



ICAR - DWR

SIGNIFICANT ACHIEVEMENTS

2021-2022



ICAR - Directorate of Weed Research
Jabalpur - 482004, (Madhya Pradesh)
<https://dwr.icar.gov.in>





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ICAR-Directorate of Weed Research

All India Coordinated Research Project on Weed Management



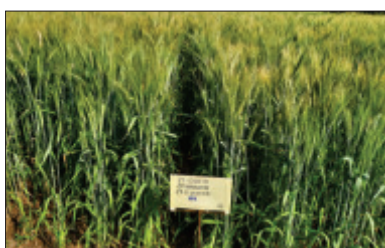
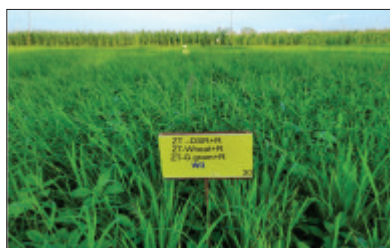


ICAR-Directorate of Weed Research

Significant Achievements 2021-22

A. Sustainable Weed Management in Diversified Cropping Systems Conservation Agriculture based systems

- Weeds are major problem in conservation agriculture (CA) based production systems. In rice-wheat/chickpea-greengram system sequential application of pretilachlor + pyrazosulfuron at 615 g/ha (pre-em) *fb* bispyribac-sodium 25 g/ha (20 DAS) *fb* HW at 40 DAS in rice, clodinafop + metsulfuron 60+4 g/ha at 30 DAS in wheat/pendimethalin 678 g/ha (pre-em.) *fb* topramezone 20 g/ha at 20 DAS in chickpea, and pendimethalin 678 g/ha (pre-em.) *fb* HW at 25 DAS in greengram considerably controlled the weeds and provided higher system productivity and profitability.



- In maize-wheat/chickpea-greengram system tank-mix application of atrazine + topamezone (500 + 25.2 g/ha) at 20 DAS in maize, clodinafop + metsulfuron 60 + 4 g/ha at 30 DAS in wheat/pendimethalin 678 g/ha (pre-em.) *fb* topamezone 20 g/ha at 20 DAS in chickpea, and pendimethalin 678 g/ha (pre-em.) *fb* HW at 25 DAS in greengram effectively controlled the weeds and provided higher system productivity and profitability.



- In rice-wheat system, ZT wheat (paddy residue retained on surface) sown with Happy seeder (narrow tyne spacing of 20 cm) provided higher suppression of weeds and similar/higher wheat grain yield than Happy seeder (conventional tyne spacing 22.5 cm) (AICRP-WM, PAU, Ludhiana).



Organic cropping systems

- In organically grown turmeric, paddy/wheat straw mulch at 5 t/ha (0-3 days after planting-DAP) *fb* HW at 30 and 75 DAP or interculture (IC) + HW at 30 DAP *fb* paddy/wheat straw mulch 5 t/ha at 30 DAP *fb* HW at 75 DAP provided effective weed management, higher yield and net returns (AICRP-WM, AAU, Anand). The highest soil quality index (SQI) at 0-15 cm soil was obtained in crop residue mulch (5 t/ha) *fb* 2 hand weeding (0.78), *fb* *Glyricidia* live mulch (10 t/ha) *fb* + 2 HW.



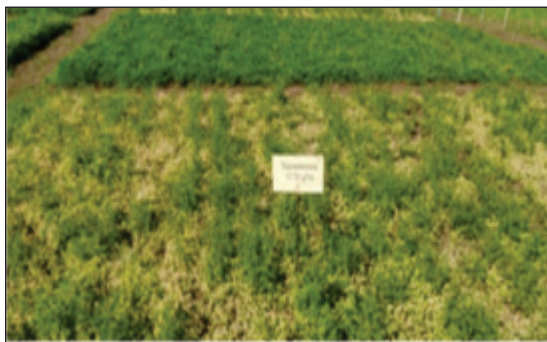
- In baby corn-cabbage organic cropping system, inter-row poly-film mulch (25 micron thickness) *fb* intra-row hand weeding at 30 DAS in corn and groundnut shell mulch (3 t/ha) or interrow poly-film mulch followed by intra-row hand weeding at 30 DAS resulted in efficient weed control and higher yields and net returns (AICRP-WM, PJTSAU, Hyderabad).



