopodium album, Melilotus albus, Eragrostis cillansis, Parthenium Hysterophorus, Anagallis arvensis, Cyperus rotundus* and *Sperogula arvensis* were the most dominant weeds flora in onion crop.

## P - 212 Weed management in sunflower through sequential application of herbicides

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A field experiment was conducted during *rabi* 2010-11 at Tirupati campus of Acharya N.G. Ranga Agricultural University, to evaluate the performance of sequential application of pre-emergence herbicides (pendimethalin 1000 g/ha and oxadiargyl 250 g/ha) followed by the application of post emergence herbicides (fenoxaprop 60 g/ha, propaquizafop 60 g/ha and quizalofop 50 g/ha) including hand weeding twice and unweeded check in a randomized block design. The predominant weed flora present in the experimental field was *Cyperus rotundus, Trichodesma indicum, Euphorbia thymifolia, Digitaria sanguinalis* and *Dactyloctenium aegyptium*. The experimental results indicated that the sequential application of pendimethalin 1000 g/ha as pre-emergence followed by propaquizafop 60 g/ha at 20 DAS resulted in the lowest density and dry weight of total weeds with higher weed control efficiency, among the sequential application of herbicides tried and it was the next best weed management practice to hand weeding twice to suppress the weed growth. The highest achene yield of sunflower was recorded with the sequential application of pendimethalin 1000 g/ha as pre-emergence followed by propaquizafop 60 g/ha at 20 DAS, which was significantly higher than rest of the weed management practices tried. This might be due to maintenance of weed free environment throughout the crop growth period, which led to increased stature of growth and yield components. The reduction in achene yield of sunflower due to unchecked weed growth was 50.03 per cent compared to the best weed management practice. Pre emergence application of oxadiargyl 250 g/ha alone or sequential application of oxadiargyl followed by any of the post emergence herbicides were not effective as that of pendimethalin 1000 g/ha alone or sequential application of post emergence herbicides in suppressing the weed growth in general and *Trichodesma indicum,* a broad leaved weed in particular. The highest achene yield and maximum economic returns, besides broad spectrum weed control were obtained with pre-emergence application of pendimethalin 1000 g/ha followed post-emergence application of propaquizafop 60 g/ha at 20 DAS.

## P - 213 Quality parameter of potato tuber as affected by metribuzin application

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Herbicides drastically influence all aspects of primary and secondary metabolisms in crops when given to control undesired weeds. Herbicide applications in fields limit harmful effects of weeds. However, they may effect biochemical process of crops and ultimately crop quality. Metribuzin [4-amino-6-tert-butyl-4, 5-dihydro-3-methylthio-1,2,4-triazin-5-one], an extensively used herbicide in potato, inhibits photosynthesis. It interferes with photosynthetic electron transport between the primary and secondary acceptors of photosystem II (PSII). Field and laboratory experiments were conducted with potato tuber variety *Kufri jyoti* at CSK HPKV Palampur during *rabi* 2010-11 to study the effect of different doses of metribuzin on biochemical composition of potato. Metribuzin was applied at three concentration *viz.,* 0.25, 0.50 and 1.00 kg/ha. All three rates of herbicide application resulted into numerical increase in values of reducing sugars content, sucrose content, starch content and ascorbic acid content. Highest reducing sugar content (139.26 mg/100 g), ascorbic acid content (0.60 mg/100 g) and starch content (9.93 mg/100 g) were obtained with application of metribuzin 1.00 kg/ha. However herbicide application over control resulted into lower values of chip colour and phenols.

## P - 214 Weed growth and crop yield in direct seeded rice-blackgram cropping sequence: effect of long-term tillage and weed management practices

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Severe weed infestation is critical for lower productivity of direct seeded rice-blackgram system followed in Assam. A field experiment was conducted in the Instructional Research Farm of AAU, Jorhat with varieties *Disang* in rice and *T-9* in blackgram crop. Butachlor 1.5 kg/ha and pendimethalin 1.0 kg/ha were applied as pre-emergence in rice and blackgram, respectively and compared with weedy check and hand weeding at 20 and 40 days after sowing (DAS) in each crop. The tillage treatments comprised conventional and minimum tillage in each crop and their combinations in alternate crops. The rice crop was sown during March to 1st week of April and harvested in July/August. Blackgram was sown during mid August to mid September and 1st picking and harvesting completed in the month of December all throughout the three years of study. *Cynodon dactylon, Digiteria setigera, Eleusine indica, Panicum repens, and Paspalum conjugatum* comprised the major grassy weeds and *Ageratum houstonianum, Mimosa pudica, and Spilanthes paniculata* amongst the broadleaved species in rice. The dominant weed flora in blackgram were *Cynodon dactylon, Digiteria setigera, Eleusine indica, Eragrostris unioloides, Panicum repens, and Paspalum longifolium* amongst the grasses; *Cyperus iria, C. rotundus and Fimbristylis littoralis* amongst the sedges and *Ageratum houstonianum, Alternanthera philoxeroides, Commelina diffusa, Cuphea balsamona, Eclipta prostrata, Fissendocarpa linifolia, Mimosa pudica, and Murdania nudiflora* as broadleaved species. Conventional tillage in respective crops resulted lowest weed dry weight. Hand weeding at 20 and 40 days after sowing (DAS) was more effective compared to application of herbicide. Hand weeding at 20 & 40 DAS recorded highest mean grain yield (10.7 q/ha) in rice while application of herbicide produced the highest seed yield of blackgram (4.05 q/ha) over hand weeding. Maximum number of seeds in the soil was accumulated under zero tillage condition in both the crops.

## P - 215 Effect of different weed control treatments in chickpea under *kandi* belt of low altitude sub-tropical zone of Jammu

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A field experiment was conducted at Research Farm of Pulses Research Sub-Station, Samba of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during *rabi* 2010-11. Total twelve treatments consisting of three doses of the POE herbicide (imazathypr) at 3 different durations (10, 20 & 30 days after germination-DAG) along with weedy check (control), hand weeding and weed free treatment were tested in randomized block design. Significantly maximum total weed density and weed biomass at 70 DAG and harvest were recorded in weedy check with the corresponding values of 14.05 and 14.56/$m^2$ and 41.2 and 51.3 g/$m^2$, respectively. Results revealed that weed free treatment registered significantly higher number of yield attributing characters like no. of pods/plant (15.7 and 5.3), no. of seeds/pod (1.63 and 1.10), seed index (40.7 and 23.6 g), dry-weight/plant (8.71 and 6.57 g) and seed yield (698.90 & 440.70 kg/ha) than weedy check, respectively during the period under study. However, it was on par with two hand weedings at 25-30 & 50-55 DAG and imazathypr 20 g/ha at 30 DAG with the grain yield values of 681.30 and 656.40 kg/ha, respectively. The weed population at 70 DAG and at harvest reduced biological yield of chick pea crop with the rate of -173.4 and -166.0 kg/ha with an accuracy of 94 and 92 percent, respectively. The yield and yield attributes were highly negatively correlated with weed infestation.

## P - 216 Efficacy of pre and post emergence herbicides on weed dynamics and yield of mungbean

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A field experiment was conducted during two consecutive *kharif* seasons of 2010 and 2011 at Agricultural Research Station, Ummedganj, Kota. The experiment was carried out in randomized block design with three replications comprised of eight treatments *viz.,* weedy check, hand weeding at 25 days after sowing (DAS), pendimethalin 1.0 kg/ha, pendimethalin extra 0.75 kg/ha, pendimethalin extra 1.0 kg/ha, pendimethalin + imazethapyr 0.75 kg/ha, quizalofop ethyl 50 g/ha and fenoxaprop-p-ethyl 70 g/ha. The soil of the experimental field is clay loam, low in organic carbon (4.1 g/kg), medium in available phosphorus (20.5 kg/ha), high in available potassium (292.5 kg/ha) and slightly alkaline in reaction (pH 7.5). Results revealed that hand weeding observed lowest weed density (2.37/$m^2$) and weed biomass (3.45 g/$m^2$) recorded at 30 days after sowing and remained statistically at par with pendimethalin + imazethapyr 0.75 kg/ha, pendimethalin 1.0 kg/ha, pendimethalin 0.75 kg/ha and pendimethalin 1.0 kg/ha over the rest of the herbicide treatments and weedy check, respectively. Maximum and significantly higher weed control efficiency (89.17) and seed yield (1160 kg/ha) was observed with hand weeding at 20 DAS over post emergence herbicides and weedy check. The next best herbicide treatment was pendimethalin + imazethapyr 0.75 kg/ha recorded significantly higher weed control efficiency (86.80 %) and seed yield (1143 kg/ha) followed by pendimethalin 1.0 kg/ha over quizalofop ethyl 50 g/ha, fenoxaprop-p-ethyl 70 g/ha and weedy check, respectively.

## P - 217 Solarization effects on potting medium of nursery plants

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Soil solarization is a method of hydrothermal disinfestation of moist soil accomplished by covering it with transparent polyethylene sheets during the hottest period of the year. This non-chemical method is useful in controlling several soil borne diseases, insects, and weeds besides altering some chemical changes in the soil. An experiment was conducted to examine the effects of soil solarization on soil temperature, soil microflora, and nutrient status of potting medium used for nursery plants. The potting mixture was prepared using soil, sand, and powdered cowdung in the ratio 1:1:1, and using it, raised beds of 3.0 m length, 1.0 m width, and 20 cm height were prepared. The treatments included were solarization for 15 days, 30 days, 45 days, fumigation with dazomet, and control. Organic carbon, total nitrogen, ammoniacal nitrogen, nitrate nitrogen, available phosphorus, exchangeable potassium, calcium, and magnesium were estimated from the soil samples using standard procedures. Population of soil fungi, bacteria, and actinomycetes were also counted. Soil solarization increased the soil temperature, and the difference in temperature was 7-9.5°C at 5 cm depth between solarized and non-solarized plots. Solarization for 30 and 45 days and fumigation were very effective in controlling weed growth and biomass of weeds in the nursery. Solarization also reduced the population of soil fungi, bacteria, and actinomycetes substantially. There was a corresponding reduction in microbial population as the period of solarization increased from 15 to 45 days. Solarization increased the amount of available phosphorus, exchangeable potassium, calcium, and magnesium in solarization treatment for 30 and 45 days. At the same time, organic carbon, total nitrogen, ammoniacal nitrogen, and nitrate nitrogen content in the soil were unaffected.

