

Proceedings of the ISWS Biennial Conference – 2024
Theme: “Climate-smart Weed Management for Global Food Security”
(28-30 November, 2024)

Venue: Banaras Hindu University, Varanasi, India

The Indian Society of Weed Science, ICAR-Directorate of Weed Research, Jabalpur, and Banaras Hindu University, Varanasi jointly organized the Biennial Conference on “*Climate-smart Weed Management for Global Food Security*” at BHU, Varanasi during November 28-30, 2024, to address weed-related losses, discuss climate-resilient weed management strategies, and promote global food security. Approximately 400 delegates from India and abroad attended.

28th November 2024

The inaugural session of the conference was held on November 28, 2024, chaired by Dr. Panjab Singh, Chancellor of Rani Lakshmi Bai Central Agricultural University (RLBCAU), Jhansi and Former Secretary (DARE) & DG, ICAR. Dr. S.K. Chaudhari, DDG (NRM), ICAR was the Chief Guest, while Dr. Samunder Singh, President of the International Weed Science Society, USA, was the Guest of Honour.

At the outset, Prof. U.P. Singh, Dean of the Institute of Agricultural Sciences (IAS), BHU, welcomed the delegates, outlined educational and research activities at the IAS, BHU, Varanasi, and emphasized the importance of food security amidst climate change. Dr. J. S. Mishra, President of ISWS and Director, ICAR- Directorate of Weed Research, Jabalpur, addressed key weed-related challenges, including biodiversity threats, health and environmental concerns, herbicide residues, and resistance issues. He highlighted opportunities like genetic engineering for herbicide-tolerant crops, drone-based herbicide applications, and robotics in weed management. Dr. Mishra also reviewed ISWS's proactive efforts in addressing emerging weed science challenges under climate change.

Dr. S.K. Chaudhari emphasized leveraging technologies like machine learning, block chain, drones, precision farming, robotics, remote sensing, digital farming, and AI to develop climate-smart weed management practices. However, he expressed concern over their limited transformative potential in direct-seeded rice (DSR) and other ecologies due to insufficient efforts and understanding. He urged the scientists to enhance their capacity for these technologies, promote public-private partnerships, and prioritize strategic interventions for sustainable agriculture. He suggested including sessions for young entrepreneurs and start-ups on new technologies and incentivising farmers for effective weed management. Additionally, he recommended drafting policy briefs to address key weed management gaps aligned with government priorities and good agricultural practices.

Dr. Panjab Singh highlighted the significant crop losses of up to 37% caused by weed infestation and the impact of climate change on weed dynamics, herbicide efficacy, and cropping systems. He stressed the need for smart weed management technologies to address water shortages, environmental degradation, and shifting weed dynamics. He also called for research on nano-technology, remote sensing, weed seed bank management, and developing new crop types for weed suppression. Dr. Singh emphasized the role of biological weed control and strategic interventions, particularly in transitioning from conventional to natural farming. He also discussed controlling parasitic weeds through resistance breeding.

Dr. Samunder Singh linked climate change to GDP loss, noting that a 1°C rise in temperature could reduce GDP by 12%, with additional losses due to water contamination. He highlighted Kyminasi Plant Crop Booster for drip irrigation and suggested exploring CRISPR-Cas9 genome editing for climate-smart weed management.

Three publications were released on the occasion *viz.* एकीकृत खरपतवार प्रबंधन की नवीन तकनीकियाँ by RP Dubey, JS Mishra and VK Choudhary; Proceedings (Abstracts) of the Biennial Conference-2024 (Eds. Yadav Ashok, Subramanyam D, Kaur Simerjeet and Dubey RP) and the fourth issue of *Indian Journal of Weed Science*.

The ISWS Awards for the Biennium 2022-2023 were announced by Dr. R.P. Dubey, Secretary, ISWS.

ISWS Awards	Year	Recipients
Lifetime Achievement Award	2022-23	Dr. A.N. Rao
Special Recognition Award	2022-23 2022-23	Dr. N.N. Angiras Dr. U.S. Walia
ISWS Gold Medal	2022 2023	Dr. Shobha Sondhia Dr. Gulshan Mahajan
ISWS Fellow	2022 2022 2022 2023 2023	Dr. V.K. Choudhary Dr. U.P. Singh Dr. P. Murali Arthanari Dr. Simerjeet Kaur Dr. D.K. Roy
ISWS Recognition Award	2022-23 2022-23	Dr. Shikha Joshi Dr. Avanish Prakash Singh
ISWS Dr. T.V. Muniyappa Young Weed Scientist Award	2022-23	Dr. B.S. Gohil
ISWS Prof. V.S. Rama Das Young Weed Scientist Award	2022-23	Dr. Jeetendra Kumar Soni
ISWS Shree A. Rama Rao Best Ph.D. Thesis Award	2022-23	Dr. Rishi Raj
ISWS Mrs. A. Anasuya Best Ph.D. Thesis Award	2022-23	Dr. Sonaka Ghosh
ISWS Best Book Award	2022-23	Prof. Mahesh K. Upadhyaya
ISWS Prof. B.S. Chauhan Best Paper Award	2022 2023	Sachin Kumar <i>et al.</i> Aayoush Raj Regmi <i>et al.</i>

The session concluded with a vote of thanks by Dr. M.K. Singh, Local Organising Secretary of the conference.

