Asian-Pacific Weed Science Society

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## MESSAGE FROM EDITOR-IN-CHIEF

Dr. Bhagirath S. Chauhan
Queensland Alliance for Agriculture and Food Innovation (QAAFI)
The University of Queensland
Gatton, Queensland, Australia,
b.chauhan@uq.edu.au

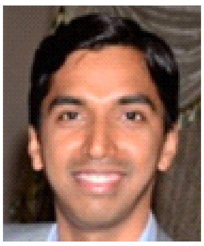
The newsletter of Asian-Pacific Weed Science Society (APWSS) for the month of December 2016 is out now. We have tried to cover different aspects including integrated weed management and weed biology. Recent findings revealed that more work is needed to develop new ways of weed control to overcome the evolutionary barriers associated with weed biology and management. There is a need to keep herbicide use in a more environment friendly and cost-effective way to prevent/delay the evolution of herbicide resistance in weeds. On the behalf of APWSS, I am thankful to all the contributors and participants from different countries for their active involvement in this newsletter. My sincere thanks to Arslan Peerzada who helped me compiling the information. We are trying to improve the structure and materials for this newsletter so that we can increase our accessibility to the diverse audience, particularly young researchers. Therefore, senior weed scientists and researchers are encouraged to send short insight articles covering personal views, new methods, and breaking news related to weed science and invasive plant management. Researchers from Bangladesh, India and Pakistan submit their reports to the contact person for your country (see below). Contributors from other countries submit their reports to Arslan (a.peerzada@uq.edu.au) and copy to me (b.chauhan@uq.edu.au). The next newsletter will be published in June 2017, so please submit your contributions by 15th May 2017.

Merry Christmas and a very happy new year - Bhagirath S. Chauhan

### Country & contact details

Bangladesh - Sharif Ahmed
Specialist-Agricultural Research and Development, Pakistan
International Rice Research Institute
Email: s.ahmed@irri.org

India: Dr. Disha Jaggi
Senior Research Fellow
Plant Physiology
Directorate of Weed Research
Jabalpur, M.P., India
Email: disha.jaggi@gmail.com



Pakistan: Dr. Hafiz Haider Ali
Assistant Professor
University College of Agriculture
University of Sargodha, Sargodha, Punjab, Pakistan
Email: haider3993@gmail.com

## MESSAGE FROM Dr. HIROSHI MATSUMOTO (PRESIDENT, APWSS)

Dear Colleagues,

I hope this year has been going well for everyone. It is now less than a year to the next APWSS conference in Kyoto, Japan (September 2017). Planning by the local organizing committee is well under way. Speakers for keynote and plenary sessions and those of the society's 50th anniversary commemorative symposium have been decided. This information will be shown on the conference website soon. Information about accommodation, call for papers, and grants/awards has been uploaded. Please visit the website once.

Kyoto was the old capital of Japan and is a very popular city among tourists from all over the world. In addition, the venue, Kyoto Research Park, is a well-facilitated meeting place located in the downtown of the city. The local organizing committee has set an early-bird registration fee of JPY 50,000 and late fee of JPY 60,000. The fee for students will be half of these. Banquet, reception, and lunches are included in the fee. In addition, the local committee struggles for fund-raising. Fortunately, many international and local companies are interested to be sponsors. We aim for a scientifically high-level meeting that covers a wide range of weed science topics from the basics to applications. I am looking forward to seeing everyone at the conference.

**Dr. Hiroshi Matsumoto**
President, APWSS
Chairperson, 26th APWSS Conference, 2017

## Research Notes

### MANAGE WEEDS THROUGH ENHANCED CROP COMPETITION IN ASIAN-PACIFIC

***B S Chauhan and A M Peerzada***
*Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), TheUniversity of Queensland, Gatton 4343, Queensland, Australia.*
***email***: b.chauhan@uq.edu.au

In modern agriculture, herbicides from different chemical groups have been used for efficient weed control. Most studies recommend chemicals as a reliable option for controlling weeds as compared to manual or mechanical weed control. However, over reliance on herbicides has resulted in an increased level of resistance in certain weed species in developed regions of Asian-Pacific, particularly Australia, China, Japan, South Korea, Malaysia, New Zealand. Increased weed population shifts and herbicide resistance in weed species against different herbicide groups has increased the concerns of weed management for crop growers. Introduction of herbicide-tolerant crops and increased use of herbicides have resulted in the evolution of several weed species with multiple-resistant traits. In addition, increased dosage of herbicides has also contributed in increasing environmental pollution, as herbicides remain in the soil for many years and may leach down to the underground water bodies. The ultimate solution for reducing the development of herbicide-resistant weed species is the avoidance of repeated uses of herbicides from the same mode of action group. Unfortunately, rotation of herbicides with different modes of action is restricted in developing countries due to limited herbicide options.

Focusing the future concerns of increased chemical weed control, the use of crop competitive abilities against weed species seems to be a valuable cultural weed control strategy in integrated weed management programs across Asia-Pacific. We believe that these ecologically-based weed management approaches have a great potential to meet the challenges associated with conventional weed management strategies. Recent research on crop competition has demonstrated that weed production diminishes under altered or modified crop management practices that reduces the competition between weeds and crops for essential growth resources. Introduction of competitive crop cultivars, modified row spacing and orientation, increased seed rate, and intercropping would be the main tools to enhance crop competition against different noxious weed species. Previous studies also proved that modifying crop management practices will reduce the production cost and decrease the risks of environmental pollution associated with herbicides. In future, researchers and scientists need to investigate the impact of modified crop management practices on weed eco-physiology, phenology, and seed bank dynamics to understand whether these techniques would help in reducing the aggressiveness and invasive mechanisms of different economically damaging and difficult-to-control weed species across this region. Successful findings of cultural weed management strategies should be disseminated among the growers as a sustainable weed management option that will reduce their reliance on herbicides and help combat herbicide-resistant weeds in Asian-Pacific countries.