## P - 218 Physiological, biochemical and molecular studies in *Vigna radiata* and associated weeds under high $CO_2$ environment

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An experiment was conducted to study changes in physiological, biochemical and molecular aspects in *Vigna radiata* L. (Wilkzek) and associated weeds (*Euphorbia geniculata* and *Commelina diffusa*) under high $CO_2$ environment in Free Air $CO_2$ Enrichment (FACE) system. Enrichment of atmospheric $CO_2$ (550 ppm) had a positive effect on overall growth of both mungbean and weed species, though, the effect was more pronounced in weeds. Rate of photosynthesis increased, while, stomatal conductance and rate of transpiration decreased in mungbean and *Commelina diffusa* at elevated $CO_2$ as compared to that at ambient $CO_2$. Conversely, exposure of *Euphorbia geniculata* plants to high $CO_2$ led to an increase in stomatal conductance and rate of transpiration along with increase in rate of photosynthesis suggesting unique adaptive potential of this weed species to newer situation. Plants exposed to elevated $CO_2$ possessed higher activity of carbonic anhydrase in all the three plant species (mungbean, *Euphorbia geniculata* and *Commelina diffusa*) as compared that at ambient $CO_2$ level and may be a contributing factor to the observed higher rates of photosynthesis at elevated $CO_2$. *In situ* staining of leaves with ROS-specific dyes revealed that $CO_2$ enrichment resulted in accumulation of hydrogen peroxide ($H_2O_2$) and superoxide radicals in mungbean, however, weed species showed lesser accumulation of these reactive oxygen species as compared to those at ambient $CO_2$. A transition in redox status (reduced ascorbate: oxidized ascorbate; GSH: GSSG ratio) from reduced to oxidized state can be seen in mungbean after $CO_2$ enrichment, while no such change was evident in *Euphorbia geniculata* and *Commelina diffusa*. Activity of antioxidant enzymes (catalase, superoxide dismutase, ascorbate peroxidase, glutathione peroxidase and glutathione reductase) showed differential isoenzyme pattern in mungbean and weed species at elevated $CO_2$. Enrichment of $CO_2$ had an effect on transcription of various genes involved in antioxidant defence system in mungbean. Together, results suggest that rise in $CO_2$ concentration influenced photosynthesis, antioxidant defence mechanism defence mechanism and weeds showed more responsiveness to elevated $CO_2$, hence dominate the mungbean crop.

## P - 219 Effect of weed management on growth and yield of lentil

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Lentil an important grain legume in India with total area of 1.38 million ha, total production of 0.95 million tones and average yield of 693 kg/ha during 2008-09 (Directorate of Economics and Statistics, New Delhi). Due to its relatively short stature and slow early growth, it competes poorly with weeds and yield reductions up to 60 per cent due to weed has been recorded. Mulching is a possible way to controls weeds besides it has a positive influence of effective conservation of moisture. Moreover, a suitable weed management strategy inclusive of chemical, mechanical and cultural means is expected to bring about an effective control of weeds in lentil. A field experiment was conducted during the *rabi* seasons of 2008-09 and 2009-10 at the Instructional-Cum-Research Farm of Assam Agricultural University, Jorhat to study the effect of rice straw mulching and weed management techniques in lentil. On farm trials were also carried out to confirm the results. The results revealed that mulching brought significant reduction in weed density and dry weight, thereby higher grain yield. Application of oxyfluorfen 150 g/ha + hand weeding 20 DAS gave best control of weeds and highest grain yield of the crop. It also resulted higher B:C ratio (2.81) than the farmers' practice of two manual weeding at 20 and 30 DAS (2.33).

## P - 220 Effect of new molecule herbicides on density and growth of weeds grown in association with blackgram

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The present investigation was carried out during *kharif* season of 2009 at the Research-cum-Instructional Farm, IGKVV, Raipur. The experiment was laid out in RBD with three replications. The treatment comprised of 14 weed management practices, *viz.,* $T_1$ : unweeded check, $T_2$ : hand weeding 20 and 40 DAS, $T_3$ : pendimethalin 1.0 kg/ha PE, $T_4$ : quizalofop-p-ethyl 37.5 g/ha PoE (20 DAS), $T_5$ : chlorimuron-ethyl 4.0 g/ha PoE (20 DAS), $T_6$ : fenoxaprop-p-ethyl 60 g/ha PoE (20 DAS), $T_7$ : quizalofop-p-ethyl 37.5 g/ha + chlorimuron-ethyl 4.0 g/ha PoE (20 DAS), $T_8$ : fenoxaprop-p-ethyl 60 g/ha + chlorimuron-ethyl 4.0 g/ha PoE (20 DAS), $T_9$ : imazethapyr 25 g/ha PE, $T_{10}$ : chlorimuron-ethyl 4.0 g/ha PPI, $T_{11}$ : quizalofop-p-ethyl 37.5 g/ha + chlorimuron-ethyl 4.0 g/ha PoE (35 DAS), $T_{12}$ : fenoxaprop-p-ethyl 60 g/ha PoE (35 DAS), $T_{13}$ : pendimethalin 1.0 kg/ha PE *fb* quizalofop-p-ethyl 37.5 g/ha + chlorimuron-ethyl 4.0 g/ha PoE (35 DAS), $T_{14}$ : pendimethalin 1.0 kg/ha PE *fb* fenoxaprop-p-ethyl 60 g/ha + chlorimuron-ethyl 4.0 g/ha PoE (35 DAS). Results revealed that yield attributed characters yield, and weed control efficiency were obtained under hand weeding twice (20 and 40 DAS), followed by imazethapyr 25 g/ha PE and minimum was obtained under unweeded check. In the experimental field, *Celosia argentia, Cynodon dactylon, Phyllanthus niruri* and *Cyperus rotundus* were the dominant weeds and found throughout the crop growth period.

## P - 221 Evaluation of glyphosate resistant cotton hybrids for weed control efficacy and seed cotton yield in winter irrigated ecosystems of Tamil Nadu

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Cotton is one of the important crop that has been genetically altered to address challenges with weed and insect control. The experiment was conducted with glyphosate resistant cotton hybrids during winter season of 2009-10 and 2010-11 at the experimental site of Tamil Nadu Agricultural University, Coimbatore. The experiments were laid out in a randomized block design replicated thrice with the objective to find out the weed control efficacy and yield of transgenic cotton hybrid with the application of glyphosate. Glyphosate was applied as early POE application on 25 and 65 DAS at 900, 1350, 1800, 2700, 3600 and 5400 g/ha in MRC 7347 BG-II RRF test hybrid. Along with hand weeding twice on 15 and 30 DAS and unweeded control were tested. The total weed density was significantly altered by different weed control treatments during both the years. In both sprays, early POE application of glyphosate 2700, 3600 and 5400 g/ha registered lower weed density, weed dry weight and higher weed control efficiency due to better control of weeds at critical stage (50 DAS) of crop growth during winter 2009-10 and 2010-11, in herbicide tolerant transgenic cotton compared with other treatments. Glyphosate at 2700, 3600 and 5400 g/ha recorded significantly lower weed density and dry weight. The yield was significantly higher in POE application of glyphosate 2700 g/ha (3195 and 3092 kg/ha during 2009-10 and 2010-11, respectively). This might be due to glyphosate at 2700 g/ha recorded higher number of bolls, fruiting points and boll setting percentage. This was followed by glyphosate at 3600, 1800 and 5400 g / ha recorded higher seed cotton yield than all other treatments. Increased use of transgenic cotton with herbicide and pest resistance has resulted in more efficient insect and weed management practices.

## P - 222 Productivity of chickpea + mustard intercropping system under subtropical foothills of Jammu and Kashmir

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A field experiment was carried out on loamy soil during 2009-2010 and 2010-2011 at Research Farm, Main Campus, Chatha of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu to study the weed management practices in chickpea (*Cicer areitinum* L.) + mustard (*Brassica juncea* L.) intercropping system under subtropical conditions of Jammu and Kashmir. The experiment consisted of four main plot treatments*;* chickpea (sole), mustard (sole), chickpea + mustard (additive series) and chickpea + mustard (replacement series) and six sub plots treatments *viz.,* weedy check, weed free, fluchloralin 1kg/ha, pendimethalin 1kg/ha, isoproturon 0 .75 kg/ha and quizalofop-ethyl 50 ml/ha. The studies revealed that among intercropping systems, significantly higher plant height, dry matter accumulation and leaf area index was recorded in sole chickpea and sole mustard followed by replacement and additive series. Various yield attributes and grain yields of chickpea and mustard were found to be superior with sole cropping, followed by chickpea + mustard (additive series) and chickpea + mustard (replacement series). Chickpea + mustard (additive series) appeared to be biologically most efficient and economically viable system giving the highest chickpea and mustard grain yield, chickpea equivalent yield (10.92 and 17.75), land equivalent ratio (1.63 and 1.66) and area time equivalent ratio (1.47 and 1.50), relative yield total(1.63 and 1.67) and net returns (Rs.16257.97 and Rs. 34529.27). Higher seed yield of component crops in intercropping systems showed complementary relationship which resulted in higher chickpea-equivalent yield. Chickpea + mustard (additive series) recorded not only reduced the total weed population, dry weight of weeds, weed index and weed control efficiency weed control efficiency.