Keynote and Plenary Lectures

Chair: Dr. Raghavan Charudattan, USA
 Co-chair: Dr. M.S. Bhullar, PAU, Ludhiana
 Rapporteurs: Dr. P.K. Mukherjee and Dr. T. Ram Prakash

Keynote Lecture

Dr. Robert L. Zimdahl, Professor Emeritus, USA was invited to deliver the Keynote Lecture, however, he could not join the conference hence, a recording of his lecture on “The Future of Weed Science” was played. The major highlights of his address were:

- Humans shape the landscape, and agricultural production must remain sustainable while addressing society's moral responsibilities.
- Agriculture should prioritize environmental protection, biodiversity, and planetary health over profitability alone.
- The rapid pace of climate and ecosystem change necessitates urgent, thoughtful action.
- Justifying agricultural practices solely by the need to feed a growing population is insufficient to counter their negative environmental and social impacts.
- Agriculture faces scientific challenges: sustainability, maintaining production, addressing resistance (pesticides/antibiotics), managing invasive species, preserving biodiversity, biotech/GMOs concerns, and mitigating pollution.
- Agriculture's ethical responsibilities includes achieving sustainability; addressing water, soil, and human pollution; preventing habitat destruction and species harm; supporting small farms and rural communities; responding to concerns about biotechnology/GMOs and food nutrition and preserving crop genetic diversity.
- Sustainable weed management should focus on preventing weeds through better understanding of seed dormancy and germination, rather than post-germination control. Early weed emergence is less harmful than later growth, emphasizing timely herbicide use and integrated techniques.

- Agricultural science curriculums should include the societal and environmental impacts of agriculture.
- Understanding weed population dynamics is crucial for sustainable weed management.
- Achieving sustainable weed management requires integrating herbicide technology with other approaches, including nanotechnology, weed biology/ecology, and robust management practices.
- Non-herbicidal weed management research must demonstrate a low risk of crop failure and profitability.
- Advocate integrating agroecological weed management with socio-economic and technological approaches.
- Weed scientists should develop comprehensive, economically viable integrated cropping and weed control systems that include herbicides as a critical component.
- Aim to create integrated crop management systems that prevent crop failure, minimize environmental harm, and ensure food security for all.

Plenary Lecture - 1

Dr. Nimal Chandrasena, Australia delivered a lecture on “*Weeds as Boundary Objects and Promoting the Utilization of Weeds – A Way Forward*”. The major highlights were:

- Weeds, comprising 9-10% of known plant species, are integral to Earth's biological diversity and are ecologically "colonizing plants."
- These colonizing species contribute significantly to all five ecosystem services: provisioning, regulating, habitat, cultural, and evolutionary.
- The concept of "weeds" and their utilization serves as a "boundary object," bridging diverse perspectives while fostering rational discussions and stakeholder collaboration.
- Weeds demonstrate resilience and adaptability to climate change and selection pressures, highlighting their pioneering ecological role.
- Weed scientists should engage more with policymakers and social ecologists to address weed management holistically.
- Developing a better understanding of colonizing taxa is crucial to avoiding unsustainable and harmful weed management practices. Lessons from the rapid evolution of herbicide-resistant weeds should guide future strategies.
- Weeds stabilize ecosystems by providing vegetative cover, anchoring nutrient cycles, enriching biodiversity, and supporting pollinators and food webs for humans and animals.
- As colonizing species, weeds can significantly contribute to achieving the United Nations Sustainable Development Goals (SDGs).
- Fast-growing, drought-tolerant colonizing plants (weeds) will play a vital role in the development and maintenance of future urban and rural landscapes.
- Many countries have successfully utilized weedy taxa and their bioresources, but the Asia-Pacific region has yet to prioritize weed biodiversity and utilization in its discourses.

Technical session 1: Climate-smart weed management and herbicide resistance and its management

Chair: Dr. L.S. Brar

Co-Chair: Dr. T.K. Das

Rapporteurs: Dr. K.N. Geetha and Dr. C.R. Chethan

The session included one lead lecture and eleven oral presentations. The key highlights were:

- The application of AI for weed identification and management is essential for future advancements in weed control.
- The use of nano-herbicides delivered through drones is expected to play a key role in the future of weed management.
- Sequential application of imazethapyr (100 g/ha, as early and late post-emergence) in herbicide-tolerant rice provides effective weed control, particularly for weedy rice.

