

Proceedings of Golden Jubilee International Conference of Indian Society of Weed Science

(21-24 November, 2018)

Venue: ICAR-Directorate of Weed Research, Maharajpur, Jabalpur (Madhya Pradesh)

Theme: *“Weeds and Society: Challenges and Opportunities”*

Weeds cause a grave biotic constraint in agricultural production systems globally. Weeds adversely affect biodiversity, animal health and environmental security besides reducing crop yield and quality. Weed problem are further aggravating due to climate change, globalization of trades and development of herbicide resistance in weeds. Realizing the increasing weed infestations in the non-cropped, cropped lands and aquatic situations, agricultural scientists have been undertaking research and sharing their findings at various platforms. Indian Society of Weed Science was established in 1968 and All India Coordinated Research Project on Weed Control was launched in 1978. The establishment of National Research Centre for Weed Science in 1989 at Jabalpur and its up-gradation as ICAR-Directorate of Weed Research (DWR) in 2009 was a major step forward to undertake systematic research and development programmes on weed management in a holistic manner by adopting multi-disciplinary approach.

More than 60% of India's population are depending on agriculture sector, therefore, Indian agriculture plays a major role in the country's economy. India may require at least 20 million tons of additional food every year to meet the minimum food and nutritional demands of the growing population, which is expected to be 1.7 billion by 2050. The greatest challenge of the 21st century is to meet the rising food demand while maintaining the sustainability of the natural resources. Reduced agricultural production in many crops in Indian agriculture as indicated by modest average crop yields is another concern for a sustainable growth in Indian economy. Therefore, a big challenge for Indian agriculture is to produce more with minimal input resources in a sustainable manner without causing imbalance to environment and agricultural sustainable.

Hon'ble Prime Minister of India, Shri Narendra Modi has urged all the concerned including scientists to double the income of farmers by 2022. In order to address the emerging challenges and for doubling farmers' income over the next three years, Indian Society of Weed Science has organized ISWS Golden Jubilee International Conference on the theme of '*Weeds and Society: Challenges and Opportunities*' during 21-24 November, 2018 at ICAR- Directorate of Weed Research, Jabalpur (Madhya Pradesh). Following sub-themes were focused during the event.

- Weed biology, ecology and climate change
- Weed management in rainfed and irrigated rice-based cropping system
- Sustainable weed management in cereals, pulses, oil seed crops, commercial crops, fibre and fodder crops
- Weed management in fruits, vegetable, medicinal, spices, floriculture crops and landscape horticulture
- Management of problematic weeds of crops and non-crops situations
- Non-chemical weed management including biological control
- Herbicide resistance in weeds and herbicide tolerant crops
- Herbicide residues, monitoring, mitigation and effect on non-target organisms in weed management
- New herbicides molecules/formulations and low dose herbicides including nano-herbicides, herbicide compatibility with other agro input *etc*
- Socio-economic implications, improving profitability of farming by new techniques, weed utilization and adoption
- Weed threat to plant biodiversity in forest, wasteland and aquatic ecosystem

The major highlights of the conference included: (i) About 400 delegates from all over India and overseas including members of the Society, scientists from agricultural research institutions and State Agricultural Universities (SAUs), representatives from concerned government departments and industries attended the Conference, (ii) There was General Body Meeting of ISWS on 21 November 2018, (iii) Eleven technical sessions were organized, (iv) One Keynote lecture, one Presidential lecture, 7 Plenary presentations, 20 lead papers, 97 oral papers and 292 posters were presented, (v) Cultural programme on 21 November 2018, (viii) Field visit of the delegates to On-Station and On-Farm trials and aquatic weed problem in aquatic bodies on 24 November, 2018.

Inaugural ceremony

The conference was inaugurated by Dr Jonathan Gressel from Israel, the Chief Guest of the function and an eminent weed scientist of the world. The other dignitaries on the dais were: Dr. P. D. Jual, Vice Chancellor of ND Veterinay University, Jabalpur and Guest of Honour; Dr. G.S. Rao, Director, TFRI, Jabalpur and Guest of Honour, Smt. Dr. Mildred Xess, General Manager, NABARD, Dr. V.P. Singh, President, ISWS, Dr. P.K. Singh, Director, DWR, Jabalpur and Dr. Sushilkumar, organizing Secretary of Conference and Secretary of ISWS. Other dignitaries in the hall were: Dr. N.T. Yaduraju, Ex-President, ISWS; Dr. L.S. Brar, Former Presidents, ISWS; Dr. A.R. Sharma, Ex-Secretary, ISWS, ICAR-DWR, Dr. Bhagirath Chauhan from Australia, Dr A.N. Rao from ICRISAT, Hyderabad, Dr Mayank Yadav from Corteva Agriscience™, Dr R.M. Kathiresan from Annamalai, Dr. V.K. Tiwari from IIT, Kharakpur and many other from India participated in the conference. From USA, Dr K.K. Krishna Reddy, Dr Mithila Jugulam, Dr Prashant Jha, Dr Megh Singh, Dr Muthu Bagavathiannan *etc* participated. Dr Yoshiharu Fujii, an eminent scientist from Japan also participated.

Dr. V.P. Singh, President ISWS welcomed all the dignitaries and delegates and highlighted the current scenario of weed problems in the country and the world. In his presidential address, he informed the gathering about the role of mechanical, chemical and integrated weed management in improving the input-use efficiency, productivity and profitability. He informed the house the importance of Golden Jubilee of ISWS and hoped that this conference will lead a path to develop new and ecofriendly strategies to solve the problem of many problematic weeds.

Dr. P.K. Singh, Director, DWR also welcomed the delegates in the DWR and Conference and highlighted the importance of weed. He hoped that present conference will be highly useful for the delegates representing all the states of India and many countries.

Dr. P.D. Jual, Guest of Honour highlighted the problems of weed posed in the life of man and animals. He informed deleterious effect of weeds on animals and appealed all the scientist to come up strategies to fight with the problematic weeds and to increase the fodder availability to animals not only as crop but also under non-cropped situations.

Dr. G.R. Rao, Guest of Honour and Director, Tropical Forest Research Institute praised the efforts of organizers to propose the theme on the challenges posed by weeds and the opportunities to develop effective technologies to manage the weeds for the benefit of the society.

At this occasion, Smt. Dr. Mildred Xess, General Manager, NABARD and representative from National Agricultural Board for Rural Development (NABARD) briefed the house the role being played by NABARD for the benefit of farmers and development of agriculture growth in the country. She also informed the house about many current projects of NABARD being run in the country for the benefit of farmers.