## P - 223 Weed management study in potato in NEH region

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A field experiment was conducted during summer season of 2011 at Central Potato Research Station, Shillong on weed management study in potato in NEH region. The trial was laid out in randomized block design, replicated thrice, with 12 treatments *viz.,* weedy check, weed free check through repeated manual weeding, one hand weeding followed by earthling up, farmers practice of weeding during earthing up, mulching with organic material, metribuzine 1kg/ ha, oxyflourofen 0.2 kg/ha, pendimethalin 1kg/ha, metribuzine 1kg/ ha followed by one hand weeding at 40 DAP, oxyflourofen 0.2 kg/ha followed by one hand weeding at 40 DAP, pendimethalin 1kg/ha followed by one hand weeding at 40 DAP and two hand weeding at 20 and 40 DAP. All the herbicides were applied as a pre emergence in the experiment. Maximum potato tuber yield of 29 t/ha was recorded in weed free check followed by 28 t/ha in treatment involving metribuzine application 1 kg/ha as pre emergence and one hand weeding at 40 DAP. Both the treatments were significantly superior over weedy check and farmers practices but at par among other herbicidal treatments. The difference in yield reduction ranged from 4 to 34%. Maximum yield reduction (34%) was recorded in weedy check treatment while minimum yield reduction were observed in metribuzine application 1kg/ ha and one hand weeding at 40 DAP. The herbicidal treatments were at par with each other but were superior to farmers' practices and mulching of organic material. Although maximum yield was obtained in weed free check but the net return was less due to higher cost of cultivation. From economics point of view, Metribuzine 1kg/ ha + 1 hand weeding at 40 DAP was more effective in controlling the weeds in potato crop.

## P - 224 Influence of weed management on weed dynamics, weed control efficiency and productivity of chickpea + mustard intercropping under subtropical conditions of Jammu & Kashmir

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A field experiment was carried out on loamy soil during *rabi* 2009-2010 and 2010-2011 at Research Farm, Main Campus, Chatha of Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu to study the weed management practices in chickpea (*Cicer areitinum* L.) + mustard (*Brassica juncea* L.) intercropping system under subtropical conditions of Jammu & Kashmir. The experiment consisted of four main plot treatments; chickpea (sole), mustard (sole), chickpea + mustard (additive series) and chickpea + mustard (replacement series) and six sub plots treatments *viz.,* weedy check, weed free, fluchloralin 1kg/ha, pendimethalin 1kg/ha, isoproturon 0 .75 kg/ha and quizalofop-ethyl 50 ml/ha. The predominant weed flora observed in the experimental field were *Medicago sativa, Anagallis arvensis, Cyperus rotundus Traychyspermum spp., Phalaris minor, Rumex cresipes and Fumaria perviflora,* during both the years of experimentation. Among the weed management treatments, weed free treatments proved most effective with respect to weed control efficiency followed by pre emergence application of pendimethalin 1kg/ha recording weed control efficiency of 78.26 and 87.27% during 2009 and 2010, respectively. The values mere however, statistically similar to pre-plant incorporation of fluchloralin 1kg/ha and post- emergence application of isoproturon 0.75kg/ha. Pre emergence application pendimethalin 1kg/ha of also recorded lowest weed density, dry weed weight and resulted in significantly highest grain yields of chickpea to the tune of 7.71 and 8.78 q/ha and mustard to the tune of 10.22 and 11.76 q/ha during both the years, respectively As regards relative economics of various treatments, maximum net returns to the tune of Rs. 17190.83 and Rs. 27514.48 were recorded with pre emergence application of pendimethalin 1kg/ha followed by pre-plant incorporation of fluchloralin 1kg/ha to the tune of Rs. 15721.68 and Rs. 26240.76 respectively during both the years.

## P - 225 Awareness and adoption levels of weed management technology in wheat

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Wheat is an important *rabi* crop of Bathinda district of Punjab. Survey on adoption and awareness of weed control technology in wheat was conducted in 22 villages of Bathinda district situated at 14-42 kms away from Bathinda. 30 farmers were surveyed having 4-42 acres holdings. Fifty three (53) percent farmers were having high school level education while only 13 % were graduates. Only 39 % farmers were in touch with SAU's while 30% used to consult officers of state department of Agriculture. 12.4% farmers were depended on pesticide dealers and their fellow villagers and relatives as against 12% on radio. All the farmers (100%) were well aware of weed management options in wheat. Fifty seven percent farmers adopted cultural as well as chemical weed control measures while 100% farmers adopted chemical means to control weeds in wheat crop because of severe infestation of *P.minor* in rice-wheat cropping system. For control of grassy weeds, 32% farmers preferred only sulfosulfuron and all used only recommended dose of this herbicide while 49% farmers adopted clodinafop. Only 2.7% farmers used fenoxaprop. Mix formulation of isoproturon+ metsulfuron was also the choice of 8 % farmers due to its good efficacy against complex weed flora.

## P - 226 Relative efficacy of integrated weed management in irrigated cotton

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The experiment was laid out during summer season of 2003at Agronomy Farm, PGI, Instructional farm, MPKV, Rahuri (Maharashtra) in randomized block design and replicated three times with ten treatments. The treatments consisted of preplant incorporation of trifluralin and fluchloralin at 1200 and 1120 g/ha respectively, post emergence sprays of glyphosate and haloxyfop (21 DAS) at 1200 and 100 g/ha respectively, along with or without hand weeding at 42 DAS, weed free and weedy check. The significant reduction in weed density and weed biomass was due to weed free treatment followed by post directed application of glyphosate at 1200 g/ha with a follow up hand weeding (42 DAS). Maximum weed control efficiency was recorded due to post emergence spray of glyphosate at 1200 g/ha after 21 DAS with a follow up hand weeding (42 DAS), (86.69%). The nutrient uptake in weedy check was observed to be significantly more than those recorded in other weed control treatments. The highest seed cotton and lint yield were obtained under weed free treatment (16.99 and 5.85 q/ha) closely followed by post emergence spray of glyphosate at 1200 g/ha with follow up hand weeding at 42 DAS (10.80 and 3.71 q/ha, respectively) and pre plant incorporation of fluchloralin at 1120 g/h ha with a follow up hand weeding (10.66 and 3.65 /ha, respectively). Weed competition throughout the crop growth period in irrigated cotton reduced the seed cotton and lint yield by 71.5 and 72.0%, respectively. Ginning percentage and lint index of cotton were highest under weed free treatment followed by post emergence spray of glyphosate at 1200 g/ha after 21 DAS with a follow up hand weeding at 42 DAS. The highest benefit cost ratio was recorded under post emergence spray of glyphosate at 1200 g/ha after 21 DAS with a follow up hand weeding at 42 DAS.

## P - 227 Effect of weed management on weed dynamics, weed control efficiency and productivity of winter maize+potato intercropping system in sub tropical region of Jammu

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A field experiment was conducted on sandy loam soil during the *rabi* 2009-10 and 2010-11 to study effect of weed management practices on growth, yield and weed dynamics of winter maize (*Zea mays* L..) + potato (*Solanum tuberosum* L.) intercropping system in sub tropical region of Jammu. The experiment consisted of four main plot treatments; winter maize (sole), potato (sole), winter maize + potato (additive series) and winter maize+ potato (replacement series) and six sub-plot treatments comprising of weedy check, weed free, alachlor pre 1.5 kg/ha, atrazine pre 0.5 kg/ha, E-post alachlor 2.0 kg/ha and atrazine post 0.75 kg/ha and laid out in split plot design with three replications. The predominant weed flora in the experimental field were *Medicago sativa, Angallis arvensis, Cyperus rotundus, Phalaris minor, Trachyspermum sps., Cynodon dactylon, Chenopodium album , Dacus carota ,Poa annua, Melilotus and Convolvulus arvensis,* and in their respective order of dry matter production. Among the weed management treatments, weed free treatments proved most effective with respect to weed control efficiency followed by pre emergence application of atrazine 0.5 kg/ha recording weed control efficiency of 83.42 and 86.93% during 2009 and 2010, respectively. Pre emergence application of atrazine 0.5 kg/ha also recorded lowest weed density, dry weed weight and resulted in significantly highest grain yields of winter maize to the tune of 39.26 q/ha and 41.26 q/ha and pre emergence application of alachlor 1.5 kg/ha to the tune of 207.56 and 210.56 q/ha during both the years, respectively. Maximum net returns and B: C ratio were recorded with pre emergence application of atrazine 0.5 kg/ha followed by pre emergence application of alachlor 1.5 kg/ha.

## P - 228 Productivity of winter maize + potato intercropping system in sub tropical foothills of Jammu & Kashmir

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A field experiment was conducted on sandy loam soil during the *rabi* 2009-10 and 2010-11 to study effect of weed management practices on growth, yield and weed dynamics of winter maize (*Zea mays* L..) + potato (*Solanum tuberosum* L.) intercropping system in sub tropical region of Jammu. The experiment consisted of four main plot treatments; winter maize (sole), potato (sole), winter maize + potato (additive series) and winter maize+ potato (replacement series) and six sub-plot treatments comprising of weedy check, weed free, alachlor pre 1.5 kg/ha, atrazine pre 0.5 kg/ha, E-post alachlor 2.0 kg/ha and atrazine post 0.75 kg/ha and laid out in split plot design with three replications. The studies revealed that values of land equivalent ratio (LER) and area-time equivalent ratio (ATER) with all the intercropping systems were greater than one indicating advantage in yield over the respective monocultures. All the intercrops with winter maize recorded significantly higher maize- equivalent yield than sole crop and depicting that intercropping of maize with potato was more advantageous than the respective sole crops. Winter maize + potato (additive series) appeared to be biologically most efficient and economically viable system giving the highest maize-equivalent yield (154.46 q/ha and 165.46 q/ha), land equivalent ratio (1.57 and 1.59), area time equivalent ratio (1.30 and 1.32) and relative yield total (1.60 and 1.61) followed by winter maize + potato (replacement series) during 2009 and 2010, respectively.