## TAKING SORGHUM PRODUCTION TOWARD ECONOMICALLY RELIABLE WEED MANAGEMENT

***A M  Peerzada and B S Chauhan***
*Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), TheUniversity of Queensland, Ga  on 4343, Queensland, Australia.*
***email***: a.peerzada@uq.edu.au

Sorghum is the major summer grain crop of the northern region, providing food and feed grains to the poultry, diary, pig, and beef industry in Australia, including New South Wales and Queensland. Production of sorghum in this region is expected to increase because of the increased demand of grains for ethanol production across the world. In these sorghum-growing areas, crop interference with weed species has been reported as an important biological constraint in reducing the crop yield. Farmers have been reluctant to spend money on appropriate weed control measures in sorghum. Furthermore, the increasing use of chemicals and tillage practices has increased the production cost with reduced net economic returns to the farmers. In addition, different chemicals have been reported with reduced efficacy in sorghum due to increased herbicide resistance and crop phytotoxicity. Recently, different economically important weed species have been extending their spread and threatening the grain crop productivity in the northern grain production areas of Australia. Enhanced weed growth under varying climatic and soil conditions make these weed species a big problem to growers and advisers. In addition, only a few herbicides are registered against these weeds.

Focusing the highlighted problems in the control of these weeds, the University of Queensland weed team initiated different research trials for the effective and timely management of various weed species in sorghum through the integration of different chemical and non-chemical approaches. In addition to this, different studies on ecology and biology of key weed species will also be included in the project. The purpose of the study is to identify variations in the growth patterns and reproduction of these weeds. A broad range of techniques will be used to assess the biology, interference, and management of the weed species. Based on findings, suitable management strategies will be evaluated in the field experiments.

## WEED TO WOOD: USING *Lantana* spp. FOR MAKING ECO-FRIENDLY WOOD POLYMER COMPOSITES

**A. N. Rao**

***Consultant***, *ICRISAT Development Center (IDC) & International Rice Research Institute (IRRI), ICRISAT, Patancheru, Hyderabad - 502324, India, email:* anraojaya1@gmail.com

The scientists from the Institute of Wood Science & Technology (IWST), Bangalore have reported that they were successful in converting a Lantana weed's wood to produce wood polymer composites (WPC) by using nanotechnology to mix Lantana wood and plastic. They believed that WPC can be used as cost-effective and eco-friendly alternatives for a variety of applications, such as the construction of window frames, doors, and decks to make household items, like furniture and foot mats. Till to date, WPCs are produced using imported materials in India. WPCs made from wood fibre, thermoplastics, and biopolymers are called green composites, which use recycled materials and are potentially biodegradable with recycling potentiality. Currently, the low-maintenance


Information and Photo source
http://iwst.icfre.gov.in/

WPCs may not be as cheap as wood, but as the market for this new product grows, the prices may come down.

The forest departments in different parts of India normally cuts down tones of Lantana weed and burns it. This weed regenerates as faster as it gets uprooted and burnt. Hence, the IWST scientists are currently working with the forest departments of Karnataka, Tamil Nadu, and Punjab to tackle this menace by using it to make the wood polymer composites. A few NGOs, like the Shola Trust, are also reported to encourage the people living in tribal areas to use the wood for making furniture. These efforts of using Lantana weed are effective means of managing this invasive and fast spreading and poisonous weed. Such initiatives of managing weeds by using them are to be explored for other invasive weeds too.

Information and Photo source: http://www.thebetterindia.com/62268/bengaluru-scientists-lantana-wood-polymer-composites/

## INTEGRATED WEED MANAGEMENT STRATEGIES FOR IMPROVING PIGEONPEA YIELD IN INDIA

**Suryakant Nagre[a] and Subhash Chander[b]**

[a]*Directorate of Weed Research, Jabalpur, M.P. - 482 004, INDIA*

[b]*Economic Botany/Plant genetic Resources, Directorate of Weed Research, Jabalpur, M.P. 482004, India.*

***Correspondence***: sk.nagre07@gmail.com

Pigeonpea [*Cajanus cajan* (L.)] is the fifth prominent legume crop in the world. It is also the second most important pulse crop of India, which has diversified uses as food, feed, and fuel, next to chickpea (*Cicer arietinum* L.). It has been recognized as a valuable source of protein for the vegetarians in their daily diet. Due to cultivation in rainy seasons, slow initial growth, and sowing in wide spaced rows, severe infestations of weeds have been observed in this crop, which results in low grain yield. The most predominant broad- and narrow-leaved weeds reported in pigeonpea are garden spurge (*Euphorbia hirta* L), false amaranth (*Digera arvensis*L), horse purslane (*Trianthema portulacastrum* L.), black catnip (*Phyllanthus niruri* L.), red spiderling (*Boerhavia diffusa* Linn.), Asian spider flower (*Cleome viscosa* L.), Bermuda grass [*Cynodon dactylon* (L.) Pers.], button grass [*Eleusinea egyptiaca* (L.) Desf.] and sedges (*Cyperus spp*.). These weeds compete with the crop for resources, such as moisture, nutrient, and light. However, some major weeds, like purple nutsedge (*Cyperus rotundus* L.) and *D. arvensis*,for instance, are known to have an allelopathic effect on pigeonpea. It has been observed that the initial weed infestation usually depends upon the extent of primary tillage, availability of soil moisture, and the tilth of the seedbed. However, frequent rains intensify the weed problems, and they become difficult to hand weeding at the appropriate time. Furthermore, non-availability of labour for hand weeding is another problem. Studies have reported that these weed species do not cause harm to crops equally all through the growing period. There are certain stages in the crop growth cycle when weeds are more damaging to crop growth and yield. Usually, early season weed competition is most detrimental to the crop and therefore, early season weed control is indispensable. Studies have reported that the specific duration of weed-free situations of a crop resulting into near maximal yield is sufficiently close or equal to that obtained by the season-long weed-free situation. In most of the crops, the first one-fourth ($1/4^{th}$) to one-third ($1/3^{rd}$) period of the total growing duration of a crop, irrespective of growth stages, weed species and environmental (climatic and soil) conditions may be assumed critical for weed competition. In pigeonpea, the initial 6-8 weeks period is the critical period of the crop-weed competition. In this period, crop yield losses due to weeds have been estimated to be up to 60%. Therefore, weeds must be controlled during this period for realizing higher grain yields.