Release of publications: A book ‘*Fifty Years of Weed Research in India*’ (Eds. Sushil Kumar and J.S. Mishra), published by Indian Society of Weed Science was released by the Chief guest and dignitaries. On this occasion, Proceedings of Biennial Conference entitled “*Weeds and Society: Challenges and Opportunities*” was also released. A booklet on “*ISWS History and Memories*, written and compiled by Sushil Kumar and Gyaanendra Pratap Singh was also released.



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

Life Time Achievement Award	Dr. R.P. Singh, Varanasi, (2016-17)
ISWS Gold Medal	Dr. T.K. Das, New Delhi, (2016) Dr. Prasanta C. Bhowmik, USA (2017)
ISWS Fellow	Dr. P.K. Singh, Jabalpur, (2016) Dr. Anil Kumar, Jammu, (2016) Dr. G.N. Dhanapal, Bengaluru, (2016) Dr. Virender Sardana, Ludhiana, (2017) Dr. B.D. Patel, Anand, (2017) Dr. D. Subramanyam, Tirupati, (2017)
ISWS Special Recognition Award	Dr. Mayank Yadav, Hyderabad
ISWS Young Scientist Award	Dr. C. Sarathambal, Kozhikode, (2017)
ISWS Best Ph.D. Thesis Award	Dr. Chaitanya Prasad Nath, New Delhi, (2016) Dr. Maninder Kaur, Ludhiana, (2017)
ISWS Best Book Award	Dr. Shobha Shondia, Jabalpur for the book “Herbicide Residue analysis”, (2016)
IJWS Best Paper Award	Authors: Rajender Kumar, Jayesh Singh and S.K. Uppal “Management of weeds in sugarcane-wheat intercropping system in sub-tropical India” Volume: 49(2): 139-146
ISWS Student Travel Grant Award	Miss. Anannya Ghosh, BCKV, Kalyani Mr. Ashirbachan Mahapatra, IGKV, Raipur Mr. Ashu Sharma, SKUAST-J, Jammu Mr. Gurpreet Singh, CSKHPKV, Palampur Mr. Jitendra Patidar, JNKVV, Jabalpur Mr. Kartik, CCH HAU, Hisar Mr. Manohar Lal, SKRAU, Bikaner Miss. N. Meena, UAS, Coimbatore Miss. Neelam Bisen, BHU, Varanasi Mr. P. Kumarsein, CCH HAU, Hisar Mr. P. Nagarjun, UAS, Bangalore Miss. Preeti Tripathi, MGCGV, Chitrakoot Mr. Rupareliya Vimalkumar Vrajajal, JAU, Junagadh Mr. S. Selvakumar, TNAU, Coimbatore Mr. Sahuji Bandyopadhyay, BCKV, Nadia Miss. Sapna Bhagat, SKUAST –J, Jammu Miss. Sneha Kumari, BHU, Varanasi Miss. Sonaka Ghosh, IARI, New Delhi Mr. Suman Sen, IARI, New Delhi Mr. Vikas Tomar, CCAU, Kanpur Miss. Writuparna Dutta, PU, Kolkata
Best poster awards	Nine best poster awards were also distributed



Proceeding of Technical Sessions

Date: 21.11. 2018

Post inaugural Session

Keynote Address and Plenary lectures;

Chair: Dr N.T. Yaduiraju

Rapporteur: Dr J.S. Mishra

Dr. Jonathan Gressel from Israel delivered the Keynote lecture on '*Intractable weed problems need innovative solutions – using all available technologies*' He highlighted the weed problems and innovative approaches being practices all over world. He especially mentioned the fast spreading problem of herbicide resistance in weed and the solution to overcome

Dr Jonathan Storkey could not attend the conference due to unavoidable circumstances. Arrangement was made for his plenary lecture through video conference. He delivered Plenary lecture on '*Ecological principles can help with weed management decisions*' The efforts of organizers to make arrangement of video conferencing was appreciated by all the delegates.

Post-lunch Plenary Session

Chair: Dr Krishna K. Ready

Rapporteur: Dr R. Puniya

Two following Plenary lectures were delivered:

Dr. A.N. Rao on '*Fifty years of weed science research in India - challenges and opportunities*

Dr Mayank Yadav on '*A new paradigm in agricultural sustainability*'

Dr. A.N. Rao presented a lead paper on "Fifty years of weed science research in India - Challenges and opportunities". He emphasized on the research published in Indian Journal of Weed Science (IJWS) during the last fifty years and its analysis and synthesis. He presented the paper along with future weed management research needs. In the initial years of Indian weed management research, researchers focused on herbicide based weed management and majority of papers were based on herbicides in major field crops such as rice and wheat in the past as well as at present. However, during recent years, papers appeared on increased number of crops. He emphasized that a vast opportunity exists for researchers in economical and ecologically safe integrated weed management strategies through interdisciplinary research such as biology; ecology; agronomy; physiology; genetic engineering; biochemistry; residue chemistry and agricultural engineering.

Dr. Mayank Yadav, presented a plenary lecture on "A new paradigm in agricultural sustainability". He emphasized that the global food security is a challenge for researchers for increasing population. He presented that during the last three decades, there is no new mode of action of herbicides came into the market. The germplasm, traits and crop protection are the important aspects of weed management. Digital agriculture with data science is creating a new important paradigm shift in current agriculture science. He described about some new products from the companies in the Indian market like *Rinskor* and *Coreon* for transplanted rice.

After tea break concurrent sessions in Main Hall, Hall-1 and Hall-2 were held

TECHNICAL SESSION 1: Weed biology, ecology and climate change

Chair: Dr S.V.R. Shetty

Rapporteur: Dr P. Saravanane

During the sessions three lead and 7 oral presentations were held. Following lead lectures were presented:

R.M. Kathiresan: *Sustainable option for managing weeds under changing climate*

Dr T.K. Das: *The dormancy breaker plus herbicides: A new approach for weed management*

Dr C.R. Chinnamuthu: *Effect of nanoparticles on the absorption and translocation of glyphosate in *Cyperus rotundus* L. and its management*

Oral presentation by the scientists from different organizations were presented on weed biology, ecology and climate change.

TECHNICAL SESSION 2: Weed management in fruits, vegetable and other high-priced crops

Chair: Dr. S.V.R. Shetty, Bengaluru

Rapporteur: Dr. P. Saravanane, PAJANCOA & RI, Karaikal, Puducherry

There were one lead and seven oral presentations in this technical session.