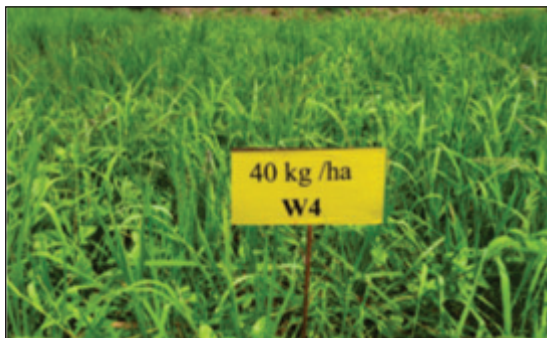
- In organic scented rice – sweet corn cropping system, motorized weeder twice (single row type) *fb* one intra row HW in rice and black polythene (25 μ) mulch in sweet corn generated the highest system yield and net returns (AICRP-WM, IGKV, Raipur).



- For management of broad-leaved weeds in chickpea, post-emergence application of topramezone at 20.16 g/ha at 20 DAS was found safe and effective.

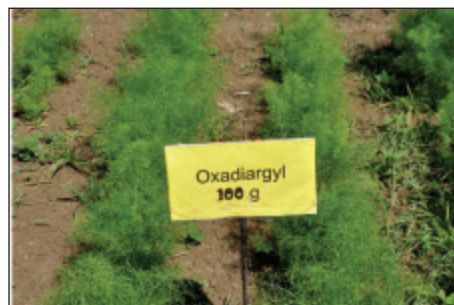


- In direct-seeded rice, seed rate of 40 kg/ha along with sequential application of pretilachlor + pyrazosulfuron 615 g/ha (pre-em.) *fb* cyhalofop + penoxsulam 135 g/ha (post-em.) provided better weed control and higher grain yield (4.7 t/ha).



Herbicide treated

- In seed spices, application of pendimethalin 675 g/ha, metribuzin 150 g/ha, fenoxaprop 100 g/ha and oxadiargyl 100 g/ha were found safe and effective in fennel, and oxadiargyl 100 g/ha, metribuzin 150 g/ha and oxyfluorfen 100 g/ha in *ajwain*.



- In millets, application of pyrazosulfuron 20 g/ha, oxyfluorfen 100 g/ha and atrazine 750 g/ha followed by either one mechanical weeding or metsulfuron 4 g/ha effectively controlled the weeds and recorded higher productivity of finger millet (*Ragi*). In barnyard millet (*Sawar*), pyrazosulfuron 20 g/ha followed by either one mechanical weeding or metsulfuron 4 g/ha was found effective.



- In minor oilseed crops, oxadiargyl 100 g/ha, metribuzin 200 g/ha, quizalofop 75 g/ha, propaquizafop + imazethapyr 100 g/ha, and atrazine 750 g/ha effectively controlled weeds in safflower. Oxyfluorfen 100 g/ha *fb* propaquizafop 100 g/ha, or oxyfluorfen 100 g/ha *fb* 1 MW at 40 DAS were effective in sesame and niger.



- Soil application of mycorrhizal consortium @ 20 kg along with 500 kg of compost /ha at the time of planting, resulted in suppression of *Striga* emergence by 38 per cent, and increased the sugarcane yield by 13.50 per cent with a B:C of 2.51 (AICRP-WM, UAS, Dharwad).

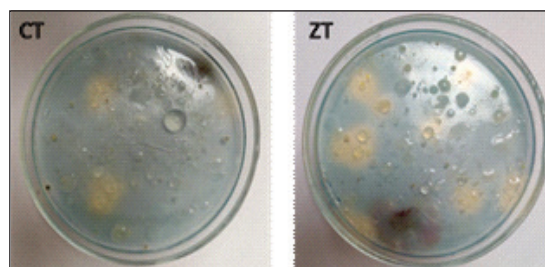
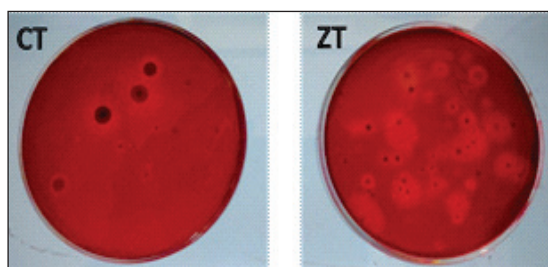


Control

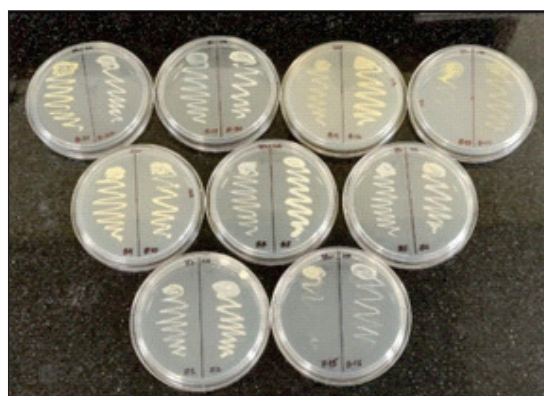


UASD AMF consortium (native)