Weed control methods vary greatly with the status of agriculture and the nature of the cropping system. At present, weeds are controlled manually, mechanically or chemically. The predominant method of weed control by mechanical hoeing and manual weeding over the extensive scale is found to decline because of a shift of agricultural labourers to industries for better and assured wages. In addition, increasing human health concerns and environmental sustainability threats restricted the chemical control of weed species. So, there is a need to find effective weed control techniques to keep the weed flora below the economic threshold level (ETL). In this scenario, clean cultivation, use of clean seeds, weed-free seedbed, using well decomposed organic manures, keeping the bunds and irrigation channels free from weeds, cleaned tools and farm machinery, and control of weeds before the reproductive stage are some of the basic and free-of-cost practices to be followed for successful cultivation of any crop. In addition to these practices, destruction of weeds by cutting and removal through hand hoeing, hand pulling, tillage and flooding or desiccation and exhaustion of weeds through burning, soil sterilization, and mulching can also be done.

Researchers reported that mulching is very effective against most of the annual weeds and some perennial weeds such as *C. dactylon* and Johnsongrass [*Sorghum halepense* (L.) Pers.]. Further, the practice of zero tillage along with residue has enough bearing towards weed suppression in cropped and non-cropped situations in addition to conserving soil moisture by reducing evaporation. Some cultural practices such as the choice of crop species, crop cultivars, planting density, crop geometry, inter cropping, crop rotation, time of sowing, crop rotation, fertilizers and irrigation practices have profound effects on weed suppression. To reduce the adverse effect of weeds in field crops, select long duration varieties as these varieties grow quickly and produce large canopy early, resulting in shading and thus suppress the growth of weeds. If initial large flushes of weeds germinating at one point of time are bypassed through manipulation of sowing time of a crop, a little earlier or later than its normal time of sowing, the crop may germinate and have initial growth under almost a weed-free or a less weedy environment.

In term of chemical weed control, pre-emergence applications alone are not sufficient to curtail repeated flushes of weeds during the rainy season, which highly necessitates a post-emergence application following pre-emergence one. Pre-emergence applications of herbicides may help in checking weed growth during the initial period. Recent studies have found pendimethalin, as a pre-emergence herbicide, to be effective in controlling weeds and improving pigeonpea yield. However, it is effective only up to one month and thereafter weeds may pose a problem again. Therefore, the use of herbicides in combination with other weed control techniques reduces the crop-weed competition and the risk of weeds growing unchecked during the period of adverse weather. The integrated weed management approach is advantageous because one technique rarely achieves complete and effective control of all weeds during the crop season. Integrated use of pendimethalin as pre-emergence (0.75 a.i. kg $ha^{-1}$) and a post-emergence application of imazethapyr (100 g a.i. $ha^{-1}$) along with one hand weeding at 50 days after sowing provided higher weed control efficiency in pigeonpea. Integrated weed management provides effective and efficient weed management in pigeonpea. Sometimes, farmers miss the application of pre-emergence herbicides and later, find it very difficult to control weeds manually. Under such situations, post-emergence applications of herbicides may help in alleviating weed problem.

## CURRENT STATUS OF CLEARFIELD® RICE TECHNOLOGY IN MALAYSIA

**Dilipkumar Masilamany[a], Song BengKah[b] and ChuahTseSeng[c]**

[a]*Inbred Rice Program, Rice Research Center, Malaysian Agricultural Research and Development Institute (MARDI), MARDI SeberangPerai, 13200 Kepala Batas, Pulau Pinang, Malaysia.*
[b]*School of Science, Monash University Malaysia, 46150 Bandar Sunway, Selangor, Malaysia.*
[c]*School of Food Science and Technology, University of Malaysia Terengganu, 21030 Kuala Terengganu, Terengganu, Malaysia.*
***email:***dilip@mardi.gov.my

Rice is a staple food for Malaysians. High demand for rice in Malaysia caused the shifting of rice seeding method from transplanting to directseeding in the 1980s. Since then, weedy rice has become a major problem in many rice planting areas. Weedy rice reduces rice yield and grain quality due to its phenotypic and genotypic diversity and its potential to compete against rice in all development stages. Weedy rice appears to possess a wide variation in the characteristics. In a recent study conducted by Monash University Malaysia, weedy rice populations in Peninsular Malaysia were found to be highly diverse morphologically (article published in Weed Science, 64: 501-512). Clustering and PCA analyses revealed four major clusters: 1) *Oryza rufipogon* and the majority of awned, black hull, and brown hull; suggestive of a type of weedy rice originating from wild *Oryza* populations, 2) elite *indica* cultivar rice and the majority of straw hull weeds; indicating weedy rice from Malaysia are mainly evolved from indirect selection on cultivars for easy-shattering feral forms, 3) the majority of brown hull and 4) a mixture of other weedy morphotypes; potentially reflecting multiple origins and subsequent admixture.

Weedy rice infestation threatened rice production in Malaysia, until the introduction of Clearfield® rice cultivars in 2010. Clearfield® rice also known as imidazolinone-resistant rice was obtained through the chemical mutagenesis of seed and traditional breeding. Exposure to a chemical mutagen caused a genetic change that resultedin an alteration to the biosynthetic enzymes produced by the acetolactate synthase (ALS) gene in rice. This change enables the plant to grow healthy even in the presence of imidazolinone herbicides. In Malaysia, two Clearfield® rice cultivars have been developed by Malaysian Agricultural Research and Development Institute (MARDI) namely, MR220 CL1 and MR220 CL2. Both these cultivars were derived from backcrosses between donor line CL1770 from the USA with a popular local cultivar, MR220. Since MR220 CL2 has a short maturity period with less than 100 days as compared with existing registered rice cultivars in Malaysia, this variety has attracted many local rice growers to cultivate even in the weedy rice-free lands. This is evidenced by the increasing numbers of Clearfield® rice cultivation areas from 2011 to 2014. In 2011, only 0.7% of the total rice hectare were cultivated with the Clearfield® varieties. This number was further increased to 5.6, 23 and 50% in 2012, 2013 and 2014, respectively.