Dr. V.K. Tiwari, IIT presented lead paper on '*Novel and innovative technologies in mechanical weed management*'. Advance techniques of weed control at present scenario are a) adoption of embedded system in agriculture for weed management eg. Embedded system based tractor mounted herbicides applicator is one such example. b) Mechanical device in weed management eg. Adoption of Intra-row weeder for wider row crops c) Future technology-Internet of Things (IOT). Artificial intelligence and big data computing are important concepts of IOT. Precision farming, use of agricultural drones, livestock monitoring, smart green house and rural health management are some possible applications of IOT in smart farming. It was brought to the knowledge of the delegates that a course on 'Advance technologies for Agriculture' is offered in IIT.

TECHNICAL SESSION 3: Weed threat to biodiversity in forest, wasteland and aquatic ecosystem and socio-economic implications

Chair: Dr G.R. Rao, Director, TFRI

Rapporteur: Dr Ajay Kumar Singh

In this session one lead and 8 oral presentations were made. Dr Moolchand Singh from NBPGR presented the lead paper on 'Risk associated with the weed seeds in imported grain' he highlighted the weeds intercepted at quarantine in the consignment of imported wheat. It was discussed to have precautions at entry points of imported consignment of cereals to check the entrance of invasive weed in the country. Among oral presentations, findings were presented on conservation agriculture, estimation of economic loss caused by weeds in India, weeds of anaman & Nicobar Island, on *Parthenium* in society

Date: 22-11-2018

Plenary lectures in Main hall

Chair: Dr L.S. Brar

Rapporteurs: Dr Simarjeet Kaur

Following 2 plenary lectures were presented:

Dr N.T. Yaduraju: Why systems approach in weed management?

Dr Yoshiharu Fujii: Utilization of allelopathy for weed control

Dr. Yaduraju discussed the system approach in weed management and emphasized that weed should be controlled in integrated way not in isolated way. He illustrated many examples of failure of weed management when isolated approaches were taken while on adopting the system approach, the weed problem was managed successfully. Dr. Fujii from Japan highlighted the utility of weeds for herbicidal and medicinal properties. It was discussed that weeds potential for useful properties has not been fully exploited yet.

TECHNICAL SESSION 4: Herbicide resistance in weeds and herbicide tolerant crops

Chair: Dr A.N. Rao

Rapporteurs: Dr V.K. Choudhary

In this session there were 3 lead presentations and 6 oral presentations. Majority of the speakers had talked about herbicide resistance scenario globally, citing the work carried out/compiled by Dr. Ian Heap. The brief proceedings of the session are -

Dr. Krishna Reddy delivered his talk on 'Herbicide-resistance crop technology in the USA 24 years after commercialization: current status and future outlook'. He briefed the house about development of herbicide resistance in canola during 1995 against glufosinate ammonium and multiple herbicide resistance in corn during 2006 (glyphosate and glufosinate). He also mentioned about effectiveness, simple application, cheap, flexible and convenience use of glyphosate. Use of glyphosate drastically reduced the use of pre-emergence herbicides. About 42 weeds become resistant against glyphosate and the infested area is about 33 million ha, which is really alarming. He suggested that these glyphosate resistance weeds populations can be minimized by adopting integrated weed management approaches. He also mentioned that instead of growing single row corn, twin row may be preferred as it covers the ground early and also suggested to follow cotton-corn or corn-soybean rotations, cover crop (hairy vetch) must be included in the system. He also informed that since last 30 years no new mode of action of herbicides has been developed. Due to increased infestation of glyphosate resistance weeds, the crop productivity is declining and land values are decreasing.

Dr. Mithila Juglam talked about 'Novel mechanism of herbicide resistance in weeds: opportunities for crop improvement'. She mentioned that herbicide resistance developed due to natural mutation, and in natural process due to selection and further multiplication their population increases. She also mentioned about non-target site resistance and target site resistance, where due to herbicide metabolism and non-binding with specific protein respectively takes place. Dr. Mithila mentioned about gene amplification where in shikimate pathway how glyphosate could not bind due to presence of EPSP synthase. She detailed about their work on gene amplification at various sites in Kansas on *Kochia*, Palmer amaranths and Water hemp. She also mentioned about production of more copies of EPSPS due to unequal crossover, retroposition (RNA mediated), Transposomes (DNA mediated), chromosomal and extrachromosomal amplifications. Dr. Mithila talked about their work with fluorescent in-situ hybridization (FISH) analysis and mapping, which tells about presence of copies of EPSPS. If EPSPS copies are increased in any plants means those plants are tolerant to glyphosate and while amplification they seem more darker than susceptible one. They also found some extra chromosomes i.e. ring chromosome having no telomere which also carries EPSPS copies. She also explained about development of back library (Fibre-FISH analysis).

Dr. Prashant Jha talked on 'Current challenges and sustainable weed management into the future: call for a transdisciplinary approach'. He also mentioned about no development of new mode of action of herbicides since 1980. To manage these weeds multi-tactic/small hammer approaches must be followed. More diverse cropping system need to be adopted and also precision weed management techniques would be appropriate option to tackle herbicide resistance problem. He mentioned that in Great Plains, wheat are grown during April, then sugar beet, corn and at last soybean/dry bean at end of May, during these periods about 90% of *Kochia* seeds get germinated, so following stale seed bed techniques seed bank can be minimized. He explained about their work on management of *Kochia* seed bank through cropping system at multi-site field studies. He suggested *Kochia* seeds were lesser in intensive tillage system

with use of ALS inhibitor herbicides and also suggested corn-drybean-wheat-sugar beet cropping system was best to suppress the kochia seed bank. More the diverse cropping system least the *Kochia* seeds were recorded. He also suggested various cohorts 1 burn down, 2 pre-emergence, 3 post-emergence, and 4 harvest. Using Harrington weed seed destructor, weed seeds can also be minimized from seed bank. He also talked about identification of crop (wheat), susceptible and resistance (GR) *Kochia* through Hyper-spectrum imaging and machine learning logarithm. Even putting camera on combine harvester resistance population can be identified and management strategies may be adopted in next year.

