

**Proceedings of
XXI Annual Review Meeting
All India Coordinated Research Project on Weed Control
12-14 February, 2014
Venue: Directorate of Weed Science Research, Jabalpur (M.P.)**

12 February, 2014

INAUGURAL SESSION

Inaugural session was graced by the presence of Chief Guest, Dr. L.S. Brar, Former Head, Department of Agronomy, Punjab Agricultural University, Guests of Honour, Dr. J.G. Varshney, Former Director, DWSR and Dr. R.K. Gupta, Team Leader, Research Station Developments, Borlaug Institute for South Asia, CIMMYT, New Delhi. The scientists of 22 coordinating and 4 volunteer centres attended the meeting. After lighting of the lamp by the Chief Guest, Dr. A.R. Sharma, Director, DWSR welcomed the participants and informed that weed control technology is the fastest adopted technology by the farmers. He stressed to practice conservation agriculture. He urged the scientists for introspection of their research work which should be visible and of high quality.

Dr. R.P. Dubey, Principal Scientist & In charge, AICRP-Weed Control presented the research highlights of the project during 2013.

Dr. R.K. Gupta addressed the challenge of producing more food from reducing land. He cautioned for technology fatigue as well as policy fatigue. Conservation agriculture practices should be adopted by the farmers of India like many other countries such as Brazil. He asked the scientists to focus on managing national weed problems i.e., *Parthenium*, water hyacinth, Lantana, *Orobanche* etc.

Dr. J.G. Varshney expressed concern for weed management in rainfed agriculture, problem of weedy rice, herbicide resistance in weeds, management of parasitic weeds. He opined to undertake research in frontier areas like biotechnology and nano-technology for weed management.

The 'Best AICRP-WC Centre Award' was presented to CCSHAU, Hisar Centre for significant achievements in weed management in the state of Haryana.

On the occasion, publications viz. 'Medicinal Uses of Weeds' (BAU, Ranchi), 'Weed Management in *Kharif* and *Rabi* Crops', 'Weed Management in Wheat' (GBPUAT, Pantnagar), 'Problem and Management of *Orobanche* in Mustard', and 'Management of *Parthenium*' (CCSHAU, Hisar), were released.

Dr. L.S. Brar congratulated the scientists of DWSR and AICRP on Weed Control on the occasion of Silver Jubilee Year of the Directorate. He asked the scientists to develop eco-friendly and economically sound weed management technologies for the farmers. Herbicides are the integral part of weed management; however, their impact on the environment and human health should be regularly monitored. He emphasized to conduct bench mark survey under weed surveillance programme. Dr. Brar asked to initiate studies on crop-weed competition and varietal evaluation for weed suppression. He also addressed the future challenges in agriculture like weed management under the regime of climate change and stressed on the farmer participatory research under AICRP on Weed Control.

Dr. Yogita Gharde, Scientist conducted the programme and proposed the vote of thanks.

Presentation of salient findings by Principal Investigators of AICRP-WC Centres in North Zone

- Chairman** : Dr. Jay G. Varshney, Former Director, DWSR, Jabalpur
Rapporteurs : Dr. V.P. Singh, DWSR, Jabalpur
Dr. C.T. Abraham, KAU, Thrissur

Dr. V.P. Singh, Nodal Officer presented an overview of research highlights, constraints and suggestions of the centres under North Zone. Centre-wise specific observations were as follows:

CCSHAU, Hisar

- Weed biology and physiology in respect of *Cyperus rotundus* under WS-2 was not conducted.
- Centre has published 4 research papers, 5 popular articles, and 1 research paper was presented in seminar/ symposia.

NDUAT, Faizabad

- Weed biology and physiology in respect of weedy rice and *Phalaris minor* under WS-2 was not conducted.
- Centre has published 4 research papers, 5 popular articles, and 7 research papers were presented in seminar/ symposia.
- Centre has conducted 7 trainings and awareness campaign and delivered 9 radio talks.
- Improvement is needed in the presentation of Annual Report 2013-14.

PAU, Ludhiana

- Centre has published 3 research papers, 3 popular articles, and 10 research papers were presented in seminar/ symposia.
- Centre has conducted 4 trainings and awareness campaign and delivered 2 radio talks.
- Improvement is needed in the Annual Report 2013-14.