## P - 229 Inegrated weed management in chickpea

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The field experiment was carried out during the *rabi* season 2010-2011 at the Experimental Farm, Department of Agronomy, Marathwada Krishi Vidyapeeth, Parbhani. Nine treatments comprised of $T_1$-Pendimethalin 0.75 kg/ha (pre-emergence), $T_2$-Trifluralin 1.0 kg/ha (pre-emergence), $T_3$-Imazepthapyr 0.75 kg/ha (post-emergence), $T_4$-Quizalofop-p-ethyl 40 g/ha (post-emergence), $T_5$-Propaquizofop 0.75 kg/ha (post-emergence), $T_6$-One hoeing (30 DAS)+2 hand weedings, $T_7$-Mechanical weeding (2 hand weeding), $T_8$-Weed free (weeding at 20 days for first 80-90 DAS), T9-Weedy check. The treatments were laid out in randomized block design with three replications. The soil of the experimental field was loamy in texture, low in organic carbon and Nitrogen and medium in phosphorus and potassium having pH 8.0 and EC 0.93 $dsm^{-1}$. The chickpea variety Vijay was sown on 20 December, 2010. Nitrogen 25 kg/ha, Phosphorus 50 kg/ha were applied through Urea and SSP as per recommendation. The results indicate that mechanical weeding ($T_{7-}$ Two hand weedings) recorded highest plant height (cm), plant spread (cm), no. of branches, no. of root nodules per plant and dry matter per plant (g) followed by $T_6$-One hoeing (30 DAS)+2 hand weedings, $T_1$-Pendimethalin 0.75 kg/ha (pre-emergence), $T_4$-Quizalofop-P-ethyl 40 g/ha (post-emergence). Among the herbicidal treatments the pre-emergence application of pendimethalin 0.75 kg/ha ($T_1$) was effective in recording higher growth parameters and followed by quizalofop-P-ethyl 40 g/ha (post-emergence) were the best treatments. The highest grain and straw yield was recorded by one hoeing (30 DAS) + two hand weedings ($T_6$) followed by mechanical weeding ($T_7$-2 hand weeding). Thus it is concluded that, for effective weed control and higher return post emergence application of quizalofop-P-ethyl 40 g/ha.

## P - 230 Evaluation of efficacy of post emergence herbicides in soybean in Marathwada region

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The field experiment was carried out during the *rabi* season 2010-2011 at the Experimental Farm, Department of Agronomy, Marathwada Krishi Vidyapeeth, Parbhani. Twelve treatments comprised of $T_1$ -Trifluraline POE 125 g/ha at 15 DAS, $T_2$ -Trifluraline POE 150 g/ha at 15 DAS, $T_3$ -Propaquizafop POE 625 g/ha at 10-12 DAS, $T_4$ -Fenaxaprop-P-ethyl POE 75 g/ha at 10-12 DAS, $T_5$ -Chlorimuron ethyl POE 12 g/ha at 10-12 DAS, $T_6$ -Quizalofop ethyl POE 40 g/ha at 10-12 DAS, $T_7$ - Tank mix (quizalofop ethyl POE 40 g/ha + chlorimuron ethyl POE 12 g/ha) at 20 DAS, $T_8$ - Imazethapyr POE 75 g/ha at 21 DAS, $T_9$ - Pendimethaline PE 750 g/ha + 1 HW at 30 DAS, $T_{10}$ -Weed free check (2 HW + 2 Hoeing) at 3rd and 5th WAS, $T_{11}$ - Farmers practice (1 HW + 1 hoeing) at 30 DAS, $T_{12}$ -Weedy check. The treatments were laid out in randomized block design with three replications. The soil of the experimental field was loamy in texture, low in organic carbon and nitrogen and medium in Phosphorus and potassium having pH 8.0 and EC 0.93/dsm. The chickpea variety *Vijay* was sown on 22 Octomber, 2010. Nitrogen 30 kg/ha, phosphorus 60 kg/ha and potassium 30 kg/ha were applied through urea, SSP and murate of potash as per recommendation. The results indicate that treatment ($T_{10}$) weed free check (2 HW + 2 hoeing at 3rd and 5th WAS) recorded highest seed yield over all other treatment. However, it was at par with ($T_9$) pendimethalin PE 750 g/ha + 1 HW at 30 DAS, ($T_8$) imazethapyr POE 75 g/ha at 21 DAS, ($T_7$) tank mix quizalofop ethyl POE 40 g/ha + chlorimuron ethyl POE 12 g/ha at 20 DAS and significantly superior over rest of the treatments.

## P - 231 Persistence pattern of three pre-emergence herbicides in maize grown on Alfisols in Andhra Pradesh

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Differential dissipation of three pre-emergence herbicides *viz.,* atrazine, pendimethalin and oxyflourfen used in maize was studied in a two-year (2010-11 and 2011-12) field experiment conducted on an Alfisol at College Farm, ANGRAU, Hyderabad. In this experiment, pendimethalin and atrazine were applied at 1.0 kg/ha and oxyflourfen was used at 0.3 kg/ha. All herbicides were applied as pre-emergence herbicide sprays on soil, 24 hours after sowing under optimum usage conditions. Soil samples from 0-10, 10-20 and 20-30 cm depth were collected at 0, 5, 15, 30, 45, 60, 90 days after application and also after harvest. Samples collected from multiple spots in the experimental plot were homogenized and the samples analyzed with GC-ECD. Mean recoveries of the herbicides from soil, studied through fortification with technical standards (2.0 ppm to 0.001 ppm) varied from 85-92% for atrazine, 96-102% pendimethlin and 86-90% for oxyflourfen. LOQ values for oxyflourfen, atrazine and pendimethalin were 0.05 ppm, 0.05 and 0.01 ppm respectively. During both the years, dissipation of the all the herbicides was biphasic, with first 50 % of the initial detected amount dissipating more rapidly than the remaining soil residue. Among the three herbicides, oxyflourfen was more persistent compared to the other two other herbicides and the residues of atrazine persisted for shortest period. The $DT_{50}$ for atrazine was varied from 19.2 to 24.2 days and the residues persisted up to 45 days beyond which they reached BDL. Pendimethalin residues persisted up to 60 days after application, when 4.9 % of the initial detected amount was noticed. Oxyflourfen's $DT_{50}$ was 36.8 to 43.2 days during two years and the residues could be detected up to 90 days after application. Residues of any of the pendimethalin and oxyflourfen could not be detected in the samples of 20-30 layers indicating their limited leaching potential.

## P - 232 Effect of pendimethalin and imazethapyr on nodulation and nitrogen fixation and pod yield in groundnut

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A field experiment was conducted to study the effect of pendimethalin and imazethapyr on pod yield, nodulation and biological nitrogen fixation in groundnut during the *kharif* 2011 at College Farm, College of Agriculture, Rajendranagar, Hyderabad. The experiment consisted of two main plots and five sub-plots replicated thrice in split plot design. *Rhizobium* inoculation and uninoculation as main treatments and five sub treatments *viz.,* no herbicide treatment (weedy check), pendimethalin at recommended dosage (750g/ha), at double the recommended dosage (1500g/ha), imazethapyr at recommended dosage (75g/ha) and double the recommended dosage (150 g/ha). The total number of nodules and active nodules increased with the crop growth upto 60 DAS. Innoculation with *Rhizobium* has significantly influenced (32% over uninnoculated at 45 DAS and 6.8% at 60 DAS) the total number of nodules throughout the crop growth period irrespective of the herbicide treatments and its dosage. Number of active nodules also increased (41.78% over uninnoculated at 45 DAS and 6.9% at 60 DAS) in *Rhizobium* inoculated treatments indicating its beneficial influence. Nitrogen fixation studied by acetylene reduction assay indicated that influence of double dose of pendimethalin on nitrogen fixation was not significant compared to recommended dose. Imazethapyr at double the recommended dose (150 g/ha) resulted in significant reduction in active nodule number and nitrogen fixed. At recommended dose the imazethapyr affected nodule formation and nitrogen fixation but the effect was transient. Mean Groundnut yield in inoculated plots was 6.9% higher (2150 kg/ha) than the uninoculated treatments. Highest groundnut yields recorded in Imazethapyr 75g/ha treatment indicated its efficient weed control over all the treatments.

## P - 233 Effect of time of sowing and weed management on yield of direct seeded rice

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The field experiments were conducted during *kharif* 2010 and 2011at the Agricultural Research Station, Kathalagere, Davanagere District. The experiment was laid out in a split plot design replicated three times by allotting time of sowing (before and after onset of monsoon) treatments to the main plots and weed management practices like W1 - pretilachlor + safener at 0.5 kg/ha at 5 DAS, W2 – azimsulfuron 50% G 35 g/ha at 20 DAS, W3 - chlorimuron ethyl 10 WP + metsulfuron methyl 10 WP (Almix 20 WP) at 4 g/ha at 20 DAS, W4 – cyhalopfop-p-butyl 10 EC 90 g + 2,4-D Na salt 80 WP 0.5 kg/ha at 30 DAS, W5 - butachlor 1.5 kg/ha - pre – emergence – 5 DAS + 1 hand weeding (30 DAS), W6 - hand weeding (20 and 45 DAS) and W7 - unweeded control to subplots. Major weed flora observed in the experimental plots was *Fimbristylis miliacea, Cyperus difformis, Scirpus* sp*, Panicum tripheron, Echinochloa colona, Ludwigia parviflora, Marselia quadrifoliata, Dopatrium junceum, Eclipta alba Spilanthus acmella* and *Rotala verticillaris.* Averaged over 2010 and 2011, the paddy yield (4512 to 4504 kg/ha) did not differ between time of sowing. Among weed management practices, hand weeding twice gave higher paddy yield (5337 kg/ha), followed by application of butachlor + hand weeding (5057 kg/ha), while other herbicides, except cyhalofop—p-butyl + 2,4-D sodium salt, gave similar yields (4681 to 4744 kg/ha). Use of herbicides lowered the cost of weeding by Rs.3350/ha in butachlor + hand weeding to Rs.5450/ha in chlorimuron ethyl + metsulfuron methyl over hand weeding and thus lowering the cost of production. Marginal gross returns was higher in hand weeding (Rs.64,142/ha), followed by herbicides (Rs.53,765 to 60,873/ha) over unweeded control.