Under oral Presentations, Dr. S.S. Punia briefed about cross resistance in *Phalaris minor* against recommended herbicides in wheat. He suggested that applying pendimethalin 1.5 kg/ha + pyroxasulfon 102 g/ha controlled around 90% of *P. minor*, this percentage further increased to 93% when pinoxaden or mesosulfuron+iodosulfuron was applied subsequently. He concluded that integration of pre-emergence followed by post-emergence herbicides are suggested to tackle *P. minor*. Dr. Priyanka Rani, talked about strategic development of herbicide to combat the massive problem of *Phalaris minor* weed through computational approach. She mentioned that Isoproturon binds with D-1 protein in photosystem II. Dr. Priyanka mentioned about development of multiple herbicide resistance (PS II, ACCase, ALS inhibitor etc). In their studies, they retrieved data from ZINC 12, Phase and Weed Science and different methodologies were used such as Ramachandran plot, PROVE, PROSA, ERRAT etc. With their studies, they find around 138 molecules which need further study in order to develop a new molecule. Dr. Manpreet Singh talked about exploiting herbicide resistance related fitness costs for managing herbicide resistance weeds. In this presentation, he explained about target and non-target site resistance and fitness cost. Adoption to a new environment will have negative pleiotropic effects on fitness in the original environment. He also mentioned that fitness cost is associated with ACCase mutant alleles, however, little work has been carried out in non-target site resistance. Dr. Raghuvveer Singh talked on current status of herbicide resistance in *Phalaris minor* in Haryana. As per the study conducted in four district of Haryana, he briefed about farmer's profile of the study area. Majority of the farmers are not aware about herbicide resistance, around 42% of the farmers hire persons for spraying, and 45% farmers are still using holo-cone nozzle and only 6.3% are using flat fan nozzles. Majority of the farmers are using lesser volume of water for spraying. The herbicide use pattern varies across the study area and somewhere farmers using 2.9 times of recommended dose of herbicides with only 73% of *P. minor* control. Due to heavy use of herbicides Govt. stopped procuring such wheat. Majority of the farmers using clodinafop due to ease of application, cheaper and phytotoxic effect on crop. Mesosulfuron + iodosulfuron is also giving considerable control but had phytotoxic effect in wet condition. Majority of the farmers reported that use of pendimethalin 750-1000 g/ha + metribuzin (175-350 g/ha) followed by sulfosulfuron at 20 DAS reported good control. Due to the severity of *P. minor* some of the farmers are leaving wheat cultivation. *P. minor* has created hue and cry situation in Haryana, majority of the farmers are using more than recommended dose, which is increasing their cost of cultivation. Dr. Ummed Singh talked on agronomic evaluation of herbicide tolerance in chickpea genotypes. They have evaluated carfentrazone at 20 and 30 g/ha and imazethapyr at 50 and 75 g/ha. They found that carfentrazone at 30 g/ha had shown phytotoxic symptoms to cv JG 16, whereas carfentrazone at 20 g/ha neither shown phytotoxic symptom nor controlled weeds. Imazethapyr had less phytotoxic and very good weed control with variety Ujjawal was reported. Dr. Subhash Chander talked on resistance development in imazethapyr in *Commelina* biotypes in soybean growing central India. In India first time resistance of imazethapyr on *Commelina* in soybean has been reported. Sampling was done from 20 district of Madhya Pradesh and during 2017, 38 biotypes were collected. The samples collected from Dewash were resistance up to 4X (imazethapyr 400 g/ha) whereas Indore biotypes were resistance to 2X and at 4X some deformities were observed. So, this is a unique case from India has been reported.

Panel discussion – Innovations in weed management for improving farmers income: Are we on right path?
(Interaction with industry retentive/scientists/innovators/students/farmers)

Chair: Dr Megh Singh

Rapporteurs: Dr Tej Pratap

Convener: Dr C. Chinnusamy

There were seven scientists present in the panel and about 40 local farmers participated in the session. There were two lead papers from the herbicide industry in which first was presented by Dr. Sunil kumar from Corteva

Agriscience on the “Role of industry in sustainable weed management solutions” about the development of different herbicides at different periods for solving the problem of farmers. The another lead paper from herbicide industry viz. A.G Bio-system Pvt. Ltd., Mumbai was present by Dr. Praharaju Laxminarayana on “Herbicides in agricultural industry – future, prospect and scope”. He also emphasized on the role of herbicides industries in management of noxious weeds like *Parthenium*, *Eichhornia* and *Lantana* by biological methods instead of herbicides through fungus and other microbes. He expressed his view that this industry developed different mycoherbicide formulations for effective weed management of aforesaid weeds.

Panelist views: First of all Dr. P.K. Singh, Director, DWR, Jabalpur expressed his concerns over application quality herbicides and perfect application technology including proper volume of spray liquid which plays a great role in management of weeds. Dr. V.P. Singh, Principal Scientist, IISR, Lucknow expressed his views over more expensive but highly effective herbicide molecules in special reference to weed management on sugarcane. Dr. Rishikant Mudgal delivered a talk on the requirement of farmers in the Eastern U.P. regarding the availability of irrigation water, use of proper machinery and transplanting of rice in the stipulated period of time instead of developing any more herbicide technology. Dr. J. S. Mishra had discussed with farmers and enquired if there was any enhancement in income by applying quality herbicides and better weed management technologies in their field. Dr. P. J. Suresh from Monsanto India Ltd., Chennai emphasized about use of precession technology e.g. use of drones, in herbicide applications. Dr. Shobha Sondhia, Principal Scientist, DWR, Jabalpur expressed her views about the indiscriminate use of herbicides by farmers and its impact on crop as well as environment. Dr. Hoshiar Singh from Monsanto India Ltd., M.P. expressed his views over the development of spray techniques in Soybean in M.P. and also suggested that the farmers should apply quality herbicides at proper time with better spray technologies. Mr. Satish Dubey, local farmer was eager to know about use of different formulations of glyphosate effective for weed management. Dr. Sant Singh, Scientist from Patna emphasized about the use of machineries in weed management. Dr. Bhumesh Kumar satisfied the queries of farmers regarding adoption of weed management technologies. At the last but not the least, chairman Dr. Megh Singh remarked about the development of herbicide industry for the development of new molecules including bioherbicides, which will be able to manage the diverse type of weed flora. He also expressed his concerns over herbicide application technologies adopted by farmers and suggested that farmers must use proper herbicide application technology for ensuring better efficacy of herbicides. Finally, the chairman was honoured by the organizerers. The session was ended with warm vote of thanks by Dr. Shobha Sonalia, Principal Scientist, DWR Jabalpur.