- Conservation agriculture (CA) in rice-based system increased microbial respiration by 19.46%, and cellulose degrading bacterial population by 2-folds compared to conventional system at 45 DAS. CA system showed augmenting effects on important biological function like microbe mediated cellulose degradation in rice soil, even in presence of herbicides. *Azotobacter* population was sensitive to application of pretilachlor + pyrazosulfuron. (pre-em.) *fb* bispyribac-sodium (25 g/ha at 20 DAS) *fb* fenoxaprop ethyl (at 40 DAS).
- The benefit of the CA system in terms of soil C built-up remained restricted within the plough layer.



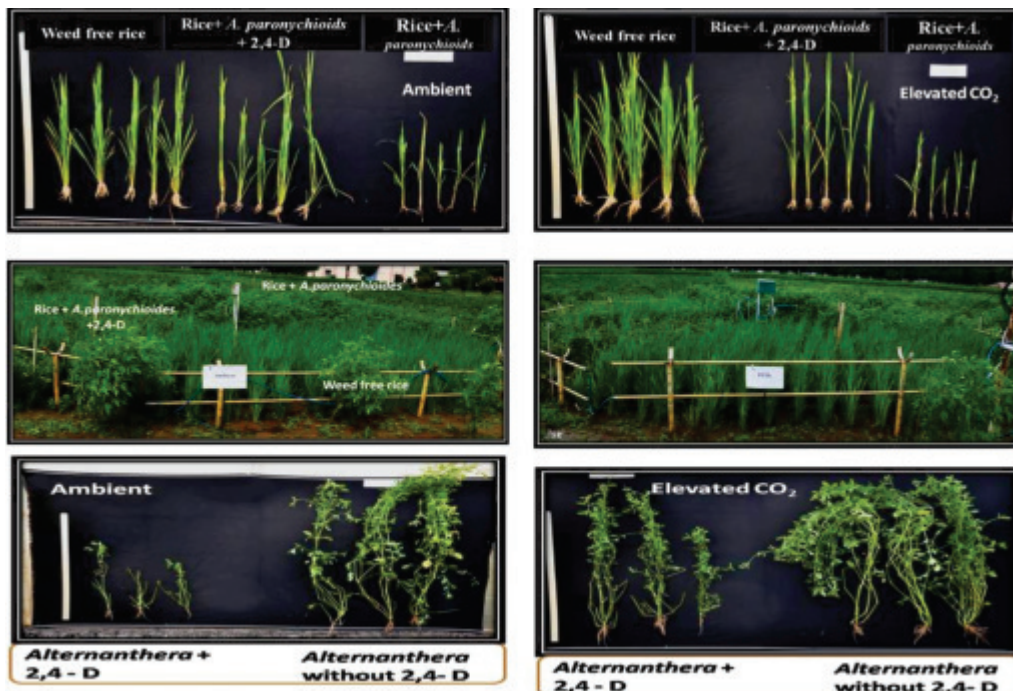
- Ten bacterias were isolated from atrazine *fb* topramezone applied soil (2 DAA) in CA-based maize-wheat-greengram, and 8 bacteria from pretilachlor + pyrazosulfuron *fb* bispyribac-sodium applied soil (2 DAA) in CA-based rice-wheat-greengram cropping system. They possess plant growth promoting attributes like phosphate solubilization, free-living nitrogen fixation, cellulose degrading bacteria and antibiosis. Being isolated from herbicide applied soils these isolates holds promising potential to improve soil health and support mitigation measure against toxic effects of herbicides.





C. Crop-weed Interference and Herbicide Efficacy under Changing Climate

- Initiated research work on 'Crop-weed interaction and herbicide efficacy under changing climate scenario under NICRA project. Growth and biomass of *Echinochloa colona* and *Alternanthera paronychioides* in rice increased under elevated CO₂. Efficacy of bispyribac sodium against *E. colona* and 2,4-D against *A. paronychioides* was significantly reduced under elevated CO₂.
- The bioefficacy of carfentrazone-ethyl was reduced against *Chenopodium album* and *Rumex dentatus* under elevated CO₂ (550±50 ppm) and elevated temperature (ambient + 2°C) in comparison to ambient. However, 2X dose efficiently controlled the *C. album* and *R. dentatus* in all the environmental conditions.