Overall,the Clearfield® technology has benefitted the Malaysian rice industry by eradicating the weedy rice problem. For instance, rice yield potentials in weedy rice infested areas have increased from 3.5 to 7.0 metric tons/ha after using Clearfield® technology. Despite the advantages, there is a drawback in this technology. A few years after Clearfield® rice commercialization, the evolution of imidazolinone-resistant weedy rice has been reported in some countries, including the USA, Brazil, Colombia, Costa Rica and Italy. It is expected that the risk of outcrossing will be several times higher in Malaysia where 2 to 3 rice planting seasons are practiced per year without crop rotation. In recent times, many complaints have been received from local farmers about the failure of imidazolinone herbicide to control weedy rice in the Clearfield® rice system. According to the survey, most farmers planted Clearfield® rice for more than 2 consecutive seasons and some extended the planting to 7 seasons. Unfortunately, some farmers ignored the stewardship guidelines by purchasing un-certified seeds, cultivating Clearfield® rice without using imidazolinone herbicide or spraying the herbicide at wrong times and reduced rates. These may have resulted in escape of the resistance trait from Clearfield® rice to weedy or wild rice by natural hybridization. In short, an area where stewardship has been poor, imidazolinone-resistant weedy rice has been discovered. Strict adherence to stewardship guidelines of this technology will be the key to its continued success. Besides, seed laws become necessary in order to combat fraud, counterfeiting and bad quality seeds that contaminate with weedy rice or carry diseases. A good seed certification system that benefits the rice industry requires high commitment and responsibility of all government agencies, private industries and farmers.

## WEEDS AS AN ECOFRIENDLY ALTERNATIVE IN HEAVY METALS REMOVAL

**Amber Raza[a], RabiaRaza[a], FareehaSabir[b], and Arslan Masood Peerzada[c]**

[a] Department of Botany, The Government Sadiq College Women University, Bahawalpur 63100, Punjab, Pakistan.

[b]Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad 38000, Punjab, Pakistan.

[c]Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Gatton, Queensland 4343, Australia.

***Correspondence*:**amber.raza@rocketmail.copm

Contamination with heavy metals, such as cadmium, copper, lead, chromium, and mercury are major environmental issues and it is increasing day by day and causing a significant threat to both the environment and public health. Even at low concentrations, these metals can cause toxicity to humans and other living organisms as their adverse effects are quite evident. Several techniques are presently employed for the removal of heavy metal, such as reverse osmosis, electro-dialysis, ultra-filtration, ion-exchange, chemical precipitation, phytoremediation, etc. Phytoremediation refers to the removal of soil contamination by using plants. Weeds are the most powerful candidate for the title phytoextractor as they pick up metal contents from the soil through their roots and store them into their stems and leaves. Being non-eatable, they pose no threat to living organisms. Upon death, they recycle the absorbed metals. However, when used commercially, they can be uprooted from the soil so the dead plants may not add the removed metals again into a clean soil.

Many weeds have been tested for phytoremediation. Water hyacinth (Eichhornia crassipes Mart.), Bermuda grass [Cynodon dactylon (L.) Pers.], Indian camphorweed[Pluchea indica(L.) Less], black-honey shrub(Phyllanthus reticulatus Pior), barnyard grass (Echinochloa colona L. Link), vetiver grass [Vetiveria nemoralis (A.) Camus.], and slender amaranth (Amaranthus viridis L.) are among the weeds suggested by the researchers for successful phytoremediation. However, not every weed has the potential for phytoremediation. Similarly, all weeds are not equal in their role as some are reported to be better than other weeds for a single metal. Growing weeds along with cash crops may pose threats to crops by serving as a competitor for minerals. Another important point is to grow weeds on soils that were previously subjected to some stress and are now unable to support important cash crops. Increasing population demand for increased supply of food thus exert large pressure on agriculture. Using weeds for phytoremediation may help us in increasing lands suitable for agriculture. In addition, weeds not only remove contamination from soil but prevent soil from erosion, and help in building soil profile by improving soil water and mineral status.

Soils contaminated by chemicals used in wars can be recycled by growing weeds continuously for 2-3 years. But this needs finance and labour. Future experiments are highly recommended to further test the suitability of weeds for phytoremediation in certain areas. Additionally, by searching the gene responsible for phytoremediation, many crops can be directly used for phytoremediation using plant breeding technique. However, this point still needs to be discussed by the researchers.

## WEED MANAGEMENT IN PAKISTAN: CURRENT SCENARIO AND FUTURE PROSPECTS

**A M Peerzada[a] and H H Ali[b]**

[a]*Centre for Plant Science, Queensland Alliance for Agriculture and Food innovation, University of Queensland, Gatton 4343, Queensland, Australia.*

[b]*Department of Agronomy, University College of Agriculture, University of Sargodha, Sargodha 40100, Punjab, Pakistan,*
**email:** a.peerzada@uq.edu.au

Technologies play a significant role in enhancing or sustaining the productivity of agriculture, which contributes significantly as a backbone of Pakistan's economy. Unfortunately, the average potential yield of economically important agronomic and horticultural crops in this country is far less than other developing countries. Despite high yielding varieties, improved technologies, and diverse research systems, the country is unable to meet the food security. In addition to other abiotic and biotic factors, weeds contribute significantly in decreasing the yield potential of important crops in Pakistan. Unfortunately, weed management in Pakistan is limited to tillage and synthetic chemicals, leaving dreadful residual impacts on the environment, plant community, soil and water degradation and human health-related issues. Farmers are facing potential constraints in the sustainable management of weed species in different cropping systems. Increasing trends of herbicide use in major cropping systems, rice-wheat and cotton-wheat, raised several chemical-related issues, including herbicide resistance, weed population shifts, crop phytotoxicity, underground water contamination, and soil degradation through altering the chemical and biochemical properties that adversely affect the germination and yielding potential of succeeding crops. In addition, introduction of several alien and parasitic weed species has further intensified the management problem in Pakistan. Furthermore, unavailability of labours due to migration towards urban areas, increased input costs, and lack of technical personnel have made it difficult for farmers to timely control the noxious weeds and their impact in agroecosystems. The situation seems to be worst in the future, especially due to farmer's unawareness regarding these potential challenges. Still, we have plentiful opportunities to mitigate these emerging challenges in weed management through the adoption of improved and reliable approaches that reduces the impact of herbicides on our agricultural system. Globally, researchers have reported that manipulation of crop management practices, such as competitive varieties, high planting density, narrow row spacing, altered row orientation (right-angled to sunlight), improved irrigation and fertilizer application, crop rotation and intercropping would suppress the competitive potential of weed species that can easily be controlled through reduced herbicide doses. Diversifying herbicide-based weed management through using rotation, tank mixtures, and sequential applications in integration with tillage will help in controlling difficult-to-control weed species. Development of risk assessment systems on the pre-border or post-border level will help in the further entry or spread of invasive weed species in non-infested areas. Utilization of natural enemies would help managing the growth, and reproduction of several noxious and invasive weeds as well as decrease weed soil seedbanks through seed predation. Most importantly, farmer's education regarding conventional or improved weed management approaches will be a significant weapon in the war against non-judicious herbicide use. In short, we have a plenty of options to be used for the development of sustainable weed management in Pakistan, but the need is to enrich the agricultural research sector with innovative researchers that may shift conventional weed management in Pakistan to a world class level. Furthermore, extension workers should be trained with modern information technologies to disseminate improved technologies to the farmers, more appropriately.