TECHNICAL SESSION 5: Non-chemical weed management including biological control

Chair: Dr Jagdish Kumar

Rapporteurs: Dr C. Sarathambal

Session was started after the tea break by 11.45 am. Chairman started the session with message of good agricultural practices and significance of integrated weed management for sustainable agricultural systems. Opening lead presentation by Dr. Muthu Bagavathiannan on “Application of advanced technologies for precision weed diagnosis and management” was made. He explained the unmanned armed vehicles for multispecies characterization of weeds and their infestation assessment. He also emphasized the ability of sensing technologies for precision detection and weed management. After that 10 oral papers were presented in this session. First paper on “Weed management in organic agriculture” by RP Dubey. He mentioned the prospects and challenges of organic agriculture. Followed by “Exploring alleochemical producing cover crops for weed management in cotton” by Dr D. Blaise. He narrated the effect of intercrops such as Bajra, sunhemp and sorghum on weed control efficiency in cotton. Next three presentations were related to biological management of *Parthenium*. Authors mainly focused on new fungal based formulations as well as mass multiplication, quarantine screening of seed feeding weevil. Subsequently presentation by Dr. Ajay kumar Singh on “Effect of mulches and weed management on unpuddled transplanted hybrid rice”. He mentioned the role of cover crops and rice residues in his paper. Dr. Aradhana Mishra presented the paper on “Nano based green approach for early blight disease of *Solanum lycopersicum*”. She focused on *in vitro* antifungal activity of silver nano particles. Next presentation on “Impact of biocontrol agents on biochemical changes of aquatic weed water hyacinth” by Writuparna Dutta. Final presentation by Ms. Manisha Rout on “Fluctuation of microbial population in response to applied herbicides

in greengram". She highlighted changes on population dynamics of basic microbial and nitrogen fixing bacterial communities due to the application of herbicides. Session was closed by chair with concluding remarks.

TECHNICAL SESSION 6: Weed management in rainfed and irrigated rice-based cropping system

Chair: Dr C.T. Abraham

Rapporteur: D. D. Chaudhari

Total 15 presentations were made in this technical session out of that 12 were presented as oral and 2 lead paper. Among these 12 presentations, 3 on weed management in conservation agriculture, 7 on different rice based cropping systems like wet, dry, direct seeded rice, transplanted rice, SRI, 1 on herbicide combinations and 1 on chocolate weed in rice were presented very precisely and thoroughly by the different scientists.

Dr A.R. Sharma, former director of DWR and renowned scientist in the field of conservation agriculture presented a lead paper on weed management in conservation agriculture systems in India: Myths, realities and way forward. Dr. Sharma explained the principle of conservation agriculture, global picture of CA, adoption of CA in different region. He also pointed out the importance of crop residue management in CA, mandatory of herbicide use in CA, weed seed bank, success story of CA at DWR, Jabalpur, and weedy rice management by use of *Dhaincha*. He also explained in detail the myths and realities about CA, constrains in the adoption of CA, need of demonstration/training/collaboration in CA and incentives to the farmers for no burning of crop residues. The lecture was well presented and very informative for the future line of work in CA.

Dr C. Chinnusamy, presented a lead paper on long-term herbicidal weed management on weed control, yield and soil environment in transplanted low land rice-rice cropping system. He explained the resources and contribution of technologies in the development of sustainable agriculture in TN. He presented the major weeds of wetland, dry land, transplanted, direct seeded and aerobic rice. He also presented the herbicide residue in long term use of herbicide in low land transplanted rice-rice cropping system and effect of the herbicide on microbial population at different interval of time and concluded that initially the population of microbes were decreased but increased after 15 day later of herbicide application. The lecture was very informative and presented very nicely.

Dr J.S. Mishra presented a paper on long-term effect of conservation agriculture on weed dynamics and productivity of rice-based cropping systems. He narrated the importance of rice-wheat cropping system in Indian agriculture. He explained the weeds, weed dynamics, weed seed bank under long term conservation agriculture system and reported that grassy weeds were increased in zero tillage after 7 year. He reported that rice yield was declined after six years of ZTDSR due to severe attack of rice mealy bug. He recommended that for obtaining sustainable productivity of rice, puddling is required after 65 years of continuous no tillage in rice based cropping system.

Dr Atluri S. Rao presented a paper on weed management in rice-based cropping systems of Andhra Pradesh. He also explained the dominance of rice based cropping system in Andhra Pradesh. He presented the different aspects of weed management in rice based system. He also narrated the weed management strategy in different rice based cropping systems like rice-fallow-maize, rice-fallow-jowar rice. rice-fallow-groundnut etc. and management of *Cuscuta* in pulses. He also emphasized the analysis of socio-economic aspects of the weed management strategies to encourage the farming community.

Dr Meera Menon presented a paper on Management of chocolate weed – an emerging weed in rice system. She presented the weed physiology and biology of new emerging chocolate weed, days to flower and complete the life cycle, its germination pattern and physical, cultural and chemical management of this weed in rice system. He also recommended the different herbicides for the management of chocolate weed.

Dr P. Prameela presented a paper on synergism and antagonism in herbicide mixtures involving cyhalofop-p-butyl in rice. She reported the synergistic and antagonistic effect of different herbicide combination with cyhalofop-p-butyl on the basis of its weed control efficiency and recommended that pyrazosulfuron combined with cyhalofop-p-butyl was very effective for broad spectrum weed control in direct seeded wet land rice. Dr. T. K. Das suggested that pre-emergence herbicide should not be mixed if it is applied as post emergence and leads to poor weed control efficiency.

Dr Malay K. Bhowmick presented a paper on weed dynamics and management options under different rice establishment methods in dry season. He found SRI was the most promising method of crop establishment. He also suggested that drum seeding of sprouted seeds (DSS) also proved to be economically viable options to CTR. He narrated

the weed management options in the SRI, CTR and DSS methods of rice cultivation in dry season. Dr. T. K. Das suggested to keep at least 20 days interval between follow-up treatment to assess the direct effect of different treatments. Dr Elizabeth K. Syriac presented a paper on nutrient uptake by upland rice and associated weeds as influenced by stale seedbed and weed management methods. She reported in the presentation that stale seedbed recorded lower weed density and weed dry biomass and there by resulting in higher nutrient uptake, grain and straw yield production of rice compared to no SSB. She recommended the integration of stale seedbed method with penoxsulam 25 g/ha *fb* hand weeding for effective weed control and yield of rice.

Dr Dhanapal G. Nanjappal presented a paper on efficacy of various herbicides combinations to control weeds in dry direct seeded rice. He concluded his presentation by the inclusion of pre and post emergence herbicides for the better weed control, grain yield and B: C ration in dry direct seeded rice with future line of work in the residue study in soil, grain and straw and herbicide resistance of weeds against different post emergence herbicides in rice need to be evaluated.

Dr Sant K. Singh presented a paper on evaluation of resource conserving weed management techniques in system of rice intensification. He narrated the benefits of SRI in context to resource conservation and climate change and management of pollution. He reported that the mechanical method (conoweeded at 15, 25 and 35 DAT) was most effective for weed control and recorded highest grain and straw yield compared to the treatments in SRI in station trial. The same results were also reported on the farmer's field in Gaya and Nalanda districts.