## P - 234 Integrated weed management in tomato in southern telangana zone of Andhra Pradesh

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A field experiment was conducted at College of Horticulture, Rajendranagar, Hyderabad, ANGRAU during *rabi,* 2010-11 to study the effect of integrated weed management involving pre and post emergence herbicides and their combinations integrated with hand weeding on growth and yield of tomato cv. *Arka Vikas*. The experiment was carried out in randomized block design with 13 treatments *viz.,* pendimethalin (PE) 1.0 kg/ha, pendimethalin (PE) 1.0 kg/ha + hand weeding at 30 DAT, pendimethalin (PE) 1.0 kg/ha + quizalofop ethyl 50 g/ha (POE), metribuzin (PE) 0.5 kg/ha, metribuzin (PE) 0.5 kg/ha + hand weeding at 30 DAT, metribuzin (PE) 0.5 kg/ha + quizalofop ethyl (POE) 50 g/ha, oxadiargyl (PE) 100 g/ha, oxadiargyl (PE) 100 g /ha + hand weeding at 30 DAT, oxadiargyl (PE) 100 g/ha + quizalofop ethyl (POE) 50 g/ha, quizalofop ethyl (POE) 50 g / ha, quizalofop ethyl (POE) 50 g/ha + hand weeding at 30 DAT, farmers practice of hand weeding at 20 and 40 DAT and unweeded control. Among the different weed management practices, application of metribuzin (PE) 0.5 kg/ha + hand weeding at 30 DAT recorded significantly highest weed control efficiency (WCE). The lowest weed index (WI) (5.30%) was recorded in farmers practice of hand weeding at 20 and 40 days after transplanting. Among the different weed management practices, metribuzin (PE) 0.5 kg/ha + hand weeding at 30 DAT produced significantly tallest plants, higher dry weight of tomato plants, higher average fruit weight (86.22 g) and higher fruit yield (30.33 t/ha). Application of metribuzin (PE) 0.5 kg/ha + quizalofop ethyl (POE) 50 g/ha recorded lowest number of days for flower initiation and 50% flowering.The nutrient (N, P and K) uptake was significantly highest (128.40, 30.26 and 139.51 kg/ha N, P and K respectively) with application of metribuzin (PE) 0.5 kg/ha + hand weeding at 30 DAT. Among the different integrated weed management practices the net returns (Rs. 100735/ha) and B: C ratio (1.98) were significantly higher with the pre emergence application of metribuzin 0.5 kg/ha + hand weeding at 30 DAT.

## P - 235 Integrated weed management in jute

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Conventional manual weeding in jute, consumes around 40 percent of the total cost of cultivation and its yield reduction isup to 70% under unweeded situations. From experiments conducted at CRIJAF, Barrackpore, WB, following integrated approaches of weed control in jute were found relevant under different socio-economic situations. Green gram cultivar, Pant mung-5, Pant mung-4 and RMG-62 when grow as inter crop (1:1) with jute (30-35 cm spacing, cv. JRO-204) suppressed weeds growth from 40-50% by smothering and produced 42-49 quintal equivalent jute fibre yield over 41 q/ha from manual weeding twice. It was sown with butachlor 1.0 kg /ha for grass control. This system produced pulse waste up to 2t/ha.Butachlor (50%EC and 5G) 1-2.0 kg/ha or pretilachlor (50%EC) 0.80 to 1.0 kg/ha (within 24 to 48 hours of sowing following good rain or irrigation) and one hand weeding (HW) yielded 36 to 40 q jute fibre/ha. Pretilachlor effectively controlled *Trainthemaspp*in jute. Propaquizafop10%EC 150 g/haand clodinafoppropagryl 100g/haat 15 DAS and one HW controlled weeds in jute and yielded 32-41.3qfibre/ha. Quizalofop-ethyl 5% EC 60g/ha and one HWproduced fibre upto 40 q/ha. Glyphosate and paraquat (1.5 kg SL/ha +0.25 kg SL/ha) were applied by CRIJAF Herbicide Applicator in between jute rows to control composite weed florain jute which yielded 36-38q fibre /ha andwas found cheaper. CRIJAF Nail Weederat 4-5 DAS controlled 80 to 85% of composite weeds floraand yielded fibre upto 42 q/h. Itacted as soil mulching tool and was cheaper than manual weeding. Provisions are here to attach other available tynes and scrappers with it.

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# Integrated weed management options for *rabi* groundnut in Andhra Pradesh

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A field experiment was conducted during *rabi* 2008-09, at College Farm, College of Agriculture, Rajendranagar, Hyderabad, to study the effect of pre, post emergence herbicides and integrated practices on weed control, growth, yield and economics of groundnut. The experiment was laid out in a randomized block design with three replications. There were twelve treatments *viz.,* control (no weeding), hand weeding twice, intercultivation at 20 DAS with star weeder, intercultivation at 20 DAS with star weeder followed by (*fb*) hand weeding at 40 DAS, pre emergence application of pendimethalin 1.0 kg/ha, post emergence application of imazethapyr 100 g/ha, post emergence application of quizalofop-p-ethyl 50 g/ha, pendimethalin *fb* imazethapyr, pendimethalin *fb* quizalofop-p-ethyl, pendimethalin *fb* handweeding at 40 DAS, imazethapyr *fb* handweeding at 40 DAS and quizalofop-p-ethyl *fb* handweeding at 40 DAS. Three species of grasses, one species of sedge and twelve species of broad leaved weeds were identified and they belonged to 10 families of which *Parthenium hysterophorus* being predominant. Among the weed control treatments, hand weeding twice (20 and 40 DAS), intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS, pendimethalin 1.0 kg/ha as PE *fb* hand weeding at 40 DAS, imazethapyr 100 g/ha at 20 DAS *fb* hand weeding at 40 DAS and pendimethalin 1.0 kg/ha as PE *fb* imazethapyr 100 g/ha at 20 DAS were effective against all types of weeds and also gave higher weed control efficiency. Plant height and LAI were higher with hand weeding twice (20 and 40 DAS) which was comparable with intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS, pendimethalin 1.0 kg/ ha as PE *fb* hand weeding at 40 DAS and higher dry matter production with hand weeding twice (20 and 40 DAS), pendimethalin 1.0 kg/ ha as PE *fb* hand weeding at 40 DAS, imazethapyr 100 g/ha at 20 DAS *fb* handweeding at 40 DAS and pendimethalin 1.0 kg/ha as PE *fb* imazethapyr 100 g/ha at 20 DAS which were on par with each other. The total number of pods per plant, filled pods per plant, pod weight per plant, 100 pod weight, 100 kernel weight and shelling percentage were more with hand weeding twice (20 and 40 DAS), intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS, imazethapyr 100 g/ha at 20 DAS fb handweeding at 40 DAS, pendimethalin 1.0 kg/ha as PE *fb* hand weeding at 40 DAS and pendimethalin 1.0 kg/ ha as PE *fb* imazethapyr 100 g/ ha at 20 DAS and also these treatments are followed similar trend in pod yield the range between 1649-1754 kg/ ha and haulm yield (ranged 2400-2439 kg /ha). The lower nutrient uptake by weeds and higher amount of uptake by the crop in hand weeding twice (20 and 40 DAS) and intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS over the other treatments. The higher N status and lower P and K status of the soil in the treatments hand weeding twice (20 and 40 DAS), intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS, imazethapyr 100 g/ha at 20 DAS fb handweeding at 40 DAS, pendimethalin 1.0 kg / ha as PE *fb* hand weeding at 40 DAS and pendimethalin 1.0 kg/ha as PE *fb* imazethapyr 100 g/ha at 20 DAS over the other treatments. Net returns was highest with intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS (Rs.24777/ha) which was comparable with pendimethalin 1.0 kg /ha as PE *fb* hand weeding at 40 DAS (Rs. 24436/ ha), hand weeding twice at 20 and 40 DAS (Rs. 24235/ha), imazethapyr 100 g/ha at 20 DAS *fb* handweeding at 40 DAS (Rs. 23940 /ha) and pendimethalin 1.0 kg/ha as PE *fb* imazethapyr 100 g/ha at 20 DAS (Rs. 23935/ha). The higher benefit cost ratio (Rs. 1.77) with pendimethalin 1.0 kg / ha as PE *fb* imazethapyr 100 g/ha at 20 DAS which was comparable with pendimethalin 1.0 kg/ha as PE *fb* hand weeding at 40 DAS (Rs. 1.72) and intercultivation with star weeder at 20 DAS *fb* hand weeding at 40 DAS (Rs.1.71) treatments.

## P - 237 Effect of varying planting methods and weed control measures in rainfed lowland rice of eastern Uttar Pradesh

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A field experiment was conducted at demonstrational farm of Krishi Vigyan Kendra, Kotwa, Azamgarh during rainy season of 2008 and 2009 to evaluate the comparative efficacy of various planting methods and weed control measures on weeds and growth, yield attributes, grain yield and economics of rice (*Oryza sativa* L.) *var. Godawari*. Four main rice establishment techniques (direct dry seeded rice, direct drum seeded rice, unpuddled transplanted rice and puddled transplanted rice) were comprised with six sub plot weed control practices (weed-free, weedy check, mechanical weeding twice, pretilchlor 750 g/ha pre emergence), pretilchlor 750 g/ha supplemented with mechanical weeding at 25 DAS/DAP and Pretilchlor 750 g/ha combined with cyhalofopbutyl 60 g/ha post emergence) was laid out in split plot design & replicated thrice. The *Echinichloa colona*, *E. crus-galli*, *Cyperus rotundus*, *C. difformis* and *Commelina benghalensis* were predominant weed species. Among the rice establishment techniques, puddled transplanted practices proved best for reducing weed dry matter accumulation and produced significantly highest mean grain yield (38.9 q/ha) along with yield contributing parameters in comparison to rest planting methods. Direct drum seeded rice under puddled condition were observed to be significantly superior and recorded 7.15 q/ha more mean grain yield over direct dry seeding. Application of pretilachlor 750 g/ha pre emergence followed by cyhalofopbutyl 60 g/ha post emergence at 25 DAS/DAP was found quite effective against mixed weed flora which recorded statistically similar grain yield to that of repeated hand weedings. The integration of herbicide with tools *viz.,* pretilachlor 750 g/ha supplemented with mechanical weeding at 25 DAS/DAP again found equally effective in increasing the grain yield as pre and post emergence applied herbicides.