## FUTURE NEEDS TO DEVELOP RELIABLE WEED MANAGEMENT TECHNOLOGIES IN HORTICULTURAL CROPS

**F Zulfiqar[a], C Nadeem[a], N Amjad[a], A M Peerzada[b] and S T Bukhari[c]**

[a]*Institute of Horticultural Sciences, University of Agriculture, Faisalabad 38000, Punjab, Pakistan.*
[b]*The Centre for Plant Science, Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Toowoomba, Queensland 4350, Australia.*
[c]*PirMehr Ali Shah, Arid Agriculture University, Rawalpindi 46000, Punjab, Pakistan.*
***email***: ch.faisal.zulfiqar@gmail.com

Horticulture sector contributes not only in public food security, but also improves the economic situation of the growers, and entrepreneurs through increasing land efficiency, generating employment, and increasing exports. Additionally, it provides growers with an opportunity to consume undulating or waste lands and it also act as a source of raw material for horticulture-based industries. Among different biotic and abiotic factors that affect horticultural crop yield potential, weeds are considered as the major biological constraint, which result in high yield losses through competition for essential growth resources or allelopathic interactions as well as providing shelter to serious insect pests and pathogens as an alternative host. Different weed control practice, such as, preventive, cultural, mechanical, biological, chemical control and their integration are widely used for weed management. However, the weed management choice differs in accordance with vegetation life cycles, invasion extent, environmental considerations and management goals. From the previous literature available, we observed that these control options have some limitations regarding their efficacy in different horticultural crops. For example, manual weed control is very less efficient in controlling weed population on large areas due to rigorous weed re-growth, increased labour shortage, and high labour prices. Similarly, delayed weed control due to weather conditions and crop injury as the result of tillage may limit output and subsequently weed control failure are some consequences associated with mechanical weed management. Additionally, many researchers have reported that herbicides may influence the physical as well as chemical properties of products and their quality.

Focusing the emerging concerns of weed problems in economically important horticultural crops, young horticulturists from different renowned institutes are determined to initiate improved weed management in these crops. They believe that still there are many unmet weed control needs in horticultural crops as the agricultural industry has never been interested or able to meet these needs. For example, ecologically-based or non-conventional weed management tools may offer solutions to aggravating problems of herbicide resistance, environmental pollution, weed diversification, biological invasion, and yield losses. In this prospects, improved cultural, mechanical, and biological control can play a part for reducing the overall requirement for herbicides. Advance information on the ecology and biology of weeds, for example, prediction ability of germination or emergence behaviour of weed species with respect to cultural and meteorological proceedings presents numerous practical prospects to cope these challenges. Commercially, systems based on flaming, hot water and steam are used for weeding in horticulture, greenhouses and on hard surfaces. In addition, soil solarisation seems to be an environmentally friendly, simple, and cost-effective practice, suitable to agricultural community with no special precautionary procedures. In future, bioherbicides are supposed to be an economical and environmentally-friendly advancement to balance conventional methods, which will facilitate to meet the new demands for weed management in horticultural crops. With the advancement of electronics and information technology around the world, diverse sensing systems have been developed for horticulture production systems. In addition, abrasive weed control is in great potential for increase the profitability and sustainability of organic vegetable cropping systems by effective weed control. Towards enhanced integrated weed management, many momentous research steps are forwarded, but still weeds are at the top distress among specialty crops growers. No doubt weed management in these horticultural crops are as important as other crop protection approaches, still there are gaps that need to be filled in the future. We are hopeful that development of more advanced and reliable weed management strategies will open new ways for weed control in horticultural crops.

## ACETYL-CoA CARBOXYLASE INHIBITOR RESISTANCE IN LITTLESEED CANARYGRASS-FIRST CASE FROM PUNJAB, PAKISTAN

**T Abbas[a], M A Nadeem[a], A Tanveer[a] and H HaiderAli[b]**

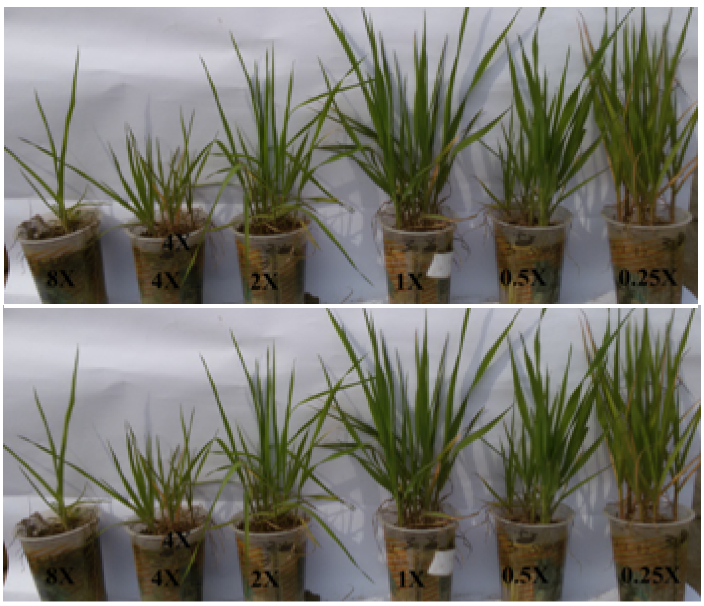
[a]*Department of Agronomy, University of Agriculture, Faisalabad, 38040, Punjab, Pakistan.*
[b]*Department of Agronomy, University College of Agriculture, University of Sargodha, Sargodha 40100, Punjab, Pakistan,* ***email***: tagondaluaf@gmail.com