- Efficacy of clodinafop + metsulfuron was reduced and response was delayed against *Medicago polymorpha* under drought stress in comparison to irrigated condition. However, this herbicide combination efficiently controlled *Phalaris minor* under drought stress.



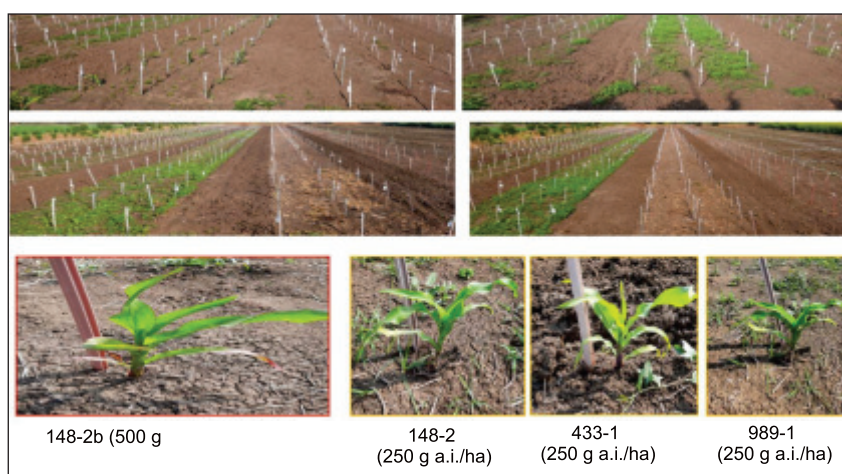
D. Herbicide Tolerant Crops

- In soybean, 104 accessions received from ICAR-Indian Institute of Soybean Research, Indore, were evaluated for tolerance against herbicide (glyphosate and glufosinate - ammonium). Eight soybean genotypes tolerant to glyphosate (1000 g a.e./ha) were identified in the primary screening which will be used for further molecular studies.



- In maize, 100 genotypes received from ICAR-Indian Institute of Maize Research, Ludhiana, were evaluated for tolerance against herbicide (glyphosate and glufosinate-ammonium). One maize genotype (148-2) tolerant to glufosinate ammonium (500 g a.i./ha) and three genotypes (148-2, 433-1 and 989-1) tolerant to

glufosinate ammonium (250 g a.i./ha) were identified in the primary screening which will be used for further molecular studies.



- The herbicide-tolerant variety (SAVA 134FP) developed by Savana Seeds was evaluated in DSR. The sequential application of imazethapyr at 100 and 125 g/ha at 14 and 28 DAS recorded absolute control of complex weed flora including weedy rice, and harvested with 4.2-4.5 t/ha of grain yield, which was superior to bispyribac-sodium at 25 g/ha (2.1 t/ha).



E. Management and Utilization of Invasive Alien Weeds and Weed Risk Assessment

- Developed technology for the biological control of invasive alien aquatic weed *Salvinia molesta* using host-specific bioagent *Cyrtobagous salviniae*. Successful control of *Salvinia* was achieved in a 20 hectare pond of Padua village in Katni district of Madhya Pradesh by initial release of 2000 weevils and augmenting of about 1000 adult weevils after 6 months. Adult population increased gradually and reached maximum up to 121.5/m² in 11 month corresponding to decline in weed density and biomass. Subsequently complete control of the weed was achieved within the 18 months.

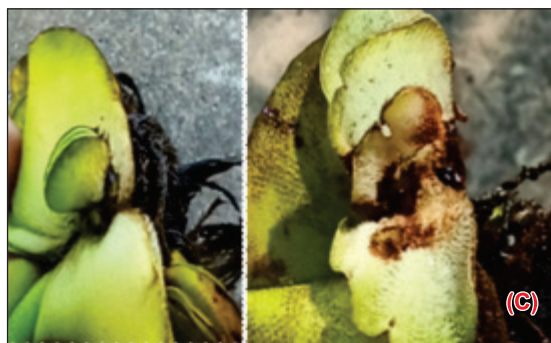


Fig. Sequential biological control of *Salvinia molesta* using insects; (A) Severely infested pond before release of bioagent, (B) 80 % control, (C) Destruction of growing points of weed by insects, (D) Complete control of weed.

- For management of invasive weeds in gaporedaisy (*Sphagnetti colatrilobata*) in non-cropped areas/plantations, premix herbicide metsulfuron-methyl + chlorimuron-ethyl at 10 g/ha or metsulfuron-methyl, 10 g/ha along with the sticker, or combination spray of 2,4-D at 1.25 kg/ha + glyphosate 2.0 kg/ha have been found effective (AICRP-WM, KAU, Thrissur).