- Using *Sesbania* (60 kg/ha) as a cover crop combined with the herbicide bispyribac-sodium followed by 2,4-D provides effective weed management in direct-seeded rice (DSR).
- Paired row planting of pigeon pea (45 cm) with Urd bean or sesame (2:2 ratio) offers excellent weed control and increases yield.
- Future predictive models for weed distribution should be enhanced with basic ecological parameters.
- In pearl millet intercropped with custard apple, application of pendimethalin (1.0 kg/ha) followed by (*fb*) 1 hand weeding at 25 days after sowing (DAS); atrazine (1.0 kg/ha) *fb* 1 hand weeding at 25 DAS or atrazine (1.0 kg/ha) *fb* tembotrione (100 g/ha) provides excellent weed control with improved economics.
- Atrazine (1.0 kg/ha pre-emergence) *fb* topramezone (25.2 g/ha as post-emergence) with irrigation water (IW) or crop evapotranspiration (CPE) ratio of 1.2 provides excellent weed control in maize.
- *Phalaris minor* is effectively controlled by ACM 9 (a combination of clodinafop and metribuzin).

Technical Session 2: Recent approaches for integrated weed management in rice and rice-based cropping systems

Chair: Dr. A.N. Rao
 Co-Chair: Dr. P. Prameela
 Rapporteurs: Dr. V. J. Patel and Dr. J.K. Soni

The session included one lead lecture, two invited and fourteen oral presentations. The key highlights were:

- Develop a reconnaissance system for weed monitoring, infestation prediction, and early warnings. Advanced tools like digitally-enabled monitoring, herbicide-tolerant rice, and drone-based control for direct-seeded rice systems need to be utilized.
- Integrate herbicides for herbicide-tolerant (HT) rice for weed control, such as pendimethalin (750 g/ha) as PE *fb* imazethapyr (100 g/ha) as PoE or pendimethalin + penoxsulam (625 g/ha) as PE *fb* imazethapyr PoE. Also, rotate herbicides with different modes of action to delay resistance development.
- Important to develop strategies for managing weeds in deepwater rice along the Brahmaputra river ecotone to boost deepwater rice productivity.
- Capsule-based herbicide application with precise dosage offers a cost-effective and environmentally friendly approach to weed control in transplanted rice. Advanced delivery systems such as hydrogels, nano-herbicides, drones, and biodegradable mulch reduce herbicide loss, improve efficiency, and support sustainable agriculture.
- Integrated weed management in rice-wheat-sesbania systems, combining herbicide use with hand weeding effectively controls weeds and enhances yields. Zero tillage in wheat and direct-seeded rice (DSR) improves sustainability and weed management.
- Under conventional tillage, applying pendimethalin (1.0 kg/ha) as PE *fb* fomesafen (110 g/ha) + fluazifop-butyl (110 g/ha) as PoE (at 20 DAS) in greengram leads to higher seed yields and profitability.
- Applying penoxsulam 9% + pyrazosulfuron-ethyl 6% WDG (340 g/ha) as PE ensures effective weed control and improved yields in transplanted rice.
- Zero tillage and herbicide strategies in rice-wheat-greengram systems applying pyrazosulfuron-ethyl (25 g/ha) PE *fb* cyhalofop-butyl + penoxsulam (100 + 25 g/ha) PoE at 20 DAS (in rice), pyroxasulfone PE *fb* clodinafop + metsulfuron PoE (127.5 *fb* 60+4 g/ha) in wheat and pendimethalin (1000 g/ha) PE, *fb* imazethapyr (100 g/ha) PoE at 20 DAS for optimal control of weeds and higher system productivity.

- In upland rice in Meghalaya, weed control during the critical period for weed competition (15–66 DAS) prevents yield loss. Spatial analysis and GIS can monitor weed density and diversity in high-density areas, aiding in long-term strategies.
- In semi-dry rice, combine irrigation (when water drops 10 cm below the soil) with pendimethalin (1.0 kg/ha) PE and bispyribac-sodium (25 g/ha) PoE at 15 DAS. This approach enhances crop growth and productivity.
- Using the Arize 6444 hybrid of rice with square planting under DSR, hand hoeing at 12 DAS, and *Sesbania aculeata* co-culture at 45 DAS effectively reduces weed density while improving sustainability.
- Weed management in rice-chickpea-greengram systems, zero-tillage with crop residue retention (ZTR) coupled with weed management pretilachlor + pyrazosulfuron (615 g/ha) PE *fb* bispyribac-sodium (25 g/ha) in rice, pendimethalin + imazethapyr (1000 g/ha) *fb* hand weeding at 30 DAS in chickpea and pendimethalin (678 g/ha) *fb* hand weeding at 30 DAS in greengram provided sustainable weed control and higher system productivity.
- Under CA, Z+R in rice-wheat systems reduces weed density (22.12% in rice, 28.43% in wheat) and increases productivity (14.5%). Rotating herbicides prevents resistance and minimizes resource degradation.
- Short-duration rice variety Purna excels under dry DSR conditions with traits like early emergence, tall stature, and early maturity, offering high yields and net returns. Purna, IR64-Drt1, and Abhishek are recommended under varying weed pressures.
- Remotely piloted Aerial Systems (RPAS), RPAS for aerial herbicide application offers comprehensive weed control. Future research should optimize nozzle types and formulations for uniform distribution across growth stages.