## P - 238 Studies on post-emergence herbicides for weed control in wheat

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The field investigation was conducted during *rabi* season 2009-10 at the Experimental Farm, Department of Agronomy, Marathwada Krishi Vidyapeeth, Parbhani with a view to study the efficacy of post-emergence herbicides, effect of herbicides on growth and yield of wheat and to work out the economics of herbicidal treatments.The experiment was laid out in randomized block design. The experiment was carried out with ten treatments which are $T_1$ – Pendimethalin PE 750 g/ha, $T_2$ – Carfentrazone PoE 25 g/ha, $T_3$ – Fenoxaprop PoE 120 g/ha, $T_4$ – 2, 4-D Na salt PoE 750 g/ha, $T_5$ – Metasulfuron methyl PoE 4 g/ha, $T_6$ – Metribuzin PoE 300 g/ha, $T_7$ – Fenoxaprop + metribuzin PoE 90 + 140 g/ha, $T_8$ – Weed free, $T_9$ – Two hand weedings and $T_{10}$ – Weedy check. Each experiment unit was repeated three times of 5.4 m x 6 m gross plot size and having 3.6 m x 4.2 m of net plot size. The experimental field was leveled and well drained, clayey in texture, medium in available nitrogen, phosphorus and high in available potassium. Variety of wheat used for experimental study was *NIAW-301* (Trimbak). Sowing was done manually on 2nd December, 2009. On the basis of present studies taking in to consideration the intensity of weeds in *rabi* season and the extent of damage by them in wheat it could be stated that either weed free or metsulfuron methyl PoE 4 g/ha or metribuzin PoE 300 g/ha can satisfactorily manage the weeds in wheat and produce higher yield of wheat. Metsulfuron methyl PoE 4 g/ha was beneficial for net monetary returns followed by metribuzin PoE 300 g/ha. Therefore metsulfuron methyl PoE 4 g/ha or metribuzin PoE 300 g/ha may be used for weed management in wheat.

## P - 239 Cadmium, nickel, copper and manganese extracting potential of water weeds of Jabalpur

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The pollution by heavy metals is serious concern for surface water and ultimately for animal and human health. Huge volume of water from human habitation is discharged daily through open ditches part of which find its way to the surface water bodies in Jabalpur. The investigation was therefore carried out to assess the water quality and metal extracting potential of weeds including *Eicchornia crassipes, Alternanthera philoxeroides* and *Canna indica* grown in various ponds of Jabalpur. It was observed that among water quality parameters pH and EC of pond water were within the permissible limits whereas the chloride content was observed above the permissible limit at Mahanadda, Ranital and Gullowa pond. The sequence of heavy metal concentrations in water were Fe > Cd > Mn >Ni >Cu. Among the weeds, *Eichhornia crassipes* retained higher concentrations of cadmium, nickel, copper and manganese than other weed species. However, lower transportation of metals were recorded in shoot part of *Eichhornia crassipes.* Conversly, *Alternanathera philoxeroides* transported higher concentration of cadmium, nickel, copper and manganese from roots to shoots than *Eichhornia crassipes* (water hyacinth) and *Canna indica*. Having metal extracting ability, *Alternanthera philoxeroides* can be applied for phytoextraction of heavy metals from the contaminated sediment of surface water bodies.

## P - 240 Influence of rice crop establishment methods and weed management practices on succeeding zero till maize

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A field experiment conducted for two consecutive years (*kharif* and *rabi* seasons of 2010 -11 and 2011-12) to suggest suitable weed management package to rice-zero till maize cropping system at college farm, ANGRAU, Hyderabad. The experiment was laid out in split plot design during *kharif* and double split during *rabi* with three replications. The main plots consist of crop establishment methods *viz.,* system of rice intensification, direct sowing of sprouted seeds and transplanting. The sub plots consists of four weed management practices *viz.,* bensulfuron methyl + pretilachlor (6.6%G) 10 kg/ha product as pre emergence application at 3 DAS/DAT followed by mechanical weeding at 25-30 DAS/DAT, bispyribac-sodium 25g/ha as post emergence application at 15-20 DAT, farmer's practice (conoweeding in SRI, hand weeding in direct sowing and transplanting) and weedy check. During *rabi*, weed management practices in maize were weedy check, atrazine 1.0 kg/ha at 2 DAS, atrazine 1.0 kg/ha followed by topramezone application 30g/ha at 30 DAS and weed free. The predominant weed flora observed are *Ammania baccifera, Eclipta alba, Ludiwigia parviflora,Cyerus difformis, Cyperus iria, Echinochloa crusgalli, Echinochloa colonum*, The results revealed that application of bensulfuron methyl + pretilachlor (6.6%G) 10 kg/ha application 3 DAS/DAT + mechanical weeding at 25-30 DAS/DAT was found most effective against sedges, graases and broad leaf weeds and recorded significantly higher grain (5.67t/ha) which was closely followed by farmer's practice (5.8t/ha). Among rice establishment methods transplanting recorded higher grain yield compared to other establishment methods. There is no significant effect of weed management practice on zero till maize. In maize atrazine 1.0 kg/ha + topramezone 30g/ha effectively controlled the weeds and resulted in higher yield (6.2t/ha)

## P - 241 Performance of *Arundo* based bioremediation technique for removal of inorganic contaminants in drain water

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Agriculture has been victim and cause of soil and water pollution. It is victim in respect of entering heavy metals in food and animal chain through crops irrigated with untreated drain water emanated from sewage and industrial sources. Intensive agriculture has also become the cause of water pollution by transport of agro-chemicals such as nitrates, phosphates from contaminated field to down site water bodies deteriorating its water quality. The removal of contaminants by macrophyte treatment of polluted water at source is easier than from sites where these get accumulated by adsorption. To cope up with these concerns weed assisted bioremediation facility has been developed at DWSR. The system consisted of pre-treatment overhead settling zone and treatment zone having three pairs of sequential tanks (3 x 2 x 0.75m). The fast growing *Arundo* is planted hydroponically in first pair of tanks and in porous media in surface and sub-surface tanks. The polluted water from waste water carrying drain is injected into pre-treatment overhead tanks and after settling of solid particles at bottom, the water is directed through sequential treatment tanks. The water samples collected from the system analyzed for nitrates, phosphates and heavy metals after treatment in bioremediation system. It was observed that extensive root system (110-134 cm in length) was developed in hydroponically grown tanks. The average density of plant grown in surface and subsurface tanks was 172.3/ $m^2$. As far as water flow through porous media is concerned, no clogging has been occurred resulting free discharge of water through gravity flow on irrigation plots. The concentration of total soluble salts (TSS), nitrate, copper, nickel, zinc and manganese were reduced to the extent of 64.0, 88.4, 69.3, 62.4, 78.0 and 61.7 per cent respectively in treated water as compared to untreated drain water. Thus based on performance, *Arundo* based treatment system has indicated its usefulness for removal of heavy metals prior to irrigation use. Reduction of various contaminants in treated water also has implications for protection of pond water quality from drain water contamination where aquaculture is practiced.

## P - 242 Influence of varieties and weed management practices on growth and yield of rice under SRI culture

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A field study was undertaken during *kharif* season of 2011 to assess the influence of varieties and weed management practices on growth and yield of rice under SRI culture. The treatments include three varieties [(*JR 201* (short duration), *Kranti* ( medium duration) and *Pusa Basmati* (long duration)] and five weed management practices (Conoweeder Alone, herbicide alone (bispyribac-sod. 25g/ha PO- 15 DAS/DAT), herbicide (pretilachlor 750 g/ha 3-7 DAS/DAT) + conoweeder, 2 handweeding and weedy check). Rice field was infested with *Echinocloa colona*, *Caesulia axillaris*, *Alternanthera sessilis* and *Mecardonia procumbens*. Results revealed that there was significant effect of main treatment, sub treatment and their interactions. The maximum yield was observed in varity *Kranti* (3725 kg/ha) which was significantly superior over *JR201* (1986 kg/ha) and *Pusa Basmati* (1862 kg/ha). Among Weed management practices the maximum yield was observed with 2 Hand weeding (2693 kg/ha) which was at par with herbicide alone (bispyribac-sod. 25 g/ha PO- 15 DAS/ DAT) (2680kg/ha), conoweeder alone (2667 kg/ha), herbicide (pretilachlor 750 g/ha 3-7 DAS/DAT) (2454 kg/ ha) and all were significantly superior over control (2113 kg/ha). Interaction effect of both the treatments was significant and maximum yield (4164 kg/ha) was recorded with *Kranti X* conoweeder alone and was at par with *Kranti* X herbicide alone (bispyribac) (4018 kg/ha) and was significatly superior over all other the treatments.