Dr M. Madhavi presented a paper on impact of methods of rice establishment and weed management options on productivity, profitability and environment. She reported that quality of water has effect on the efficacy of applied herbicide. He explained the energy balance as influenced by different established methods and weed management practices. She also reported alkaline and acid phosphate activity as influenced by different established methods and weed management practices

Dr V.K. Choudhary presented a paper on Weed dynamics and crop productivity in rice-wheat-greengram cropping system under conservation agriculture in vertisol. He thoroughly presented the effect of tillage and weed management practices on weed dynamics in rice, wheat and greengram under different system and concluded that direct seeded rice (ZT) gave at par yield to TPR if thin layer of water maintained. He also explained the need of herbicide rotation for broad spectrum weed control. He recommended the transplanted rice-ZTR-ZTR system for more profitability over rest of the system.

At the end of the session, Dr. C. T. Abraham, Chairman of the technical session 6 gave his concluding remarks about the presentation made by the speakers and thanked for the cooperation for smooth and in time completion of the session to scientists, delegates and rapporteur.

TECHNICAL SESSION 7: Weed management in cereals-based cropping system

Chair: Dr V. P. Singh

Rapporteurs: Dr Manoj Kumar Singh

In this session, one lead and 13 oral presentations were made. Dr Vijay Nandula from USA presented lead paper on 'History of chemical weed control: The good, the bad, and the ugly. Dr M.S. Bhullar informed about long-term effects of tillage systems and weed control on weed dynamics, crops productivity and soil health in a maize-wheat production system. Dr Jai Kuma presented his findings on post emergent herbicidal weed management in maize Dr R.S. Chhokar Management of herbicide resistant grassy weeds in wheat. Dr M.L. Kewat from JNKVV, Jabalpur shared his findings on day time effect on efficacy of mesosulfuron-methyl against weeds in irrigated late sown wheat while Dr Gurusharan Panwar on effect of herbicides combination for control of complex weed flora in wheat, Dr Udai Pratap Singh from BHU, Varanasi discussed his findings on conservation agriculture practices for efficient weed management. Dr Vikas Sharma from Jammu & Kashmir shared his work on weeds of maize + rajmash crop system under real farm conditions of semi-temperate zone of Rajouri while Dr Dibakar Ghosh from ICAR-DWRm Jabalpur discussed effect of integrated weed and nutrient management practices on growth, nutrient uptake and soil health of hybrid maize production system at alluvial soil of India. Dr Vasudev Meena preentied his findings on bio-efficacy of ready-mix herbicides on weed dynamics and crop productivity in late sown wheat (*Triticum aestivum* L.) under sub-tropical conditions. Dr Neetu Sharma from J&K discussed on effect of sowing dates and weed management on productivity and profitability of wheat in irrigated plains of Jammu & Kashmir

TECHNICAL SESSION 8: Weed management in pulses and oilseeds crops

Chair: Dr Jay G. Varshney

Rapporteurs: Dr Mukesh Kumar

In this session 2 lead paper and 8 oral paper were presented. Dr. Ratikanta Ghosh presented lead paper on “*Critical crop-weed competition period – Critical factor for annual planning of weed pest management to increase sustainable crop productivity*”. He emphasize on annual planning of weed management *i.e.* (i) reduced weed seed bank before crop planting either by stale seed be, crop diversification and best management practices (ii) weed control after crop planting/sowing and it must be under critical period of weed crop completion otherwise it would not be effective and economical. (iii) weed control prior to crop harvest to prevent weed seed dispersal and reduce weed infestation in succeeding crop. Dr. Narendra Kumar presented lead paper on “*Weed Management in pulses*”. He emphasized the necessity of weed control in pulses to achieve the future target of 39.80 mt pulse production up to 2050, because 20-50 % reduction in yield due to weeds. He presented recent weed management practices in pulse alternative to costly prevalent manual weeding are pendimethalin 1.0 kg/ha as pre emergence followed by imazethapyr 100 g/ha at 20-25 DAS for *kharif* pulses (mung, urd bean and pigeon pea), pendimethalin 1.0 kg/ha as pre emergence followed by quazalofop ethyl 100 g/ha at 20-25 DAS for *Rabi* pulses (chick pea lentil and pea) and imazethapyr 100 g/ha at 20-25 DAS for summer/spring pulses (urd bean and mung bean). Further, he stated some germplasm of chick pea and lentil found to be tolerant to imazethapyr which will helpful to developing herbicide tolerant chick pea and lentil crop in future. Further, he presented challenges in weed control in pulses like weed control in lentil grown in rice fallow or in conservation agriculture, controlling of *Convolvulus arvensis* a perennial weed in conservation tillage, controlling broad leaved weed in pulses, to control herbicide resistant weeds.