Technical session 3: Current trends in integrated weed management in pulses and oilseeds

Chair: Dr. V. Pratap Singh

Co-chair: Dr. Arvind Verma

Rapporteurs: Dr. D. Sreekanth and Dr. Puja Ray

The session included one lead lecture, two invited and sixteen oral presentations. The key highlights were:

- Integrate advanced technologies like AI-based machinery, weed mapping, robotics, and site-specific weed management with biotechnology under the integrated weed management (IWM) framework. These innovations were highlighted as essential for efficient and economical weed control to sustain pulse production.
- Efficacy and economic benefits of the sodium salt of acifluorfen combined with clodinafop were established for chickpea weed management compared to other post-emergence herbicides.
- The importance of studying genotypic sensitivity to herbicides within the IWM framework in oilseed crops was highlighted.
- Sulfentrazone + clomazone can serve as an alternative to pendimethalin for weed control in soybean.
- Pendimethalin (PE) *fb* sodium acifluorfen + clodinafop (PoE) is a suitable option for weed control in black gram.
- The bio-efficacy of topramezone applied early PoE in chickpea reduces weed density and dry biomass.
- Excellent weed control and yield enhancement in soybean was obtained using fluazifop-butyl + fomesafen.
- Identified herbicide-tolerant pulse genotypes such as field pea (*P 637* against metribuzin) and chickpea (*JCC 121315* against imazethapyr).
- Pendimethalin + imazethapyr is effective for weed control in lentil.

- Advocated conservation agriculture (CA) as part of IWM, focusing on weed reduction and profitability in the maize-wheat-greengram system.
- Propaquizafop is an effective herbicide for sesame.
- Propaquizafop + imazethapyr is effective in managing weeds in common beans.
- Combined guar gum polymer with propaquizafop + imazethapyr is effective for managing *Melochia corchorifolia* in sesame.

In the evening a General Body meeting of ISWS members was held to discuss various issues concerning the functioning of the Society. ([Proceedings in Annexure-I](#))

29th November 2024

Plenary Lectures - 2

Chair: Dr. N.T. Yaduraju
 Co-Chair: Dr. B. Muthukumar
 Rapporteurs: Dr. Simerjeet Kaur and Dr. Surabhi Hota

Dr. Samunder Singh, discussed global and Indian food production status and herbicide use, focusing on herbicide-resistant (HR) weeds in wheat, rice, and soybean. He explained that HR weeds arise due to the selection pressure from the continuous use of a single herbicide over time.

- Manage HR weeds using strategies like herbicide rotation, herbicide mixtures, and non-chemical methods such as stale seedbeds, crop rotation, zero tillage, residue retention, and precise agricultural practices (e.g., optimized water and fertilizer use).
- Ensure effective herbicide application through proper stewardship and spray technology.

Dr. A.K. Singh, highlighted the need for herbicide-tolerant (HT) rice varieties in direct-seeded rice (DSR) systems. He further detailed the yield and economic benefits of HT rice adoption in farmers' fields and shared success stories demonstrating the effectiveness of DSR in weed control.

- Formulate and implement stewardship guidelines to ensure sustainable weed management using HT technology.

Dr. Mithila Jugulam presented a lead lecture wherein she emphasized the impact of climatic stress on herbicide behaviour. Also noted cases such as poor kochia control under high temperatures due to reduced translocation of dicamba and glyphosate absorption, and increased resistance of *Amaranthus tuberculatus* from accelerated metabolism of 2,4-D.

- Incorporate an understanding of climatic stress effects into herbicide usage strategies to optimize weed control and minimize resistance development.

Technical session 4: Digital technologies and extension strategies in weed management

Chair: Dr. N.N. Angiras
 Co-chair: Dr. I.C. Barua
 Rapporteurs: Dr. N. Ananda and Dr. Deepak Pawar

The session included two lead lectures and eight oral presentations. The key highlights were:

- Digital tools are revolutionizing weed control by enhancing precision, efficiency, and sustainability. The role of Precision Agriculture (Sensors, GPS, and analytics for targeted weed control), Remote Sensing (satellite and drone imagery for monitoring weed growth), AI and Robotics (Systems for weed detection and autonomous weeding) were highlighted. It can reduce herbicide use, lower labour costs, real-time data access, and environmental sustainability. The integration of AI, IoT, and big data for future advancements was emphasized.