## P - 243 Bioherbicidal potential evaluation of allelochemicals – a case study of tropical soda apple seed allelochemicals

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The natural products and their relatives have been viewed as sources of potential environment-friendly herbicides, though spectacular successes in this area are still awaited. Plants have several constituents including secondary metabolites belonging to various chemical classes. There is rising interest in exploring plant constituents for use as an herbicide in crops. The present investigation reports bioherbicidal potential evaluation of allelochemicals – a case study of tropical soda apple (*Solanum viarum* Dunal) seed allelochemicals. The allelochemical crude was prepared, its constituents were solubilized in different solvents, and further fractionated to chemical classes of phenolics, alkaloids and terpenoids using chemical class specific chromatography. At each step the fractions showing herbicidal activity on the target were taken up for further investigations. Using the fraction isolation, herbicidal activity verification and further fractionation approach, none of the six phenolic fractions was found toxic to a representative test floating weed water lettuce (*Pistia stratiotes* L.) and submerged weed coontail (*Ceratophylum demersum* L.) individually or in combinations up to 100 ppm. Out of five terpenoids isolated, second and fourth fractions (from origin in thin layer chromatography) were lethal to coontail at 100 ppm. All the fractions combined at 15 ppm were lethal to coontail. The alkaloid fraction comprised of four components, of which fourth fraction was lethal to coontail at and above 100 ppm. This fraction comprised of two components. The components are being isolated in larger quantities for further work.

## P - 244 Assessment of cyhalofop-p-butyl leaching in sandy clay soil and identification of secondary metabolites in soil and leachates by LC/MS/MS

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Field experiment was conducted during June-September 2011 to assess leaching behaviour and movement of cyhalofop-p-butyl in sandy clay loam soil. Leaching behavior of cyhalofop-p-butyl was evaluated in lysemeters of 1 to 3-metres depths that received rainfall of approximately 1358 mm under field conditions. Cyhalofop-p-butyl was sprayed at 90 and 180 g/ha on to the lysimeter under field conditions and allowed to receive natural rain. After every rain leachates were collected and analyzed for cyhalofop-p-butyl residues. cyhalofop-p-butyl residues were evaluated in the soil at various depth viz. 0-25, 25-50, 50-75, 75-100, 100-125, 125-150, 150-175, 175-200, 200-225, 225-250 and 250-275 cm to see the movement of cyhalofop-butyl in soil and to predict possible risk of ground water contamination under natural rains infield conditions. Residues of cyhalofop were detected in significant amount from the soil at various depths upto 10 days. After 10 days three major metabolites of cyhalofop *viz.,* cyhalofop acid, diacid, and phenol were detected from leachates and soil at various depths which were identified by HPLC and characterized by LC/MS/MS. Cyhalofop residues were higher in the leachates of 1-metre depth lysemetre as compared to 2 and 3-meter lysemeters. Cyhalofop residues were higher in surface soil. Increase in pH of the leachates from 7.20 to 9.52 was noticed after one month which showed movement of cyhalofop through soil profile. EC of leachates (water samples) was high (1757 µS/cm) in the initial leachates (5-days after application of cyhalofop) of 1, 2 and 3 metres lysemetres and decreased slowly in leachates collected later to 1018 µS/cm and to approximate 752 µS/cm after one month of soil column after cyhalofop application.

## P - 245 Evaluation of *Hyptis suaveolens* as an additive in polyfilms and hand made paper

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*Hyptis suaveolens* Poit, a member of Lamiaceae family considered as a potent waste land weed in India. However, *Hyptis* also has good medicinal value owing to the presence of essential oil. It is known to be used in several traditional medicine in folklore for the treatment of various illnesses and has been found to possess significant pharmacological applications. It is also a potential source of polysaccharide –mucilage and lingo-cellulosic material. In this work, we have explored the compatibility of *Hyptis* seeds polysaccharide with biopolymer- starch and in preparation of recycled paper. Starch-based films were prepared by casting technique. Films were prepared using suspension of plasticizer, starch and lignin isolate of weed *Hyptis*. Solubility and swelling percentage of films were tested in different solvents *viz.,* water , hexane ,oil ,acid (1NHcl) and alkali ( 1N NaOH). Mechanical properties i.e. tensile strength, the percentage elongation at break and young's modulus of films were found to be 15.38M Pa, 7.9% and 655.2, respectively. Films showed only 0.87% swelling in water while no solubility was observed in hexane and acid after 24 hours. Results indicated that films have good strength, compared with films without lignin isolate as additive and low solubility as well as swelling power. Similarly, mixing of *Hyptis* seeds with paper pulp also enhanced the strength of recycled paper. Study revealed that *Hyptis* is a potential source of polysaccharides which can be utilize as an additive in polymeric materials to change the properties of according to their applications.

## P - 246 Dissipation of oxyflourfen in soil and its residue analysis in rice crop at harvest

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Oxyfluorfen {4-[2-chloro-4-(trifluoromethyl)phenoxy]-2-ethoxy-1-nitrobenzene} is a member of diphenyl-ether group of chemistry of herbicide, commercially available as goal, oxygold in 23.5 EC and 0.35GR formulations. It is selective pre-emergence and post-emergence herbicides, used primarily to control broadleaf weeds, some grasses and sedges and used in crops like wheat, onion, tea, groundnut, cauliflower, cabbage, direct sown and puddled rice *etc.* Oxyfluorfen acts by free radical formation via inhibition of protoporphyrinogen oxidase (Protox), which is the enzyme that converts protoporphyrinogen IX to protoporphyrin IX and induces necrosis in treated plants. It is used at 100-240 g/ha. Study was undertaken under field condition for the persistence of oxyflourfen in soil of Tarai region of Uttarakhand. Soil was rich in clay per cent with high per cent of organic carbon. Oxyflourfen was applied as pre emergence herbicide on transplanted rice crop at recommended (240 g/ha) and double recommended (480 g/ha) doses. Soil samples of 0 – 15 cm depth were collected from each plots from the day of treatment at different time intervals till harvest time while rice crop were taken at harvest. Soil was extracted with methanol: acetonitrile solution mixture dried and subjected for cleanup. HPLC conditions were Column: $C_{18}$ ODS -2, Mode: Isocratic, Mobile phase: acetonitrile: water [60: 40 v/v], Flow rate: 1 ml/min, Detector UV at 210 nm, injection volume 20 ml. The retention time of oxyfluorfen was 4.2 min. The recovery of oxyflourfen from straw, grain and soil samples varied from 81.0-84.5, 82.6-86.2, and 86.1-90.4 % respectively. Oxyflourfen persisted in soil upto 60 days for both doses after which it was below detectable. Dissipation of oxyflourfen followed first order kinetics. At harvest oxyflourfen residues were below detectable limit in soil, rice grain and rice plant/straw. The limit of detection of oxyflourfen was 0.005µg/g of soil.

## P - 247 Evaluation of penoxsulam for weed control in transplanted rice in Kuttanad

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The weed population in transplanted rice is generally considered low compared to direct seeded rice but becomes a menace during the Puncha (*rabi*) season (November-December to February- March) when continuous submergence is not possible due to less availability of water. The highly fertile below sea level rice ecosystem in Kuttanad is conducive for the growth and establishment of different category of weeds including *Echinochloa, Isachne, Cyperus, Fimbristylis, Monochoria, Ludwigia and Sphenoclea*. A broad spectrum low dose herbicide controlling all the major weeds in a single application is recognised as an effective strategy for efficient and economic weed control. The chemical penoxsulam 24 SC was evaluated for its efficacy as a promising pre emergence and early post emergence herbicide in transplanted rice during *rabi* 2007-08 and *rabi* 2008-09 at Rice Research Station, Moncompu. The treatments included two doses of this chemical 0.0225 and 0.0250 kg /ha as pre emergence and two doses 0.020 and 0.0225 as early post emergence, Butachlor 1.0 kg /ha as pre emergence, weed free check, hand weeding twice and an unweeded control. The pooled analysis of the data for two seasons indicated that penoxsulam was effective for both pre and early post emergence weed control. The grain yield obtained for all the doses of the herbicide were on par with weed free check and hand weeding twice. Among the treatments, penoxsulam 24 SC 0.020 kg/ha recorded the highest grain yield (6608 kg/ha) and weed control efficiency (63%) and could be recommended as an early post emergence(8-12 DAT) herbicide for effective weed control in transplanted rice in Kuttanad.

## P - 248 Degradation of chlorimuron ethyl by *aspergillus* niger isolated from rice rhizospheric soil

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Chlorimuron-ethyl, ethyl 2- (4-methoxy-6-chloro-pyrimidin-2-yl) amino] carbonyl] amino] sulfonyl] benzoate, is a post emergence herbicide for the control of important broad leaf weeds in soybean and maize. Though it is degraded in the agricultural environment primarily via pH and temperature dependent chemical hydrolysis, microbial transformation has also an important role to degrade this compound. Present studies were undertaken to assess the fate of chlorimuron ethyl under the action of fungi isolated from agricultural soil. Fungi like *Fusarium* and *Alternaria* could not survive in the artificial media containing chlorimuron ethyl at the level of 25mg $L^{-1}$. The only fungus sustained in that media is characterized as *Aspergillus niger*. This fungus can even survive in the minimal broth having chlorimuron at the level of 50mg per 200mL media. *Aspergillus niger* degrades the herbicide to harvest energy through two major routes of degradation. One route involves the cleavage of sulfonylurea bridge resulting in the formation of two major metabolites, *viz.,* ethyl-2-aminosulfonyl benzoate (I) and 4-methoxy-6-chloro-2-amino-pyrimidine (II). The other route is the cleavage of sulfonylamide linkage, which forms the metabolite *N*-(4-methoxy-6-chloropyrimidin-2-yl) urea (III). Two other metabolites, saccharin and *N*-methyl saccharin, formed from the major metabolite-II, were also identified. Thus, a metabolic pathway for the degradation of chlorimuron by *Aspergillus niger* has been proposed. These findings reveal that the enzymes involved in these transformations can be characterized and utilized to decontaminate soil and water from chlorimuron contamination.