- Developed methodology for isolating good quality and quantity RNA from the *Parthenium* flower bud and root tissues containing high amounts of allelochemicals for downstream molecular biology applications. The developed method performed better than the commercially available RNA isolation kits.



Fig. Root tissues collected for RNA isolation

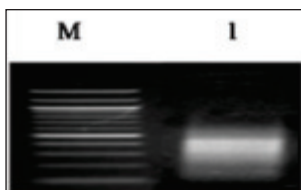


Fig. First strand cDNA after RT-PCR reaction

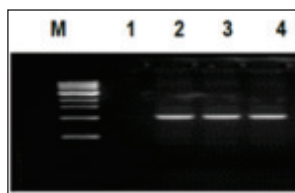


Fig. Agarose gel electrophoresis of RT-PCR product of endogenous gene *EIF1 a*

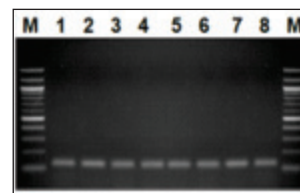


Fig. Agarose gel electrophoresis of RT-PCR product of *ALS* gene

- In potato -maize cropping sequence, mulching with water hyacinth at 6 t/ha in potato and application of atrazine 1 kg/ha (PE) in maize efficiently controlled the weeds and increased the tuber yield of potato and grain yield of maize (AICRP-WM, AAU, Jorhat).



Initiated work on Weed Risk Assessment (WRA) and evaluated 06 major weeds viz., *Phalaris minor*, *Chenopodium album*, *Lantana camara*, *Cyperus rotundus*, *Echinochloa colona* and *Avena ludoviciana*. All these six weeds were of high risk with scores of 24, 24, 20, 18, 15 and 12, respectively.

- Developed prediction maps showing the future distribution of *Alternanthera sessilis*, *Phalaris minor* and *Physalis minima* in India.

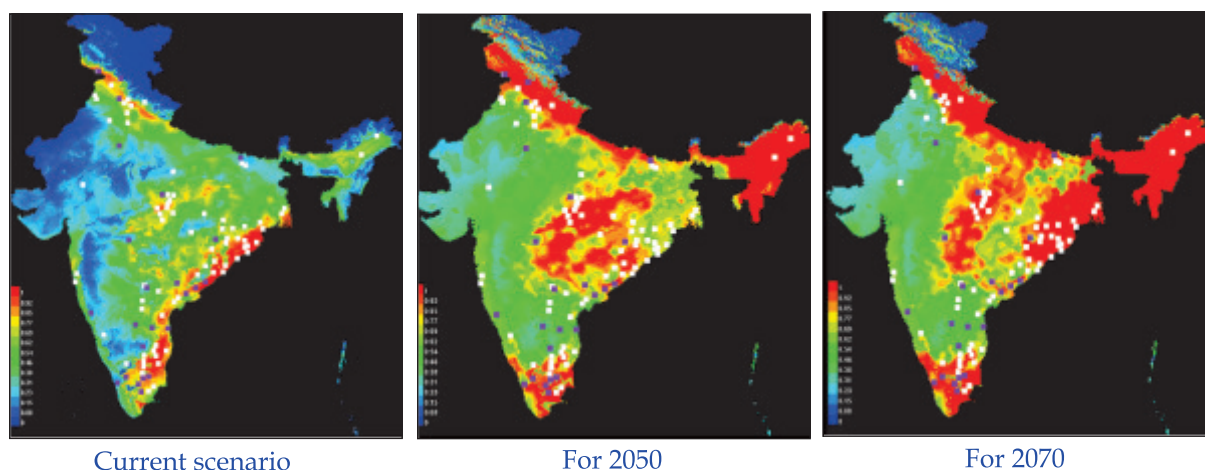
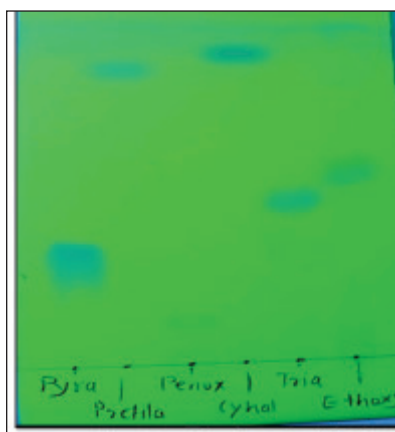
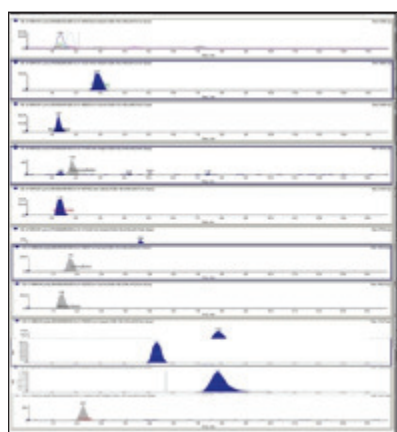