- There is increased weed competition due to the absence of flooding. Integrate biological and mechanical strategies, including the "tar-vattar" approach with Lucky Seed Drill, which enhanced root depth, minimized evaporation, and improved soil adaptability for weed management in DSR systems.
- The efficacy of a brush-cutter with rotary tiller, was reported to be 85% weeding efficiency, reduced labour by 94%, and significant cost savings compared to manual weeding.
- Punjab's success in transitioning 2.5 lakh hectares to *Kharif* maize, has played a big role in reducing water use and promoting sustainable intensification.
- Triafamone + ethoxysulfuron (47.25 g/ha) may be applied via drones for sustainable weed control in rice, achieving high weed control efficiency and crop yields.
- Genetic profiling of *Echinochloa* species, identifying high genetic similarity and implications for managing herbicide resistance.
- Adopting improved weed management technologies increased rice yield by 4.15 q/ha and wheat by 1.68 q/ha, translating to significant income gains for farmers.
- A computational approach was presented for herbicide development using physicochemical parameters and scaffold analysis to design target-specific molecules.
- Comparison of weed control practices in dry and tar-wattar direct-seeded rice methods, showed lower weed control costs and greater efficiency in tar-wattar sowing.
- Superior performance of bensulfuron-methyl 0.6% + pretilachlor 6% GR (RM) 660 g/ha PE herbicides in rice in diverse agro-climatic zones of Odisha was reported.

Technical Session 5: New Directions for Integrated weed management in wheat, maize, and cotton

Chair: Prof. U. P. Singh

Rapporteurs: Dr. M.K. Bhowmick and Dr. Himanshu Mahawar

The session included two lead lectures and fourteen oral presentations. The key highlights were:

- The holistic management of soil, crops, and the environment for effective weed control, with a focus on rational residue management in CA systems. The significance of soil microclimate and weed ecosystem dynamics in CA practices, noting the role of weed seed predation in reducing the weed seed bank was discussed.
- It is a myth that tillage practices negatively impact soil nutrition and highlighted conservation agriculture as a sustainable approach to weed management. It is important to adopt climate-smart weed management and diversifying crop sequences for better agricultural sustainability.
- Integrated Weed Management (IWM) practices in maize achieved up to 88% weed control efficiency (WCE) against itch grass (*Rottboellia cochinchinensis*). Discussions included new herbicide molecules and tank-mixed herbicides for managing complex weed species and mitigating herbicide resistance.
- The research highlighted the compatibility of nano-urea with herbicides, offering a dual benefit of nutrient application and improved weed control in wheat.
- Early post-emergence herbicides, premix and tank-mix herbicides, and cotton-based intercropping were shown to enhance weed control efficiency and boost yields of cotton.

Technical session 6: Current developments in integrated weed management in agri- and horticultural crops and system

Chair: Dr. A. S. Rao

Co-chair: Dr. Simarjeet Kaur

Rapporteurs: Dr. M.G. Deeksha and Dr. Manpreet Singh

The session included one lead lecture, one invited lecture and eleven oral presentations. The key highlights were:

- The importance of seed spices like coriander, cumin, fennel, fenugreek, and dill in the agricultural economy, particularly in arid and semi-arid regions was highlighted. Weed infestation poses a significant challenge, reducing yields and affecting crop quality. Key strategies include Cultural practices (crop rotation and mulching), mechanical methods (inter-cultivation and timely weeding), chemical herbicide use (judicious application at recommended rates) and biological controls (utilizing weed-suppressing cover crops).
- The importance of IWM for improving millet productivity and ensuring sustainable cultivation was highlighted. Millets, known for their climate resilience and nutritional value, often face significant yield losses due to weed competition. Strategies for effective IWM in millets could be cultural practices (timely sowing, optimal plant density, and crop rotation), mechanical methods (use of hand tools or mechanical weeders for physical removal) and judicious herbicide use (targeting specific weeds and applying at appropriate growth stages). IWM minimizes environmental impacts while enhancing crop performance, making it essential for sustainable millet cultivation.
- Combining atrazine (PE) with tembotrione (3-4 leaf stage) and two hand weedings significantly improved pearl millet productivity.
- Incorporating summer mung before direct-seeded rice (DSR) reduced *Cynodon dactylon* infestation, and benefited subsequent crop establishment.
- A mix of pre-emergence herbicides, hand weeding, and nutrient management (75% RDN inorganic, 25% RDN FYM) enhanced millet productivity.
- Pendimethalin (PE) and clodinafop-propargyl (PoE) effectively managed weeds and improved sweet potato yield.
- Clomazone + sulfentrazone with partial earthing-up at 60 DAP enhanced weed control and profitability in sugarcane farming.
- A combination of propaquizafop and imazethapyr (2-3 leaf stage) improved weed control and cluster bean productivity.
- IWM effectively managed 19 identified weed species, improving crop growth and yield in major *kharif* crops.
- Polythene mulch with intra-row hand weeding (30 DAT) effectively controlled weeds and enhanced tomato yield.