CSKHPKV, Palampur

- Centre has published 10 research articles, and 1 research paper was presented in seminar/ symposia.

GBPUAT, Pantnagar

- Centre has published 04 research papers, 02 popular articles, and one bulletin.
- Ten research papers were presented in seminar and symposia.

Dr. M.S. Bhullar, Principal Investigator, presented the salient findings of PAU, Ludhiana Centre:

- Weed surveillance indicated that *Poa annua* and *Solanum nigrum* are coming up as troublesome weeds in wheat; *Dactyloctenium* and *Leptochloa* in direct-seeded rice, and *Ipomoea* sp. in cotton.
- *Phalaris minor* has shown signs of cross resistance to sulfosulfuron, fenoxaprop, clodinafop and pinoxaden.
- In long-term rice-wheat cropping system, continuous/ rotational use of pre-emergence and post-emergence herbicides or grasses and broadleaf weeds killers in rice and wheat provided effective control, but favoured the dominance of a particular weed species over the years.
- In puddled transplanted rice, tank-mix application of bispyribac with ethoxysulfuron or cyhalofop+metsulfuron recorded effective weed control and higher grain yield.

- In turmeric, sequential use of pendimethalin 1.0 kg, metribuzin 0.7 kg and atrazine 0.75 kg/ha *fb* paddy straw mulch 10 t/ha *fb* one hand weeding were effective.
- In greengram, pre-emergence application of imazethapyr + pendimethalin 800-1000 g/ha recorded effective weed control and did not leave any residues for succeeding mustard crop.
- Continuous use of butachlor 1.5 kg, pretilachlor 0.75 kg and anilophos 0.375 kg/ha to rice and pendimethalin 0.75 kg and clodinafop-propargyl 0.06 kg/ha to wheat for years did not leave any residues in soil, grain and straw. At farmer's field, these herbicides did not move into ground water. Pretilachlor residue remained up to 20 cm soil depth. Total amount of pretilachlor increased with increasing initial concentration and increase in organic matter.
- The centre has passed four new technologies in potato, carrot, sugarcane + garlic and soybean to state package of practices.

Comments made during discussion

- Under project 3.6, the experimental plot size was not appropriate. PI was asked to modify the layout and put the treatments in bigger plot size by sacrificing the replication.
- Presentation and quality of slides were very good.
- Presentation of annual report was not up to mark. There was improper numbering of headings, tables and figures in annual report.
- Hard copy of the annual report was not received even up to day of annual review meeting.
- PI was asked to submit the report in both soft and hard copy well before or on the last date of submission.
- Overall work done by the centre was satisfactory.

Dr. V.P. Singh, Principal Investigator, presented the salient findings of GBPUAT, Pantnagar Centre:

- Satisfactory control of *P. minor* was achieved at farmers' fields with the application of sulfosulfuron with minor toxicity to wheat crop at initial growth stage.
- In sugarcane, major problematic weed observed in patches was *C. rotundus*. Farmers are doing spot application of glyphosate to control sedges in sugarcane.
- Application of clodinafop for the control of *P. minor* enhanced the problem of *Chenopodium album*.
- *Cirsium arvense* was reported as the problematic weed, which was not controlled by any of the herbicides at present.
- Isoproturon resistant *P. minor* was controlled by clodinafop. Plants from a few sources exhibited regeneration in the sulfosulfuron treatment.
- Addition of jaggery improved efficacy of glyphosate in controlling *C. rotundus* at all the doses.
- Among the tillage systems, maximum weed seed bank was recorded with CT (TPR)-CT(wheat) method of crop establishment.
- Lowest weed dry weight and highest WCE was recorded with the combination of bispyribac-Na 25 g + ethoxysulfuron 18.75 g/ha followed by the sequential application of pretilachlor (750g/ha) PE *fb* chlorimuron ethyl 10% + metsulfuron methyl 110% (4 g/ha) .
- No residual effect of treatments applied to blackgram was observed on succeeding mustard crop
- Significantly lowest dry weight of weeds was recorded under ZT(DSR)-ZT(wheat)+ residue – ZT(sesbania). Significantly higher grain yield of rice (4275 kg/ha) was recorded under CT(TPR)-CT(wheat) as compared to direct seeded rice *fb* zero till wheat along with sesbania (zero till).
- Lowest weed dry weight was recorded with application of clodinafop 0.06 kg/ha 30 DAS *fb* 2, 4-D at 0.5 kg/ha which were at par with rest of the treatments except farmer's practice. However, highest grain yield of wheat was recorded with recommended dose of sulfosulfuron followed by isoproturon + 2, 4-D.
- The extent of damage on Parthenium by *Z. bicolorata* varied from 6-28 per cent in the first site and 7-35 % in the second site.
- The average reduction in density of *P. hysterophorus* due to *C. tora* was observed 93.1 and 95.9% respectively at both the sites selected for the study.