Fig. Distribution of *Physalis minima* under future climatic scenario (RCP 4.5)

F. Environmental Impacts of Herbicides and Mitigation Measures

- Herbicide residue studies indicated that pendimethalin residues in chickpea grains and straw were found $<0.01 \mu\text{g/g}$. Half-life of topramezone, imazethapyr, propaquizafop and pendimethalin in chickpea field soil was found to be 10.34, 14.40, 11.41 and 16.50 days, respectively.
- Half-life of pretilachlor, pyrazosulfuron, ethoxysulfuron, triafamonecyhalofop-butyl and penoxsulam was respectively 13.3, 7.84, 10.36, 10.6, 10.51, and 10.78 days in the soils of transplanted rice fields. After 90 days of application in rice field, residues of pretilachlor, pyrazosulfuron, cyhalofop-butyl, penoxsulam and triafamone in fishes of the adjacent run-off collecting ponds were below the detection limit.
- Suppressing effect of herbicides pretilachlor + pyrazosulfuron, cyhalofop + penoxsulam and triafamone + ethoxysulfuron on soil microbial biomass carbon in rice field was noticed upto 60 days after application.
- In wheat, toxic effect of pyroxasulfone and metsulfuron on soil microbes were found more pronounced in non-rhizospheric soil as compared to rhizospheric soil. Application of crop residues increases soil microbial carbon.

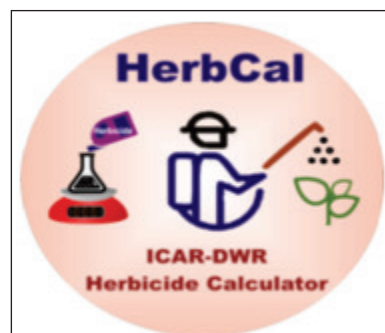
- A multi-residue method developed for simultaneous determination of 30 herbicides in agricultural commodity by LC-MS/MS. Similarly, a multi-residue method using TLC with the detection limit of $<0.01 \mu\text{g/g}$ was developed for determination of rice herbicide combination products, namely, pretilachlor + pyrazosulfuron, cyhalofop-p-butyl + penoxsulam and triafamone + ethoxysulfuron.



Herbicide	Rf, TLC (cm)	Combination product	Qualifying criteria
Pyrazosulfuron	4.4	Eros	yes
Pretilachlor	7.7		yes
Cyhalofop-p-butyl	8.3	Vinaya	yes
Penoxsulam	2.0		yes
Triafamone	5.2	Councilactiv	yes
Ethoxysulfuron	5.7		yes

G. Mobile App

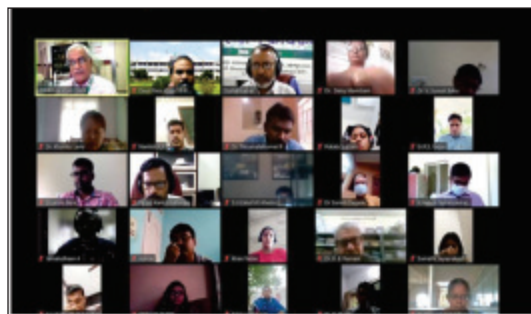
- A multi-language user-friendly mobile app named 'DWR-HerbcAl' was developed for application of correct amount of herbicide to crop fields. The app automatically calculates the amount of herbicide and quantity of water required in a given area for spray. The app is freely available on "Google Play Store".



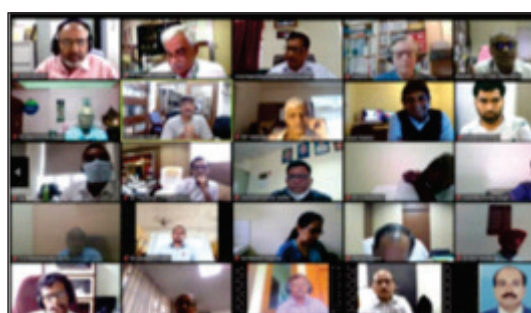
H. Capacity Development and Farmers Outreach Activities

- CA-based rice-wheat-greengram system to reduce the cost of production, enhance system productivity, profitability and sustainability of farmers. The technology of CA-based rice-wheat-greengram production system along with integrated weed management was successfully demonstrated in Madhya Pradesh. This technology has been adopted by 750 no. of farmers of Jabalpur, Seoni, Katni, Mandla, Narsinghpur and Damoh districts covering an area of 300 ha, and resulted in an average increase in yield by 18.3%, 36% and 42% respectively in rice, wheat and greengram over farmers practice. This has generated an additional income of Rs. 21.5 millions. In addition, a total emission of 2999.46 tons of CO_2e and 199.28 tons of air pollutants were avoided and $77.16 \times 10^6 \text{ MJ/ha}$ of energy potential was created from 300 ha of cultivation area by not burning the previous crop residues.