Special session on interaction with Herbicide Industry

Chair: Dr. J.S. Mishra
Co-chair: Dr. R.P. Dubey
Convener: Dr. V.K. Choudhary
Rapporteur: Dr. Yogita Gharde

- Representatives from Bayer Crop Science, Syngenta, UPL, and Corteva delivered presentations addressing advancements in sustainable agriculture and weed management:
- Bayer Crop Science (Dr. Partha Baruah) focused on regenerative agriculture and sustainable weed management. Highlighted solutions like short-stature corn, hybrid wheat, DSR (direct-seeded rice), and next-gen breeding technologies. He also emphasized the benefits of DSR for water conservation, climate resilience, and cost reduction.
- Syngenta (Dr. Sangharsh Khade) addressed weed control challenges and resistance issues. Discussed new herbicides and tools like the RISQ mobile app for resistance testing. Critiqued farmers' practices such as solo or excessive herbicide applications.

- UPL Industries (Dr. Anand Jha) presented Clethodim, a selective herbicide for soybean applied at 15-20 DAS. Emphasized its effectiveness with a single application for weed control. He also highlighted partnerships with organizations like Nuture.form and Advanta.
- Corteva (Dr. Edwin Rogbell and Dr. Neeraj Sharma) focused on sustainable crop protection and green chemistry. Presented Rinskor, an innovative herbicide for rice with reduced dosage and early soil degradation. Mentioned its application for aquatic weed control outside India.

Technical session 7: Biological weed control and weed utilization

Chair: Dr. Nimal Chandrasena
 Co-chair: Dr. Sushil Kumar
 Rapporteurs: Dr. K. Ramesh and Dr. A. Jamaludheen

The session included one lecture and nine oral presentations. The key highlights were:

- Insights into the global scenario of plant pathogens as biological control agents for weeds were discussed. The successful use of non-native pathogenic fungi and the growing importance of bio-herbicides globally was highlighted. Recent advancements in utilizing plant viruses as bio-herbicides, showcasing innovative approaches in weed management were presented.
- Medicinal properties of various weeds, presenting market values to underscore their potential for commercial exploitation were presented.
- The allelopathic effects of *Alternanthera philoxeroides* extracts, provided evidence of their bio-efficacy in enhancing blackgram cultivation.
- The climate change impacts invasive aquatic weeds and their biocontrol agents which challenges their sustainable weed management.
- Pathogenic microbes targeting *Echinochloa colona* from the phyllosphere of millet crops have been isolated and characterized.
- Oxidative stress in rice is caused by *Echinochloa colona* under drought conditions, shedding light on its physiological effects in adverse environments.
- The preparation and application of biochar in integrated weed management, showcasing its role in sustainable agricultural practices was presented.
- In Tamil Nadu, fungal pathogen *Gibbago trianthemae* is highly specific to *Trianthema portulacastrum*, demonstrating its potential for developing mycoherbicide formulations.
- The germination ecology of ryegrass (*Lolium rigidum*) in Australia under varying temperature and light conditions was presented. The findings suggested that deep tillage burying seeds below 10 cm could effectively suppress the weed's growth.
- Phytoremediation potential of *Prosopis juliflora* in Tamil Nadu, revealing its efficacy in detoxifying heavy metals in polluted sites such as industrial zones and transportation corridors was presented.

Technical Session 8: Herbicide residues and weed management in changing climate

Chair: Dr. Samunder Singh
 Co-Chair: Dr. C. Chinnusamy
 Rapporteurs: Dr. P. Murali Arthanari and Dr. Sahadeo Kuwardadra

The session included one lecture, one invited lecture and five oral presentations. The key highlights were:

- There is a need for adaptive frameworks for herbicide residue management under changing climatic conditions. Key points were the influence of temperature, rainfall patterns, and soil changes on herbicide degradation and efficacy. The effectiveness of low-volatile herbicides,

slow-release formulations, and mixtures in minimizing environmental contamination, integrated strategies that combine residue management with climate-resilient agricultural practices were discussed.

- Sustainable herbicide residue management can be achieved through a multi-faceted approach integrating cultural, mechanical, biological, and chemical weed control methods. It is important that robust monitoring systems are in place for safe crop production and reduced environmental impact.
- A herbicide *isoxaflutole* and *thiencarbazone-methyl* (Adengo SC 465®) for controlling hard-to-manage weeds in maize fields was presented. It ensures prolonged weed suppression, improved yields, and resource efficiency.
- In wheat, *Aclonifen*, *Diflufenican*, and *Pyraoxasulfone* to combat dominant weeds like *Phalaris minor*.
- Advanced methods for quantifying glyphosate and its metabolite AMPA in water samples across agro-ecological zones were presented. Emphasized large-scale deployment to monitor glyphosate contamination comprehensively in India.
- Research on biochar demonstrated its efficacy in adsorbing and reducing glyphosate residues in agricultural soils. It is a promising tool for environmental residue management.