- Residues of isoproturon, butachlor, clodinafop and MSM were below detectable limit at harvest of the crop.
- Residues of butachlor, anilofos, pretilachlor, isoproturon, sulfosulfuron, metribuzin, clodinafop, 2,4-D, atrazine, pendimethalin were not detected in water bodies.
- Oryzalin residues were not detected beyond 10 cm soil depth in both silty clay loam and sandy loam soils.
- Residues of isoproturon, 2,4-D, sulfosulfuron, clodinafop, butachlor, pretilachlor, anilofos and atrazine used at farmers field were below detectable limit.
- Adsorption of oryzalin increased with time, concentration and organic carbon.
- 23 OFTs and 24 FLDs in the hilly and plain areas in different crops such as rice, wheat and soybean were conducted during the reporting period.
- Organized farmer's fair, delivered radio talks, lectures in training programmes and Parthenium awareness week.

Comments made during discussion

- Presentation and quality of slides were very good.
- Annual Report was not up to mark. It needs further improvement. Final tabulation should be done as per format of data sheet provided from headquarter. Improper numbering of headings, tables and figures in annual report. Tabular data and line diagrams should be well presented.
- Do not highlight small differences in the text (2-3%), which are not likely to be significant.
- Check the transformation of data on weed growth. PI was asked to see the reporting in respect to leaching and adsorption behaviour of the herbicides. Same data were repeated as presented in ARM, 2013 at HPKVV, Palampur.
- Report only those publications, which have come from this project.

Dr. Dinesh Badiyala, Principal Investigator, presented the salient findings of CSKHPKV, Palampur Centre:

- Increase in dominance of *Ageratum conyzoides*, *Commelina benghalensis* and *Bracharia* sp. was observed in maize crop, and *Oxalis latifolia* and *Stellaria media* in vegetable crops.
- Entry of *Parthenium hysterophorus* in upland crops was noticed.
- Spread of *Cassia tora* and Mexican beetle on large scale was observed in some area of the Kangra and Hamirpur districts of Himachal Pradesh during August and September months.
- Infestation of weedy rice was observed between 15-50% in direct seeded rice in different districts of Himachal Pradesh.
- In turmeric, weeds throughout growing period caused reduction in rhizome yield by 77%. Application of fenoxaprop 60 g + metsulfuron 4 g/ha caused phytotoxicity in the crop.
- No shift in weed flora was observed during the period under report in permanent herbicide trial. Further, continuous or rotational use of herbicide did not develop any resistance in weeds in wheat and rice crops.
- *Azotobacter* population and phosphate solubilising microorganism, dehydrogenase activity, basal soil respiration, microbial biomass and carbon, phosphatase enzyme activities were not influenced by long-term herbicide use.
- The residue of herbicide in long term experiment was found below the detectable limit (BDL) in both crops of rice and wheat.
- In the agronomic experiments in maize-pea cropping system conducted at Palampur, residue of all the herbicides used were below the detectable level.
- No peak was observed corresponding to butachlor indicating that no herbicide residue was present in water samples collected/analysed.
- The persistence of butachlor in rice grains and soil samples collected from farmers' fields were below the detectable level.
- 8 OFTs, 5 FLDs and 5 training programmes were conducted. *Parthenium* awareness week was observed from August 16-22, 2013.

- Published 12 research papers and 4 Hindi booklets during the period under report.

Comments made during discussion

- Presentation and quality of slides were reasonably good, but number of slides was very high.
- Annual report was not up to mark. It needs further improvement. Final tabulation should be done as per format of data sheet provided from headquarter.
- WS 3.6 was started during last year only; hence the same will be reported in next ARM.
- There was no adequate work under weed biology. Similarly, not enough work has been done for weed surveillance.
- Annual report should be presented as per the prescribed format, with tables included within the text.