Widespread herbicide resistance in littleseedcanarygrass (*Phalaris minor* Retz.), a most-troublesome weed of wheat is a major wheat sustainability issue in Pakistan and many other countries. Littleseedcanarygrassis a self-pollinated winter season annual grass. Yield losses in wheat due to this grass vary between 25 to 50% and may result in complete wheat crop failure due to heavy infestation of this grass (2000-3000 plants $m^{-2}$). Therefore, use of post-emergence herbicides was crucial to control this grass in wheat. Acetyl-CoA Carboxylase (ACCase) inhibitor herbicides (fenoxaprop-P-ethyl, clodinafop–propargyl and pinoxaden) have been successfully applied to control this grass in wheat for years. Recently, the weed is becoming difficult to control in wheat fields with the most commonly used herbicide fenoxaprop-P-ethyl (Puma super). Therefore, a study was conducted to evaluate the status of fenoxaprop-resistant littleseedcanarygrass in Pakistan. In addition, the efficacy of alternative herbicides to control this grass was also tested.

We conducted a survey in collaboration with Punjab Agriculture Extension Department at different locations to collect resistant putative populations' seeds. A dose response bioassay was conducted for resistance confirmation. Also, the possibility of cross resistance and alternative herbicidal control of fenoxaprop-resistant littleseedcanarygrass to clodinafop–propargyl, metribuzin, pinoxaden, and sulfosulfuron were tested using the dose-response bioassay. All collected populations showed a different level of resistance to fenoxaprop ranging 2.5-6.0. Among the alternate herbicides metribuzin, pinoxaden and sulfosulfuron provided good control of fenoxaprop resistant populations, however, a low level of cross-resistance was shown against clodinafop. This confirmation of ACCase inhibitor resistance is the first resistant incident in Pakistan. Based on these studies, currently, there is an opportunity of using alternate herbicides including clodinafop, pinoxaden, metribuzin and sulfosulfuron to manage fenoxaprop-resistant populations. To avoid the resistance development in alternative herbicides, use of herbicide mixtures, herbicide rotation, and proper doses and time of application need to be practiced.

*Wheat field infested with of fenoxaprop resistant P. minor from Gujranwala*

Response of five P. minor populations and susceptible (left) to recommended dose (93.75 g a.i. $ha^{-1}$) of Fenoxaprop 21days after spray




Response of most resistant *Phalaris Minor* (from Gujranawala) to 7 rates (0.25-8X) of fenoxaprop 21days after spray

## WEED CONTROL THROUGH ARBUSCULAR MYCORRHIZAL FUNGUS (AMF) INOCULATION

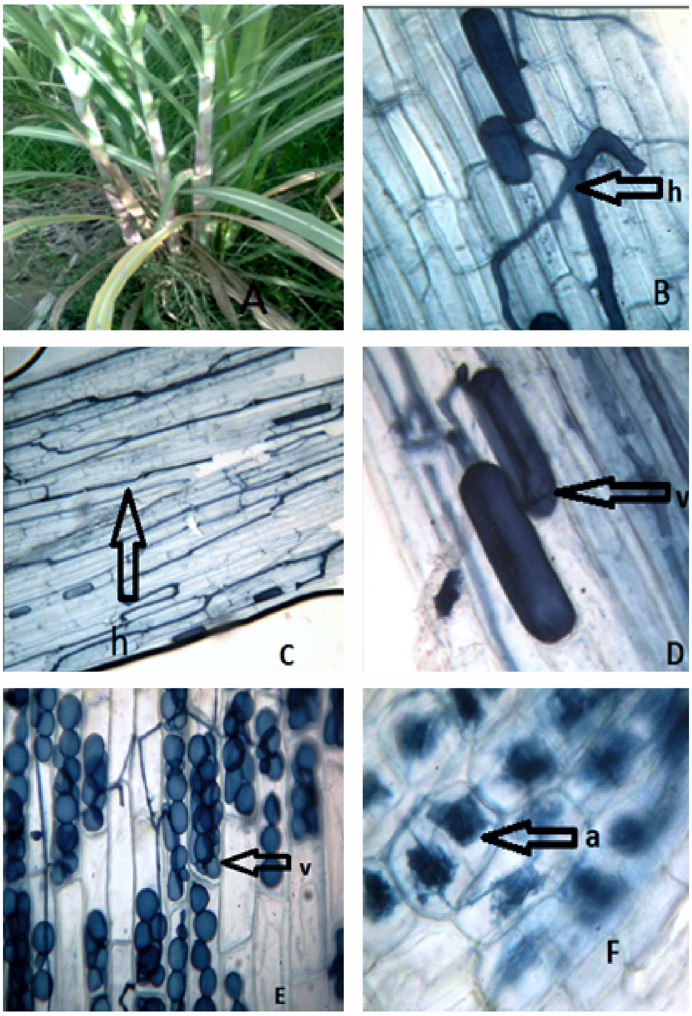
**N Batool**

*Department of Botany, Government Degree College for Women, Haroonabad 62100, Punjab, Pakistan.*
*e mail: nimrabatool22@gmail.com*

Weeds represent one of the most serious problems in crop production, with a potential crop loss of up to 34% annually. So their control is necessary for better crop growth and production. Different strategies are being used for this purpose. However, most farmers rely on chemical control for weed management due to its effectiveness and easy application. Continuous and blind use of herbicides has altered the weed genotype, thus leading to more resistant genotypes than ever. This means that there isa need to constantly develop new herbicides that not only cost time but also money. Agricultural policies also restrict the use of most of the chemical products and promote the practices that are environment-friendly in farming systems. If dependence on herbicides is reduced, farmers will be more dependent on mechanical weed control practices, like tillage that also has environmental limitations related to soil degradation. Hence, there remains a serious demand for alternative environment-friendly weed control methods that can be used as effective weed management in agricultural systems. A possible approach is biological weed control through soil microorganisms and most effectively through arbuscular mycorrhizal fungi (AMF).