Technical Session 9: Management of parasitic, invasive and aquatic weeds

Chair: Dr. C.R. Chinnamuthu

Rapporteurs: Dr. Archana Anokhe and Dr. C.P. Nath

The session included one lecture, two invited lectures and seven oral presentations. The key highlights were:

- The effectiveness of botanical formulations with nano-encapsulation in managing *Orobanche* infestations was presented.
- Various strategies for sustainable weed control in plantation ecosystems were discussed.
- Application of aquatic weed-based phytoremediation techniques across the country were presented.
- The soil nutrients and floral diversity before and after mechanical removal of *Lantana camara* in Chhattisgarh were highlighted.
- Neem-based botanicals are effective control measures against parasitic weed *Cuscuta* in Lucerne.
- Concerns were raised over the ecological consequences of Singapore Daisy invasion due to its intentional cultivation for aesthetics, calling for public awareness initiatives.
- Influence of *Lantana camara* removal on soil microbial properties in Balrampur forests, Chhattisgarh demonstrated significant microbial population increases post-removal.
- Survey on the ecological and agricultural threat of *Ambrosia psilostachya* in Karnataka emphasized its invasive potential and impact on ecosystems and agriculture.
- Phanerogamic plant parasites (parasitic weeds) can be managed by adopting integrated approaches and also as viable strategies.

Valedictory session

The session was chaired by Dr. L.S. Brar, Former Head of Department, Agronomy, Punjab Agricultural University and Former President, ISWS. At the outset, Dr. R.P. Dubey, Secretary, ISWS thanked everyone for contributing towards a successful conference and praised the high quality of technical sessions at the conference. He announced the Best Oral and Poster Award winners and also the student travel grants awardees. He suggested that in future, the travel grant awardees must attend at least 80% of the lectures to remain eligible for awards. Dr. J.S. Mishra, President, ISWS

expressed his satisfaction with the conference. He lauded the exemplary PowerPoint presentations and the introduction of awards for oral presentations for the first time in ISWS history. Dr. Brar commended the ISWS executive committee for organizing a successful conference. He encouraged active interaction during lectures and emphasized the value of conferences, particularly for young attendees.

Dr. M.K. Singh, the Local Organising Secretary proposed the vote of thanks, acknowledging key contributors, including Mr. Gyanendra Pratap Singh, ISWS office manager, for his coordination.

This Biennial Conference set a benchmark for quality and hospitality, emphasizing young professionals' engagement and interactive participation.

30th November 2024

Field visits and local sightseeing

Major recommendations

1. Align the future of weed science with ethical considerations, public awareness, climate change adaptation, and environmental protection.
2. Develop weed management systems that minimize or eliminate adverse impacts on soil, water, air, flora, fauna, humans, and other living organisms.
3. Prioritize research on weed ecology and biology to create ecologically sustainable weed management solutions. Combat misinformation about weeds and promote a collaborative coexistence approach.
4. Create user-friendly digital platforms or mobile apps for real-time weed management recommendations based on field data (e.g., weed type, growth stage, and climate).
5. Emphasize AI-driven weed mapping, robotics, and precision agriculture for site-specific weed management in both major and minor pulse and oilseed crops.
6. Foster public-private partnerships to collaboratively develop and adopt climate-smart weed management technologies for sustainable agriculture.
7. Locate herbicide-resistant weeds and develop best management practices using all possible and feasible options.
8. Formulate and implement stewardship guidelines to ensure sustainable weed management using HT technology and know-how about herbicide application technologies.
9. Focus on developing and evaluating herbicides specific to less-researched pulses, oilseeds and minor millets and fruit crops to expand weed control solutions.
10. Explore and utilize various biological weed control options and encourage botanical formulations with nano-encapsulation for effective weed management in natural & organic farming, conservation agriculture, regenerative agriculture, etc.
11. Prioritize the development of weed-suppressing crop varieties and interaction with herbicides, especially for those resistant to parasitic weed infestations for enhanced productivity.
12. Employ advanced technologies such as LC-MS/MS for nationwide herbicide contamination monitoring in soil, water bodies and food systems.
13. Further exploration of the medicinal properties of weeds is essential for developing herbal drugs to treat various human diseases. Focus on large-scale commercial utilization of medicinal compounds from these weeds.
14. Exploration of various properties of weeds (medicinal, vegetables, biochar, composting, etc.) for developing herbal drugs, detoxifying metal-contaminated sites, developing

insecticidal formulations, and supporting carbon sequestration. Focus on large-scale commercial utilization and entrepreneur development.

15. Promote the use of weeds, their extracts, and biochar for detoxifying metal-contaminated sites, developing insecticidal formulations, and supporting carbon sequestration.
16. Emphasize research to identify and develop effective bio-herbicide formulations using pathogens, including fungi and plant viruses, for sustainable weed management.
17. Increase awareness of invasive species like Singapore Daisy, focusing on regions where they are cultivated for aesthetics.
18. Conduct regular assessments of invasive species such as *Ambrosia psilostachya* to understand their ecological and agricultural impacts.
19. Encourage collaboration among researchers, policymakers, farmers and fostering collaboration between public institutions and industries for R&D and extension.



Dr. J.S. Mishra
President



Dr. R.P. Dubey
Secretary

Annexure-I.