Dr. R.K. Pathak, Microbiologist, presented the salient findings of NDUAT, Faizabad Centre:

- Dr. Jaidev Sharma. Principal Investigator did not attend the meeting because of his duties at *Kisan Mela* organized at NDUAT.
- Fifteen weeds species were recorded in each district surveyed in the *kharif* season. *Echinochloa* sp. was the most dominant weed in all the districts.
- During *rabi* season, 15 weed species were recorded in wheat fields in all the districts, *Phalaris minor* was found in all the districts, though its density varied from 19.0 to 64.2 plants/m² with the IVI values varying from 17.9 to 24.1 in different districts, respectively.
- Long-term trial on tillage in rice-wheat cropping system revealed that broad leaf weeds were found more dominating in ZT grown rice and wheat while *P. minor* population declined in ZT treatments.
- In PHT under rice-wheat cropping system no considerable variations in grain yield of rice as well as of wheat due to *kharif* and *rabi* season treatments were observed.
- During *kharif* and *rabi* season microbial properties at initial and harvest stage showed significant effect among the treatments. Maximum microbial population was observed in hand weeded plot.
- Butachlor 1.5 kg/ha, pretilachlor 0.75 kg/ha (CT) and pendimethalin 1.0 kg/ha (ZT) PE and isoproturon 1.0 kg + 2,4-D Na salt 0.5 kg/ha applied in rice and wheat cropping system did not leave harmful residues in soil.
- Isoproturon 1.0 kg/ha and 2,4-D Na 0.5 kg/ha PE persisted up to 30 days in soil of wheat while metribuzin 0.2 kg/ha, sulfosulfuron 25 g/ha and clodinafop 60 g/ha PE persisted up to 45 days of wheat in farmer's field.
- Clodinafop+metsulfuron methyl (160+40 g/ha) PoE, or clodinafop (160 g) PoE *fb* one hand weeding at 45 DAS proved superior with respect to WCE, grain yield and economics of wheat.
- Bispyribac-Na 25 g at 25 DAT, oxadiargyl 100 g PE *fb* 2,4-D Na 500 g/ha PO revealed that grassy and BLWs were controlled very effectively in rice crop.

Comments made during discussion

- Presentation and quality of slides was poor, and the number of slides was more than required.
- Data were not summarized well for presentation. Similar observations were made during presentation in ARM at Palampur. PI should give much attention for quality presentation.
- Annual report was not up to mark. It needs lot of improvement. Final tabulation should be done as per format of data sheet provided from headquarter.
- Publication record was very poor. PI was asked to report only those publications, which have come from this project.
- There was not adequate work done under weed biology.

Dr. S.S. Punia, Principal Investigator, presented the salient findings of CCSHAU, Hisar Centre:

- In weed surveillance studies, wild rice was not observed in any of rice growing districts.
- Cauliflower and cabbage were found infested with *Orobanche* in Bhiwani district.
- Poor control of *Rumex dentatus* by metsulfuron was observed at some locations in the state.

- All recommended herbicides used by farmers in direct seeded rice did not prove effective against *Leptochloa chinensis*, *Eragrostis* and *Bracharia* spp.
- Based on the observations from experiments and farmer's interview *P. minor* has shown cross resistance against clodinafop, sulfosulfuron and pinoxaden. Ready mix combination of imazethapyr + pendimethalin proved quite effective against weeds in green gram without any adverse effect on succeeding mustard crop.
- Excellent efficacy of pre-emergence use of metribuzin/pendimethalin/atrazine along with straw mulch was observed against weeds in turmeric.
- Biological control of water hyacinth, *Neochetina bruchi* weevils although multiplied but could not defoliate water hyacinth leaves.
- Front line demonstrations on *Orobanche* management in mustard were conducted on 385 acres with 66% control of *Orobanche* and 13.6% increase in mustard yield. Tembotrione at 100 g/ha (PO) along with surfactant was very effective amongst grassy weeds in five on-farm trials conducted in maize.
- New herbicide molecule UPH-309, a ready mix combination of pretilachlor + bensulfuron against complex weed flora in transplanted rice was found quite effective at 17 locations in the state.
- In long term herbicide trials, half life of pretilachlor, anilofos, and butachlor were less under green manuring conditions as compared to non green manuring conditions. No residues of any herbicide were found in paddy grains and straw.
- Persistence of rice herbicides was studied in tube well waters and 5 samples were found to contain pretilachlor residues ranging between 0.21-1.30 µg/ml. soil, grain and straw samples collected from farmer's fields revealed that only four soil samples were found to contain sulfosulfuron within range of 0.011-0.025 µg/g.
- Adsorption of pendimethalin in soil was quite strong and desorption was difficult.