## P - 249 Relative weed seed counts density in transplanted rice

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The field experiments were conducted at Krishi Nagar, Research Farm, J.N. Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during 2010-2011 and 2011-2012 in *kharif* seasons. Experiment to compare relative weed seed counts density (RWSD) in transplanted rice upto 0- 15cm soil depth. The trails were laid out in split plot design with six main plots, three subplots and three replications. The main plots having 6 post emergence herbicides Bispyribac sodium ($H_1$), Penoxsulam ($H_2$), Pyrazosulfuron ($H_3$), Cyhalofop + Almix ($H_4$), Fenoxaprop + Almix ($H_5$) and one control plot ($H_6$). The sub plot having three time of applications $T_1$- morning (8 am to 9 am), $T_2$- afternoon (12 noon to 1 pm) and $T_3$-evening (4 pm to 5 pm). The weed seed counts were studied under the experiment. Soil samples of 0.50 kg by weight taken with the help of core auger at 0-15cm soil depth from each treatment plot at 7, 21, 35, 60 and 90 days after herbicidal application (DAH). After that the weed seed counts were summed up of different staged and the RWSD were studied. The study reviled that the RWSD was highest in *Fimbristylis miliacea* (11.23%) followed by *Cyperus spp.* (11.00%) and *Alternenthra spp.* (9.07%). The lowest weed seed counts density was lower in case of *Cynodon dectylon* (5.49%) and *Paspalam distichum* (5.01%). The weed seed count density of *Echinochloa colona* (8.85%), *Ludwigia perennis* (8.25%), *Ammania baccifera* (7.70%), *Lindernia crustacean* (7.09%), *Eclipta alba* (6.92%), C*isolea auxillaris* (6.91%), *Spilanthes calva* (6.28%), and *Eragrostis tenella* (6.20%) was found in descending order. The weed seed counts were differ significantly in all plots by the application of the post emergence herbicides over control plot. There was higher weed seed counts found in control plot (1285.72/kg of soil) and Bispyribac sodium treated plot (682.07/ kg) and lower counts in pyrazosulfuron (350.19/kg of soil) treated plot upto 0-15cm of soil depth in all the stages (7, 21, 35, 60 and 90 DAH).

## P - 250 Consequence of long term herbicidal application on beneficial soil microflora, soil respiration and soil enzyme activities in maize rhizosphere

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Weed is one of the most severe pests, which can be controlled very effectively through integrated mode of approach. However, the impact of these weed management practices especially the application of chemicals herbicides on soil biological activities is a major concern. Hence, a field experiment was conducted at Main Agricultural Research Station at University of Agricultural Sciences, Dharwad during *kharif* in order to study the effect of weed management practices on total $N_2$ fixers, mineral phosphate solubilising (MPS) microorganisms, soil respiration and soil enzyme activities *viz.,* dehydrogenase and phosphatase. The results of the investigation revealed that the highest free living nitrogen fixers were recorded in the plot received two hand weeding at 30 and 60DAS, while lowest population was observed with atrazine 1.00 kg/ha as pre emergent spray. Similar results were also recorded on the 60$^{th}$ day. However, on 90$^{th}$ day the population of free living nitrogen fixers improved in the treatment with atrazine 1.00 kg/ha, which is statistically on par with mechanical weeding. Significantly higher MPS microbial load was observed with mechanical weeding compared to the treatments received pendimethalin at both the levels on all the three intervals. The dehydrogenase activity was maximum with the plots received mechanical hand weeding on 30, 60 and 90 DAS .Similar trend was noticed with respect to phosphatase and soil respiration. However, the present investigation on the above mentioned parameters on 90$^{th}$ day have revealed that the results obtained with recommended dose herbicides were found to be on par with the treatment received mechanical weeding.

## P - 251 Release and establishment of Mexican beetle *Zygogramma bicolorata* for biological control of Parthenium in Nagpur region

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*Parthenium hysterophorus*, an alien weed of Mexico origin has now widely spread in India. It has emerged as one of the most troublesome weeds in the country. Recent nation wide survey in India revealed Parthenium presence throughout the country in about 35 million hectares of land. The weed is defamed to cause detrimental effect on the health of human and animals. In Human beings, it causes allergic contact dermatitis and several other skin diseases. Parthenium has infested large rural area in Nagpur region. It has infested all the crop and fields particularly of cotton and soybean besides infesting orange orchards. Keeping in view to reduce chemical load in the environment and the public demand for its biological control, District Agriculture office of Maharashtra Agricutrual Department at Nagpur launched a scheme to release Mexican Beetle for biological control of Parthenium in collaboration with Directorate of Weed Science Research Jabalpur. About 2.2, 2.8 and 2.5 millions of beetles were released in different villages under different talukas of Nagpur region during 2009, 2010 and 2011, respectively. Release of adult beetles was targeted on the road side, on the bank sides of water canals, river sides, wasteland and community land badly infested with Parthenium. After release of bioagent, observations were taken about the establishment of the beetle and their impact in suppression of Parthenium. Population samples of bioagents taken from the released sites revealed its mild occurrence during August to Ocotober in 2009 which increased many folds in the year 2010 during rainy season. But by year 2010, the presence and impact of the bioagent was not impressive, however, there were evidences of bioagent establishment in the areas where the bioagent was released. Survey carried out in September 2011 in different villages of Kamti, Mauda, Ramtek, Katol, Narkehd, Saoner, Kalmeshwar, Umred, Kuhi, Parshvani circles revealed establishment of beetle in large area coupled with control of Parthenium. Survey confirmed the heavy attack of beetle causing 100 per cant mortality of Parthenium at many places besides causing widespread damage in different intensity. It indicates that beetle has established in the region and has potential to lower down the Parthenium intensity many fold in future. It was observed that where ever, there was complete defoliation of large plant, there was no presence of small plants of Parthenium too. The second flush was completely eaten by the beetle.

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# Evaluation of new post emergence herbicide bispyribac sodium for transplanted rice

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Field experiment wasconducted at Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai, to evaluate the new herbicide Bispyribac sodium in transplanted rice on the growth, yield and weed control efficiencies in transplanted rice varieties ASD 16 and ADT 37 during June to *kharif* 2010 and 2011 respectively. Seven treatments were included in a randomized block design (RBD) and replicated four times. The treatments consisted of pre–emergence application of Butachlor1500 g/ha, post emergence application of Bispyribac-sodium 10 SC at 25**,** 35 and 50 g/ha , weed free , hand weeding twice and an unweeded check**.** The results revealed that, among the total weed population, grasses, sedges and BLW occupied 89.8 and 18.0 , 6.9 and 10.1 and 3.3 and 71.2 per cent during 2010 and 2011 respectively. The total weed population and dry weight under Bispyribac sodium at 25 g/ha was on par with the higher doses of Bispyribac sodium at 35 and 50 g/ha during both the years of study. The weed control efficiency and weed index under Bispyribac sodium at lower dose of 25 g/ha were also comparable with that of higher doses indicating the sufficiency of Bispyribac sodium at lower dose of 25 g/ha for effective weed management in transplanted rice. The effect of Bispyribac sodium at 25 g/ha on producing tillers and panicles was also on par with that of higher doses and twice hand weeding and significantly superior than butachlor application. Post emergence application of Bispyribac sodium at 25 g/ha recorded a grain yield of 6838 and 6510 kg/ha during 2010 and 2011 respectively which were on par with higher doses of Bispyribac sodium, twice hand weeding and weed free and significantly higher than butachlor application. Higher economic benefits like net income and Benefit-Cost ratio were also associated with the application of Bispyribac sodium at 25 g/ha than all the other weed managemnet treatments indicating suitable and economical herbicidal weed management for higher productivity in transplanted rice.

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# Adoption and influence of mechanical weeding in system of Rice intensification – an experience from farmers' participatory research in Southern Tamil Nadu

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Adoption of rotary or cono weeder use in System of Rice Intensification (SRI) plays a significant role in improving growth, yield and also economics of rice. It also decides the number of labour needed, cost of weeding and rate of increase in yield. Hence eighteen on-farm demonstrations on System of Rice Intensification were carried out in ten hectares of farmers fields in Sivagangai and Madurai districts of Tamil Nadu, from October 2010 to February 2011 under Tamil Nadu-Irrigated Agriculture Modernization and Water Bodies Restoration and Management (TN – IAMWARM) Project. Two methods of rice cultivation *viz.,* SRI and conventional planting were compared. In SRI, weeding in both direction using rotary weeder at 10, 20, 30 and 40 days after transplanting (DAT) was recommended while in conventional method of rice cultivation, manual weeding twice at 15 and 30 DAT was practiced.The results revealed that adoption of SRI favorably influenced all yield attributes of rice *viz.,* number of tillers/$m^2$ and numbers of grains panicle$^{-1}$. Among the total farmers only 11.1 per cent farmers perfectly carried out four times rotary weeding as per recommendation. The percentage of farmers adopted thrice, twice and single rotary weeding were 44.4, 33.3 and 11.1 per cent respectively. Number of rotary weeding also decides the rate of yield increase by SRI. Averaging over all locations, SRI registered a mean grain yield of 6063 kg/ha against 5422 kg/ha under conventional method of rice cultivation. Thus SRI out yielded 11.06 per cent higher grain yield than conventional method. The average yield increment by four times, thrice and twice rotary weeding under SRI over conventional method were 24.1, 15.4 and 8.5 per cent respectively. The higher yield under SRI might due to the rotary weeding favoured better aeration, cut the older roots and formation of newer roots which might have absorbed more nutrients in turn leads to higher nutrient uptake. Adoption of SRI drastically reduced the cost of weeding as evident due to Rs. 2,534/ha lesser weed management cost under SRI (Rs.2989/ha) than conventional method of rice cultivation(Rs.5,523/ha). Higher gross income, net income and benefit cost ratio were also associated with SRI than conventional method of rice cultivation. The cost of cultivation was comparatively lesser in SRI which resulted in gaining an additional net profit of Rs.11,021/ha as compared to conventional method of rice cultivation.

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