As far as weeds are concerned, there are some AMF species that are able to restrict the growth of weeds because most of the weeds are non-mycorrhizal (only 10-15% are mycorrhizal).This is due to their choice of habitats during evolution such as preference of places with less abundance of AMF (e.g., disturbed habitats), less needs to acquire immobile nutrients (e.g., nutrient-rich habitats like aquatic or wetland habitat), and by developing root systems well adapted to nutrient uptake (e.g. long and highly branched). Researchers believe that AMF can be used as an effective method for weed control. Negative effects of AMF on weeds are due to production of chemicals to suppress the growth of weeds. Some weeds prefer successional environments and many have colonized agroecosystems, which are often heavily disturbed environments and particularly in areas where AMF abundance and diversity is reduced by agricultural practices, for example, mono-cropping and tillage.

AMF have been found to restrict the growth of weeds living side by side the crop plants to which they provide benefit at the same time. So, it can be hypothesized that using AMF can help not only to control weeds but to improve crop yield. These AMF species reside on plant roots and help in establishing hyphal network inside the root and soil so that nutrients can easily be transported to plants. Apart from nutrients, AMF protect plants from pathogen attacks, for example, AMF association decreases the root infection of the fungal pathogen *Fusarium oxysporum* in its susceptible plants. Yields of many crops such as cotton (*Gossypiumhirsutum* L.), sugarcane (*Saccharumofficinarum*L.), sunflower (*Helianthus annuus* L.) and wheat (*Triticumaestivum*L.) were increased by the application of some arbuscular mycorrhizal species. In addition, AMF provide several benefits to the ecosystem by influencing the ecosystem functions such as plant productivity, plant diversity, soil structure and nutrient cycling. The suppressive effect of AMF on the growth of some weeds, especially in coexistence with crop plants, is of great interest for the development of sustainable farming systems, where weeds can be managed to tolerable levels. By inoculation of AMF, the yield of crops can be increased as well there will be an obvious reduction in weed population densities. It would also lower the expenditures of intensive herbicides and tillage practices that are used in conventional farming systems.



*Saccharumofficinarum* and its roots showing AMF association which helps in exchange of materials**(A)**.*Saccharumofficinarum*plant. **(B& C)**. Hyphal interaction of AMF with roots cells. **(D & E).** AMF Vesicles (oil storing structures) in roots, **(F)**. Arbuscules (branches of AMF for exchange of nutrients).

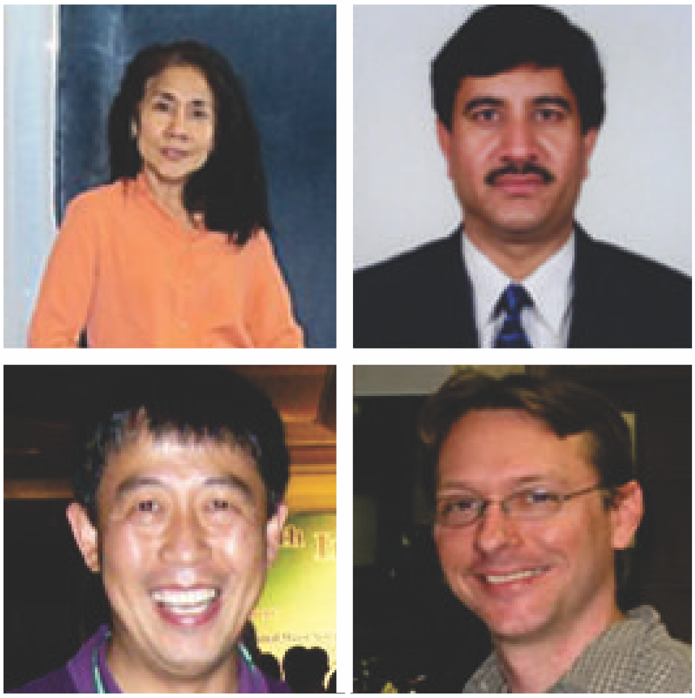
## News and Event

### NEW OFFICE BEARERS OF INTERNATIONAL WEED SCIENCE SOCIETY (IWSS)

**A. N. Rao**

**General Secretary, APWSS and *Consultant***, *ICRISAT Development Center (IDC) & International Rice Research Institute (IRRI), ICRISAT, Patancheru, Hyderabad - 502324, India, email:* anraojaya1@gmail.com

Elections were held for elections to the IWSS Board for the term of 2016-2020, prior to 7th IWSS Congress, for the positions of Vice President, Secretary and Treasurer of IWSS. At the General Body meeting by Dr. Nilda Roma-Burgos, President, IWSS has announced that: a) Dr. Samunder Singh (India) was elected as Vice President, IWSS; ii) Dr. Do-Soon Kim (Korea) was elected as Secretary, IWSS and Dr. Ian Cristofer Burke (USA) was elected unanimously as Treasurer, IWSS. Dr. Do-Soon Kim has served APWSS earlier as Secretary. All of them took charge of their respective positions and will hold the respective office during the term 2016-2020. APWSS wishes them all the best in their activities to strengthen the Weed Science, globally.



Photos: Dr. Nilda Roma-Burgos, President; Dr. Samunder Singh, Vice President; Do-Soon Kim, Secretary and Dr. Ian Cristofer Burke, Treasurer of IWSS (2016-2020).

### 7TH INTERNATIONAL WEED SCIENCE CONGRESS HELD IN PRAGUE, CZECH REPUBLIC

**A. N. Rao**

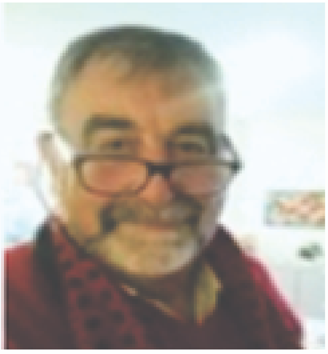
**General Secretary, APWSS and *Consultant***, *ICRISAT Development Center (IDC) & International Rice Research Institute (IRRI), ICRISAT, Patancheru, Hyderabad - 502324, India, email:* anraojaya1@gmail.com

7th International Weed Science Congress was held at Prague, Czech Republic from 19 to 25 June 2015. More than 628 scientists across the globe participated in the conference and about 257 papers were presented orally in 4 plenary and 51 concurrent sessions. In addition, 388 posters were displayed during the conference period. Plenary papers were presented by Hermann Stubler on “Weed control at cross roads – which innovations are at the horizon”; Schulze-Stentrop on “Application technique - The challenge of future spraying”; L.H. Ziska on “Climate Change, $CO_2$ and the consequences for weed biology: Threats and opportunities”; and Petr Pyšek on “Global perspectives on plant invasions”. The theme of the congress was on “Weed Science and Management to feed the planet”. However, a larger number of papers, presented at the congress, were on herbicide-resistance in weeds, indicating the severity of weeds resistance problem in developed world. At the congress, outstanding Achievement Award for 2016 were given to: Marco Quadranti (Switzerland); Bernal Valverde (Costa Rica); Jens Streibig (Denmark); PrasantaBhowmik (USA)

(Photo: 1). Large number of scientists from Asian-Pacific region have actively participated in the congress

(Photo: 2). The 8th International Weed Science Congress will be held in Thailand in 2020.