- During the year 2021-22, a total of 17 training programmes (1638 participants) and 60 Front-line Demonstrations & On-farm Trials were conducted for the farmers and other stakeholders. A total number of 773 farmers were directly benefitted under different programmes such as Farmers FIRST, Biotech KISAN Hub, *Mera Gaon Mera Gaurav* and Scheduled Caste Sub-Plan. In addition, 13 nos. of *Kisan Mobile Sandesh* containing real time agricultural information and customized knowledge on weed management technologies were delivered to the registered farmers for taking timely action to manage weeds.



- A nationwide programme on "*Parthenium* Awareness Week" was organized during 16-22 Aug., 2021 to make public aware off the ill effects of *Parthenium* and ways to control it. All SAUs, 100 other universities, 101 ICAR institutes, 750 KVKs, 150 municipalities, 200 school and colleges, 100 District Panchayat, 15 NGOs, 7 ICFRE Institute, 35 PCCF participated in this programme apart of uploading on DWR Website, Face book and Twitter. On this occasion, seven national webinars, one international webinar, one live programme and one training programme were organized. It is estimated that more than one million people have been made aware under this campaign through direct interactions and print & electronic media.





B. Linkages and Collaborations

To widen the scope of weed research, ICAR-DWR signed MoUs with following institutions.

- IEHE, Bhopal on 15 January, 2021
- ICAR-NIBSM, Raipur on 16 February, 2021
- Anugrah Narayan College, Patna on 8 March 2021
- Vikram University, Ujjain on 23 June, 2021
- RVSKVV, Gwalior on 17 August, 2021
- IRRI, Philippines on 10 September, 2021
- TFRI, Jabalpur on 20 September, 2021
- Mahakaushal University Jabalpur on 28 September, 2021
- ICAR-NRRI, Cuttack on 30 October, 2021
- Chhattisgarh Forest Department, Raipur on 29 September, 2021
- Mangalayatan University on 24 December, 2021
- RDVV, Jabalpur on 08 March, 2022



In addition, 08 contract research projects funded by various herbicide industries and other organizations were undertaken by the Directorate.

S. No.	Project title	Duration	Budget (Rs. in lakhs)	Funding Agency
1	Bio -efficacy and phytotoxicity evaluation of imazethapyr 10 SL against weed complex in herbicide tolerant rice SAVA 134	2020-2021	10.54	ADAMA India Private Limited, Telangana, Hyderabad
2	Bio -efficacy and phytotoxicity evaluation of GPH 1120 on wheat	2020-2022	12.44	UPL Pvt.Ltd. Mumbai, Maharashtra
3	Evaluation of the bio-efficacy of imazethapyr 10% SL against weed complex in herbicide-tolerant rice	2021-2022	5.00	ADAMA India Private Limited, Telangana, Hyderabad
4	Evaluation of pinoxaden 5.1% EC (New formulation) for grass weeds in wheat	2021-2023	11.89	Syngenta India Limited, Pune, Maharashtra

S. No.	Project title	Duration	Budget (Rs. in lakhs)	Funding Agency
5	Bioefficacy and phytotoxicity study of AGWH#11 (Water hyacinth), AGLC#14 (Parthenium) and AGPH#04 (Lantana)	2021-22	2.049	AG Bio Systems Hyderabad, Telangana
6	Evaluation of ADM.05001.H.1.A (New combination herbicide) against weed complex in wheat crop and its effect on succeeding crop	2021-2023	11.89	ADAMA India Private Limited, Hyderabad, Telangana
7	Impact assessment of <i>Lantana camara</i> removal in Chhattisgarh	2021-22	31.95	Department of Forest Chhattisgarh
8	Bio -efficacy and phyto-toxicity evaluation of 2,4-D Sodium salt 80% WP against weed complex in maize	2021-2023	11.50	ADAMA India Private Limited, Hyderabad, Telangana