Dr. Rajendra Hasure presented paper on “*Weed management in groundnut based (groundnut- wheat) cropping system*” According to his finding two hand weeding gave higher equivalent yield, income and B:C ratio compared to herbicide in groundnut-wheat system. Dr. Bhairathsinh Gohil presented paper “*A study on dynamics of weed-seed bank and its management in groundnut*”. He stated that, wheat residue incorporation followed by soil solarization treatment reduced the total weeds, dry weight of weeds and weed seed bank, thereby recorded lowest weed index and higher weed control efficiency. While, maximum net returns and B:C ratio were achieved with treatment pendimethalin 900 g/ha and one hand weeding. Dr. K.Srinivasulu presented paper on “*Evaluation of post-emergence herbicides for weed control in castor*” he stated that castor tolerance to pre-emergence application of pendimethalin at 1.0 kg/ha fb chlorimuron- ethyl at 10g/ha as POE at 30 DAS was excellent, thus providing the greatest opportunities for quick control of broad-leaved weeds selectively in castor. Dr. Ravi Sugumaran presented paper on “*Tank mix application of early post-emergence herbicides for efficient weed control and higher economics in irrigated groundnut*”. His results showed that application of pendimethalin 1.5 kg/ha (pre-emergence) + tank mix of imazethapyr + quizalofop-ethyl at 20-30 DAS in groundnut resulted in highest pod yield and the highest B:C ratio. Dr. Niteen J. Danawale presented paper on “*Effect of integrated weed management in pigeonpea*”. He found that Pendimethalin at 0.75 kg/ha on 3 DAS + imazethapyr at 100 g/ ha on 10-15 DAS + one HW on 50 DAS produced significantly higher weed control efficiency, pigeon pea grain yield and B:C ratio. Dr. Bodi Pramila Rain presented paper on “*Screening of blackgram varieties for their weed competitiveness and tolerance to pre- and post-emergence herbicidal application during Rabi season*”. No significant difference in grain yield was observed with response to blackgram varieties, viz. ‘GBG 1’ ‘PU 31’ ‘LBG 787’ ‘LBG 752’ to the application of pre-emergence pendimethalin 1.0 kg/ha, post-emergence application of imazethapyr 50 g/ha or a combination of both. Manual weeding treatment with n gave significantly higher yield followed by post-emergence application of imazethapyr 50 g/ha and a combination of pre-emergence pendimethalin 1.0 kg/ha fb imazethapyr 50 g/ha. Dr. Jitendra patidar presented paper on “*Bio-efficacy of fomesafen + fluazifop-p-butyl mixture against weeds in soybean*” he stated that application of higher doses at 130 + 130 g/ha of fomesafen + fluazifop-p-butyl mixture proved significantly superior over the check herbicides imazethapyr 100 g/ha market sample of fomesafen + fluazifop-p-butyl mixture 110 + 110 g/ha and imazethapyr + imazamox 35 + 35 g/ha. Dr. N.K. Jat presented paper on “*Evaluation of different post-emergence herbicides as alternative to imazethapyr for weed control in Kharif pulses and their residual effect on succeeding wheat and mustard crops in arid Rajasthan*”. He stated that imazethapyr had negative effects of on succeeding crops mustard hence, herbicide clodinafop-propargyl + sodium-acifluorfen (250 g/ha) can be applied in Kharif pulses to avoid phytotoxicity in succeeding mustard crop.

Chairman Remarked that research should be oriented toward reducing of weed seed bank in soil. To increase the persistent of pre-emergence herbicide exploit the use of Nano herbicides in pulses and other crops should be done. Development of eco-friendly

Friday, November 23, 2018

Plenary session

Chair: Dr Jonathan Gressel

Rapporteurs: Dr T. Ramprakash

In this session, 2 plenary lectures were presented. Dr B.S. Chauhan from Australia presented on 'Emerging challenges and opportunities for education and research in weed science in India'. He discussed the need of special opportunities for agricultural students in overseas. A lot of discussion was held on this topic. Dr. Chauhan encouraged students and researchers to avail such opportunities and offered his all help to potential students and researchers.

Dr. Jay G. Varshney, Ex –Director of ICAR-DWR presented his experience on invasive weeds: A threat to biodiversity and productivity. With examples of many problematic weeds in India, he emphasized the need to contain them with integrated approaches.

Mahesh K. Upadhaya Award Lecture

After tea break in the main hall, Mahesh K. Upadhaya Award Lecture on 'Biological control of Parthenium: Ecological and social indicators of success, challenges and way forward' was presented by Prof. Dr. R.K. Gupta, from Jammu & Kashmir. Dr. Gupta illustrated the problem posed by the weeds in whole India and emphasized the need of biological control. He shared his long experience of biological control of Parthenium with the help of Parthenium defoliating beetle *Zygogramma bicolorata*. He categorized this bioagent, one of the best effective agents in the country to suppress the weed in long term basis and to restore the biodiversity.

Special interaction session: Writing of Research Publications of International standard

Convener: Dr B.S. Chauhan

Rapporteur: Er. C.R. Chethan

In this session, discussion were held on development of skill to write scientific papers so that those could be published in high rating journals. Dr. Chauhan from Australia taught the students and researchers the way of writing the papers. This session was appreciated too much by the students.

TECHNICAL SESSION 9: Weed management in cash crops and minor crops

Chair: Dr R.P. Singh

Rapporteurs: Dr Puja Ray

In this session, 1 lead and 9 oral presentations were made.

Lead lecture was presented by Dr Ramesh K. Singh on 'Weed dynamics and its management in spring planted sugarcane' Dr. Singh spoke on importance of sugarcane (*Saccharum officinarum* L.) as second most important industrial crop after cotton in India. Weeds may reduce crop yield to the tune up to 20-80%. He mentioned an interesting old proverb 'Teen sinchai terah gor, tab dekhe gannae kae por', which indicates the importance of weeding in this crop. He emphasized on importance of herbicides in integrated approaches in weed management in sugarcane.

Under oral presentations, Dr Pijush K. Mukherjee spoke on 'Major weeds and their management in fodder crops. Dr Mukherjee spoke on negative impact of weed on fodder quality and quantity. He said weeds like *Trianthema portulacastrum*, *Coccinia grandis*, *Cleome viscosa*, *Amaranthus viridis*, *Spilanthes calva*, *Cichorium intybus*, *Rumex*

dentatus and *Coronopus didymus* and *Celosia argentea* drastically reduced the quality and total green fodder yield. Mixed cropping of food crop and fodder crop combinations often helps reduce some of the noxious weeds associated with fodder crops as well as improve the yield of food and fodder crops. Dr V.P. Singh from Lucknow presented on 'Challenges and opportunities of weed management in sugarcane'. Dr Singh mentioned that about 78% of world sugar demand is met from sugarcane. India ranks second, after Brazil, in area and production of sugarcane in the world. He spoke about the challenges associated with sugarcane production which include range of insect pests and weeds. Dr Singh said that weeds poses severe competition to sugarcane crop due its, wide spacing, slow germination and growth at initial stages, heavy fertilization and frequent irrigations. They severely reduce not only the tonnage, but also its quality besides hindering in the various field operations and harbouring insect-pests and disease. The nature of weed problem in sugarcane cultivation is quite different from other field crops because of inherent capacity of slow initial crop growth and heavy input requirements. Dr Singh emphasized on trash mulching of sugarcane and intercropping with integration with herbicides for effective weed management in sugarcane for improving the cane yield and farmer income. Dr Mukesh Kumar from CRIZAF, West Bengal presented his work on 'Effect of seed rate, row spacing and herbicide on weeds and yield of flax fibre (*Linum usit atissimum* L.)'. Dr Kumar enlightened us that flax (*Linum usitatissimum* L.) fibre is amongst the oldest fibre crops in the world after silk and is used for linen fabrics and also twine and rope. In India the flax is being cultivated for oil seed on residual moisture after harvest of rice and border row of many winter pulses. Weeds are one of the major constraint for enhancing the productivity as it reduced about 20-30% of flax fibre if not controlled because it is weak competitor of weeds. Dr Kumar discussed various weed control methods for flax including herbicides and cultural practices including inter-cropping and crop spacing. Dr Kumar concluded that flax fibre sown with seed rate of 80 kg/ha at 20 cm row spacing and application of pendimethalin 0.75 kg/ha effectively controlled the weeds resulted in significantly higher flax fibre yield. Other presentations were made by Ms. Sonaka Ghosh on 'Weed management in bidi tobacco (*Nicotiana tabacum* L.) nursery'; Dr Bikas Mandal on 'Effect of chemical herbicides on weed management and performance of spring planted sugarcane in Gangetic alluvium of eastern India; Dr Deepak Thorat on 'Field evaluation of interculture-cum-fertilizer applicator in cotton crop'; Dr Kamala Bai on 'Integrated weed management in cotton'; Dr Maninder Kaur on 'Influence of different herbicides on forage yield and quality of oats'

Finally the Chairperson, Dr R.P. Singh summarized the presentations and thanked the speakers and audiences.