Participants from India and other countries of Asian Pacific Region at the IWSS congress, Prague.



Recipients of the IWSS Outstanding Achievement Awards – 2016

## 13TH NATIONAL WEED SCIENCE CONFERENCE OF WEED SCIENCE SOCIETY OF PAKISTAN

**M A Khan**

***Associate Professor***, *Department of Weed Science, The University of Agriculture, Peshawar25130, Khyber Pakhtunkhwa, Pakistan, email:* azim@aup.edu.pk

*Few Glimpses of 13th National Conference of Weed Science, Upper Dir*The 13th National Weed Science Conference was heldfrom August 19-21, 2016 at Shaheed Benazir Bhutto University Sheringal, Upper Dir with the theme "Vegetation management in the era of climate change for sustainability". The conference was organized by the Weed Science Society of Pakistan (WSSP). The conference was attended by more than 180 students and faculty members from various fields of agriculture, herbal practitioners, NGOs and universities. Overall, delegates from four provinces of the country participated in the conference. Graduate students and faculty members presented 112 papers on various aspects of weed science. The president of WSSP (Prof.Dr. Khan BahadarMarwat) and Secretary General (Prof.Dr. Gul Hassan) suggested that weed management techniques need to be applied by keeping in mind the social and economic status of the people. WSSP was constituted in 1987 and initiated a research journal (Pakistan Journal of Weed Science research). Currently volume 22 is in press.



## STUDENT TRAVEL GRANTS TO ATTEND 26th APWSS CONFERENCE, KYOTO, JAPAN

**A. N. Rao**

**General Secretary, APWSS and** ***Consultant*** *, ICRISAT Development Center (IDC) & International Rice Research Institute (IRRI), ICRISAT, Patancheru, Hyderabad, 502324, India,*

*email:* anraojaya1@gmail.com

The Asian Pacific Weed Science Society Conference will be held at Kyoto, Japan from 19 to 27 September 2017. "APWSS 2017 Kyoto Student Travel Grants: were announced for students and young scientists by the local organizing committee of APWSS. The announced awards include: i. The 26th APWSS Student Travel Grant (5 awards of 30,000JPY each) and ii. The International Weed Science Society (IWSS) Student Travel Grant (3 awards; US $ 500 each). These travel grants and awards are funded by APWSS Conference Organizing Committee, the Weed Science Society of Japan, and the International Weed Science Society. These awards will provide a unique opportunity for young researchers, especially students to present their research and discuss with leaders in their fields at the APWSS Conference and receive encouragement to continue their work. The travel grants eligibility and criteria details of the awards may be obtained from the link. In addition to these, APWSS-2017 Kyoto Best Oral & Poster Presentation Award also will be awarded and the information of these awards will be provided soon by the organizing committee on the APWSS website. All the young weed scientists are encouraged to use the opportunity and attend the 26th APWSS Conference at Japan.

## Opportunities

### RECRUITMENT POSITIONS FOR PLANT/WEED SCIENTISTS

**Plant Protection Specialist**
**Employer:** Department of Agriculture, Food, and Forestry **Location:** Oklahoma, USA.
**Contact Person:** Jayce Prock
**Email:** jayce.prock@ag.ok.gov

**Ph.D. Graduate Research Assistantship**
**Employer:** Virginia Tech
**Location:** Blacksburg, VA, USA. **Contact Person:** Dr. Jacob Barney **Email:** jnbarney@vt.edu

## Upcoming Events

### INTERNATIONAL MEETING/CONFERENCES ON WEED SCIENCE AND INVASIVE PLANTS IN 2017

**19th International Conference on Plant Protection Sciences**

**Dates:** January 12-17, 2017
**Location:** Durban, South Africa

**Annual Meeting of the Weed Science Society of America-2017**
**Dates:** February 6-9, 2017
**Location:** Tucson, Arizona, USA.
**E-mail:** wssameetings@allenpress.com.

**The Biennial Conference of Indian Society of Weed Science**
**Dates:** 23 - 25 February, 2017
**Location:** Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India
**Contact Persons:**Dr. A.R. Sharma or Dr. Arvind Verma; **Email:**iswsjbp@gmail.com or arnd_verma@rediffmail.com; **Website:** http://bc.isws.org.in/

**2nd Global Herbicide Resistance Challenge Conference "Challenge Accepted"**

**Dates:** May 14-18, 2017
**Location:** Denver, Colorado, USA.
**Contact person:** Dr. Todd Gaines
**E-mail:** todd.gaines@colostate.edu

**The Annual Plant Biology Meeting-2017**
**Dates:**June 24-28, 2017
**Location:** Honolulu, Hawaii
**Contact Person:**ConferenceOrganizers **Email:** meetings@aspb.org.

**58th Annual Meeting of Society for Economic Botany**

**Dates:** June 4-9, 2017
**Location:** Bragança, Portugal
**Contact Person:** Organizers
**Email:** seb2017@ipb.pt

**14th World Congress on Parasitic Plants**

**Dates:**June 25-30, 2017
**Location:** California, USA.
**Contact Person:** John Yoder
**Email**: jiyoder@ucdavis.edu

**19th International Botanical Congress**
**Location:** Shenzhen, China. **Dates:** July 23-17, 2017
Contact Person: Congress Secretariat E-mail: office@ibc2017.cn

**26th Asian-Pacific Weed Science Conference**

**Dates:September 19-22, 2017**
**Location:** Kyoto, Japan.
**Contact Person:** Hiroshi Matsumoto
**E-mail:** hmatsu@biol.tsukuba.ac.jp

Acknowledgement: APWSS thank Mr. YSN Murthy for his help in the DTP work of this Newsletter