Proceedings of the General Body Meeting of the Indian Society of Weed Science held at Banaras Hindu University, Varanasi on 28th November 2024

General Body Meeting of the Indian Society of Weed Science (ISWS) was held on the first day of the ISWS Biennial Conference-2024 on 28th November 2024 at 6.00 PM in the Main Hall, Swatantrata Bhavan, BHU, Varanasi. In this meeting, 127 life members of the ISWS were present (list attached). The following members of the Executive Council were present and conducted the proceedings:

1. Dr. J.S. Mishra, President
2. Dr. M.K. Singh, Vice President
3. Dr. R.P. Dubey, Secretary
4. Dr. S.P. Singh, Joint Secretary
5. Dr. D. Subramanyam, Joint Secretary
6. Dr. P.K. Mukherjee, Treasurer
7. Dr. Sushil Kumar, Chief Editor



Dr. S.P. Singh, Joint Secretary of ISWS welcomed all the members to the General Body meeting. Dr. R.P. Dubey, Secretary of ISWS apprised the house about the agenda items listed for discussion. He then invited Dr. J.S. Mishra, President of ISWS to preside over the meeting.

Dr. J.S. Mishra, President, ISWS expressed his gratitude to all the members for providing support to the Executive Council and showed his satisfaction for the progress made by the Society during the last two years. He urged all the weed scientists to submit quality papers for publication in IJWS for further improving its NAAS rating.

Dr. R.P. Dubey, Secretary of ISWS, presented a report on the Society's various activities during 2023 & 2024.

- i. The renewal of Society's registration was pending for the past 9 years which was renewed after putting in a lot of effort and with the help of the Karnataka Counsellor Dr. K.N. Geetha.
- ii. A 10-day National Training on Integrated Weed Management Strategies under "Changing Agricultural Scenario" was successfully organized in online mode from 28th August to 6th September 2024. Eminent resource persons from India and abroad were invited to give lectures on the recent weed management technologies. About 350 Scientists and Students participated in this training.
- iii. During 2023-2024, 127 new Life Members were enrolled.
- iv. As decided by the Executive Council, a book on "एकीकृत खरपतवार प्रबंधन की नवीन तकनीकियाँ" has been published and released in the Biennial Conference-2024.
- v. With the efforts of Dr. M.K. Singh, VP, ISWS the Society's journal (IJWS) was listed in the UGC-CARE list.
- vi. A bid document for hosting the 9th International Weed Science Congress in India was prepared and discussed with the IWSS Board. However, the financial conditions imposed by the Board were not agreed upon by the EC of ISWS.

Dr. P.K. Mukherjee, Treasurer, ISWS presented the receipt and expenditure statement of the society during the last two years. The summary of the audited account was provided to all the members for their perusal and comments. Members appreciated the efforts made by the Society to minimize the expenditure and enhance the Society's fund position. The Balance Sheet showed the Main Fixed deposit FDs Rs. 1,13,95,127/-, Award Donations FDs Rs. 22,17,526/-, Short Term FDs Rs 48,43,159/- and Current Account Rs. 13,20,027 with a Total of Rs. 1,97,75,839 up to date: 31/3/2024.

Dr. Sushil Kumar, Chief Editor of the Indian Journal of Weed Science (IJWS) apprised the house about the current status of IJWS. He informed that IJWS is being published in-time and the hard copies of the 4th issue have been provided in registration kit on the occasion of ISWS Biennial conference-2024.



After a thorough discussion of various issues related to the functioning of the Society, the following decisions were taken unanimously by the Governing Body:

Membership Fee

- Life membership fee enhanced to Rs. 8000/-, from Rs 6000/-.
- Annual membership fee enhanced to Rs. 800/-, from Rs 500/-.

Bye-laws

- Members gave consent to hold the GB meeting through video conferencing as needed in the future.
- Since 2009, many clauses of the bylaws have been amended by the GB from time to time, however, these amendments have not been updated in the bylaws. Hence, it was decided that all such changes and any new proposal would be finalized in an online GB meeting for approval and further updating of the bylaws by the Society's Registrar.

ISWS Awards

- Henceforth, ISWS awards will be given as one Life Time Achievement Award, two Gold medals and four Fellowships per year for the Biennium, solely on a merit basis (minimum qualifying marks 60%)

Selection of the Returning Officer for the next election of the ISWS Executive Council for 2025-2027.

- The Governing Body appreciated and acknowledged the sincere efforts made by Dr. Devraj Arya, former Returning Officer, ISWS who had successfully conducted the previous five elections. Dr. R.P. Dubey, Secretary, ISWS proposed the name of Dr. Mayank Yadav (Bayer AG, Germany) for the upcoming ISWS election, which was unanimously agreed upon by the assembly.

A formal vote of thanks was proposed by Dr. D. Subramanyam, Joint Secretary, ISWS.

Dr. J.S. Mishra
President

Dr. R.P. Dubey
Secretary

Annexure II. Glimpses of the Biennial Conference-2024

https://isws.org.in/Photo_Gallery/BC2024.aspx