TECHNICAL SESSION 10: Herbicide residues, monitoring, mitigation and effect on non-target organisms in weed management

Chair: Dr Shashi Bala Singh

Rapporteurs: Dr Jai Knox

In this technical session, 1 lead and 9 oral presentations were made. In her lead presentation, Shobha Sondhia highlighted the 'Toxicological significance of MRLs with special reference to glyphosate. She narrated many examples of glyphosate long term effect on non-target species. There was lively discussion of the subject. Chairman remarked the need of indepth studies on glyphosate because of its wider use in many situations and its utility for the farmers due to its fast action on non-selective vegetation. Dr T. Ramprakash from Hyderabad presented his work on 'Leaching potential of pyriithiobac-sodium in red and black soils. While Dr. Latit Kumar from Kanpur on 'Dissipation kinetics and residues of pendimethalin in soil, straw and grain of rainy season mungbean'. Dr Kaberi Mahanta from Jorhat, Assam, gave presentation on 'Mitigation of herbicide residues through efficient bacterial consortia'. Manisha Rout discussed on 'Soil microbial population in response to applied herbicides in greengram; and Dr Bharathi Chandrasekaran on 'Mitigation measures for atrazine in soil under maize. Dr Sunil K. Chhodavadia presented work on 'Residual phytotoxicity effects of different integrated herbicides management in soils from field-treated plots and post-harvest field. Dr Irani Mukherjee discussed on ' Fate of metsulfuron methyl and clodinafop propargyl in wheat. Following presentations were also made: Dr Tirthankar Banerjee on 'Simultaneous determination of 146 multiclass pesticides in soil by LC-MS/MS ; Dr Sheeja K. Raj on ' Impact of herbicide mixtures on enzyme activity in puddled rice soil ; Dr Neelam Sharma on Dissipation studies of bispyribac sodium in rice cropped soil and its terminal residues in rice grain

TECHNICAL SESSION 11: Innovation in weed management and new herbicides molecules/formulations

Chair: Dr A.R. Sharma

Rapporteur: Dr Subhash Chander

Session was started after the lunch break by 2:30 pm in Hall-2. Dr. A.R. Sharma, Chairman of the session welcomed the entire presenters and audience. Opening presentation was made by Dr. P.J. Suresh (Monsanto representative) as lead paper on “Glyphosate: myths, reality, claims and apprehension”. He explained about the different toxicological studies on glyphosate and said it does not have any carcinogenic and mutagenic effect to animal/human being. There was a question on the compensation to Mr. Dewayne Johnson of US from Monsanto due to cancer caused by the use of roundup. For this he mentioned that, we still fighting against this case by quoting many case studies. Another lead lecture by Dr. M.B.B. Prasad Babu on “Role of remote sensing in weed delination/management”. He told that near infrared spectral reflectance can be used for the identification of weeds. After that seven oral paper were presented during the session. Among these first oral presentation on “Evaluation of Priority TM 31.95 WG with arylex TM active for post emergence weed control in wheat in India” by Dr. Vinod Mehra. In which he showed its mode of action and its broad spectrum effect on weeds compared to the existing herbicides. Followed by “ Efficacy of XR-484 benzyl ester + penosulam on broad spectrum weed control in transplanted rice” by Dr. Tej Pratap. He highlighted the efficacy of this herbicide against the broad spectrum weeds compared to the existing herbicides for the transplanted. Another two lectures on the new herbicides i.e. halauxifen+florasula+carfentrazone to manage the broad leaf weeds in wheat by Neelam Bisen and Novlect TM (rinskor and cyhalofop) for grass, sedge and broadleaf weed control in puddle direct seed rice in India by Dr. Sunil Kumar. Subsequently presentation were made by Dr. N. Bommayasamy on “Evaluation of suitable encapsulation and loading material for engineering slow release herbicide formulations for season long weed management. He used various type of material for encapsulation but natural zeolite mineral was found most suitable for engineering slow release herbicide formulation for prolonged (season) weed control. Dr. P. Kumaresan gave his presentation on “Bioefficacy of various herbicides in greengram and their residual effect on succeeding mustard crop. He showed that acifourfen + clodinafop was most efficient herbicide in greengram and does not have any phyto toxicity in succeeding mustard crop. Final presentation on “Effect of pre-and post-emergence herbicides on weed growth and yield of maize and their residual effect on succeeding greengram” by Dr. Subramanyam Doddaga. He found that pre-emergence application of alachlor *fb* halosulfuron-methyl + tembotrione (tank mix) is a best treatment to control mixed weed flora in kharif maize and does not have any residual effect of succeeding greengram crop.

MAJOR RECOMMENDATIONS

- Research efforts should be focused on need of farmers to manage the weeds in different crops.
- In response to honorable Prime Minister's call for doubling of farmers' income by 2022, input use efficiency must be increased with innovative and eco-friendly approaches in weed management.
- Development of suitable weed management approaches for organic farming.
- Development of location-specific weed management technologies for whole cropping system instead of a single crop.
- Focused research work on utilization of weeds for developing formulations for the treatment of various disease in man and their use to develop botanical herbicides
- Need of development of suitable farmer friendly Mobile App for proving weed management solution to stakeholders.
- Need of import of more host specific bio agents for biological control of Parthenium, water hyacinth and alligator weed
- Work on herbicide tolerant crops should be expedited and products must be evaluated thoroughly for commercialization.
- More strict protocols must be developed to check the entry of alien invasive weed species into India. Existing protocols may be revised suitably in consultation with nodal agency.
- Need to focus research on myth and reality of widely used herbicide glyphosate to decide its utility in weed management

Date: 17/12/2018
Jabalpur


(Sushil Kumar)
Secretary, ISWS