J. राजभाषा कार्यान्वयन

- खरपतवार अनुसंधान निदेशालय में हिन्दी पखावाड़ दिनांक 14-29 सितम्बर 2021 तक आयोजित किया गया। हिन्दी पखावाड़े के दौरान निदेशालय में सात प्रतियोगिताओं, आलेखन एवं टिप्पण, तात्कालिक निबंध लेखन, हिन्दी शुद्धलेखन, कम्प्यूटर में यूनिकोड पर टाईपिंग, आशुभाषण (तात्कालिक भाषण), विजय काटेस्ट एवं वाद-विवाद का आयोजन किया गया। निदेशालय द्वारा प्रकाशित “तृण सदेश” पत्रिका का विमोचन भी किया गया। दिनांक 13 अक्टूबर, 20 नवम्बर, 08 दिसम्बर 2021 को हिन्दी कार्यशालाओं का आयोजन किया गया। 19 जनवरी 2022 को एक दिवसीय राजभाषा पर बौद्धिक परिचर्चा एवं प्रशिक्षण कार्यशाला का आयोजन किया गया। नगर राजभाषा कार्यान्वयन समिति, कार्यालय क्रमांक- 2 द्वारा वर्ष 2020 के दौरान राजभाषा हिन्दी के प्रयोग-प्रसार के क्षेत्र में सर्वाधिक एवं सराहनीय कार्यों के लिए खरपतवार अनुसंधान निदेशालय को प्रथम पुरस्कार प्रदान किया गया। भारतीय कृषि अनुसंधान परिषद नई दिल्ली एवं खरपतवार अनुसंधान निदेशालय, जबलपुर द्वारा संयुक्त रूप से परिषद के अधीनस्थ पश्चिम एवं मध्य क्षेत्र में स्थित संस्थानों में राजभाषा का कार्य देख रहे अधिकारियों के लिए दो दिवसीय “आजादी का अमृत महोत्सव एवं राजभाषा” विषय पर हिन्दी कार्यशाला का आयोजन दिनांक 07-08 मार्च 2022 को जबलपुर में किया गया।

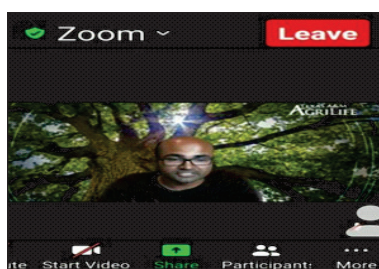
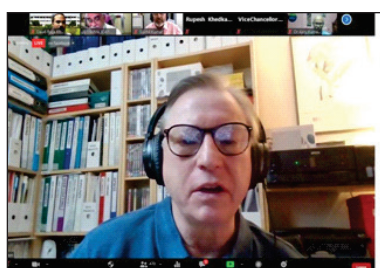


K. Publications

Directorate published 22 research papers/review articles in journals of national and international repute, 10 book chapters, 03 newsletters, 40 popular articles, 01 Souvenir and 01 Hindi magazine (*Trin Sandesh*).

L. Special Campaigns

As a part of *Azadi ka Amrut Mahotsav* celebrations on the occasion of 75th Year of India's Independence, 29 numbers of webinars and *Sangoshthis* on various aspects of weed management, were organized by the ICAR-DWR and AICRP-WM centres. A total number of 5356 participants attended these programmes.



M. Recognitions

1	Dr. Deepak Pawar: Cover Article Award for the article <i>Chenopodium quinoa</i> : A potential Source of Nutrition of Agriculture Letters, 7 Jan., 2022.
2	Er. Chethan C.R.: IEI Young Engineers Award 2021 and First prize in poster presentation.
3	Dr. V.K. Choudhary: ISA Associateship for the year 2017 by Indian Society of Agronomy
4	Dr. Himanshu Mahawar: Young Scientist Award-2021 and Innovative Article Award
5	Dr. J.S. Mishra: ' NAAS Fellowship 2022 ' and Reorganization award by the Indian Society of Agronomy
6	ICAR-DWR: 1st prize by NARAKAS Zone-2 Jabalpur on 23 December, 2021
7	ICAR-DWR: 2nd prize in the exhibition during the 5 th IAC held during 23-27 Nov, 2021.



M New Facilities Established

- Hon'ble Union Minister of Agriculture and Farmers' Welfare inaugurated the Training-cum-Farmers' Hostel on 26th February, 2021 virtually.



- Krishk Sabhagar* inaugurated on 29th December, 2021 by Dr. Panjab Singh, former Secretary DARE and Director General, ICAR.



- Technology Park and Solar energy-based irrigation system inaugurated on 8th March, 2022 by Dr. SK Chaudhari, DDG (NRM) ICAR, New Delhi.