Comments made during discussion

- Presentation and quality of slides were very good, but the number of slides was more than required.
- Annual report was satisfactory. But it needs further improvement. Final tabulation should be done as per format of data sheet provided from headquarter.
- Good quality publications were made.
- PI has shown inability to conduct the trial under WS 3.6 (Weed management in rice-wheat cropping system under conservation agriculture) because of unavailability of land. During discussion, Dr. R. K. Malik advised him to conduct this important trial at Uchani farm.
- Overall work done by the centre was relatively better with respect to WS 1.0 and WS 2.0.
- Questions were raised on the safety of application of glyphosate on mustard, to which it was explained by Dr. Punia that it is very important that the plants should not be water stressed during the application of glyphosate. Hence, irrigation should be given one day before the application. Further the dosage should be strictly maintained.

TECHNICAL SESSION – II

Presentation of salient findings by Principal Investigators of AICRP-WC Centres in South Zone:

Chairman : Dr. L.S. Brar, Former Head, Division of Agronomy, PAU, Ludhiana
Rapporteurs : Dr. Sushilkumar, DWSR, Jabalpur
 Dr. S.S. Punia, CCSHAU, Hisar

Dr. Sushilkumar, Nodal Officer presented an overview of research highlights, constraints and suggestions of the centres under South Zone. Centre-wise specific observations were as follows:

General observations for all the centers

- There was lack of proper efforts to select the perennial ponds in their area. PIs were advised to do more efforts to select the pond at first hand. It is not necessary that a perennial pond should be near around. The pond may be selected in the area of their jurisdiction for releasing bioagent for biological control of water hyacinth. We need to intensify the efforts keeping in view the seriousness of the problem.
- In most of the centers, observations on *Zygotropha bicolorata* have not been taken as per given format. All the PIs should adhere to the given format only.

Dr. M. Yakadri, Principal Investigator, presented the salient findings of ANGRAU, Hyderabad Centre:

- In PTR, pretilachlor *fb* ethoxysulfuron/metsulfuron + chlorimuron; pyrazosulfuron *fb* manual weeding were effective.
- In DSR, pendimethalin *fb* bispyribac sodium *fb* HW at 45DAS was recommended for efficient and remunerative weed management.
- Excellent establishment of *Neochetina* weevils was observed which were released for control of water hyacinth in two perennial tanks in Hyderabad
- In ZT maize soils, atrazine residues in soil could be detected up to 60 DAA; no residues of butachlor/cyhalofop could be detected in the rice grain or straw at harvest.
- Atrazine residue in water from the open wells/ tanks in Karimnagar district were not detected; tomato samples from farmers' fields did not contain metribuzin residues.
- Conducted 10 FLDs in rice, and 4 in cotton.

Comments made during discussion

- Annual report was not written properly. There was improper numbering of headings, tables and figures in annual report.
- No studies on *Striga* management in sugarcane were conducted. Similarly, no work was done on management of *Orobanche* in brinjal/tomato.
- OFTs on *Orobanche* were not satisfactory.
- Publication record needs to be improved.
- Annual report is not well written. Linkages are not mentioned.

Dr. R. Devendra, Principal Investigator, presented the salient findings of UAS, Bengaluru Centre:

- Fine droplet herbicide application and addition of surfactants reduced herbicide dosage without affecting the herbicide efficacy.
- In PTR, pyrazosulfuron *fb* manual weeding, pretilachlor *fb* chlorimuron + metsulfuron, pretilachlor *fb* ethoxysulfuron gave paddy yields better than hand weeding.
- In DSR, pendimethalin *fb* bispyribac or HW; pyrazosulfuron *fb* bispyribac; bispyribac *fb* + chlorimuron + metsulfuron gave paddy yields similar to hand weeding.
- Over 15 years, continuous use of butachlor/pretilachlor+ 2,4-D in PTR, butachlor in transplanted finger millet, pendimethalin in groundnut gave yields similar to farmers' practice of HW, without altering the soil physico-chemical, biological properties; no herbicide residue in soil, plant and grain at harvest stage in rice-rice and finger millet-groundnut systems were found.
- In sunflower, butachlor *fb* HW was effective.
- In soybean, field bean, cowpea and green gram, PRE herbicides pendimethalin, alachlor and metribuzin *fb* imazethapyr recorded significantly higher seed yield compared to pre/post herbicides alone.
- Quarantine weed - *Ambrosia psilostachya* was managed effectively with glyphosate, 2,4-D for 3-4 months; repeat application required till roots rot and no-sprouting occurs.

Comments made during discussion

- Annual report should be more concise and well presented. Check units and follow all the prescribed guidelines.
- Overall work done by the centre was relatively better with respect to weed surveillance and weed biology and physiology.
- Bengaluru centre has not conducted the studies on management of *Orobancha* in brinjal/tomato. Center has not done experiment on water hyacinth. Water hyacinth is a problematic weed in Karnataka. Center should intensify efforts on biological control by releasing/augmenting bioagents in lakes and ponds.
- Publication record is satisfactory but they should make efforts to publish paper in higher NAAS rating journals.
- The work on droplet herbicide application and addition of surfactants needs to be intensified to give concrete recommendation which may be applicable at farmers' field to enhance herbicide use efficiency.
- More efforts are required to manage quarantine weed - *Ambrosia psilostachya* by integrated approaches as more area is being reported under the attack of this weed.
- It has been suggested to report only those publications, which have come from this project.

Dr. C.T. Abraham, Principal Investigator, presented the salient findings of KAU, Thrissur Centre:

- Work was not satisfactory on weed biology and physiology. Center should make more efforts in this direction.
- Weed survey indicated that in ginger in the high altitude areas: *Ageratum conyzoides*, *Spilanthes radicans* and *Crassocephalam crepidioides* and in plains *Fimbristylis miliacea* and *Ludvigia parviflora* were the dominant weeds.
- Parasitic weed *Dendrophthoe falcate* was most competitive in terms of water uptake and nutrient removal from the host tree.
- More than 40% of earthworm migrated from soil treated with glyphosate at 1.2 kg/ha, to non-treated areas within four days.
- In PTR, pyrazosulfuron fb HW and bispyribac fb ethoxysulfuron were effective; in upland DSR, pendimethalin fb bispyribac/HW and pyrazosulfuron fb bispyribac were effective.
- More than 90% of soil applied oxyfluorfen was bound to the soil within 2 hrs; only 9.9% of adsorbed herbicide desorbed during 2 hrs.
- Oxyfluorfen 0.4 kg/ha is effective alternative for diuron 3.0 kg/ha which has high residue and toxicity problems.
- Centre has developed three technologies for management of weedy rice: Stale seed bed for reducing the soil seed bank; oxyfluorfen 0.3 kg/ha 3DBS for preventing germination and establishment; wick wipe application of glyphosate/paraquat to selectively dry ear heads of weedy rice, which emerge two weeks prior to flowering of cultivated rice. The centre has developed an applicator for this purpose and the same has been submitted for patent.

Comments made during discussion

- Annual report was not up to mark. A soft and hard copy of the report should be submitted well before the last date of submission.
- Physiological studies in long-term trials were not done properly.
- Biology of weeds was not done.
- OFR details were not clear in annual report.
- Presentation and quality of slides need improvement.
- Biological control of water hyacinth may be dropped due to flooding of water in the region
- Publication record needs to be improved.

- Keeping in view the problem of weeds in pineapple plantations, the PI was advised to take systematic trial on this aspect.
- Work done on *Loranthus* management should be published in peer reviewed journals.

Dr. N.K. Prabhakaran, Principal Investigator, presented the salient findings of TNAU, Coimbatore Centre:

- Gave detailed account of weed flora shift in last five years in cropped and non-cropped areas and discussed detailed biology of *Echinochloa* sp, *Orobanche*, *Striga* and *Cyperus rotundus*.
- In long term tillage trial in maize-sunflower system, continuous CT and atrazine/pendimethalin recorded higher net return.
- In CA trial in rice-rice system, CT + IWM recorded lowest weed density and higher grain yields.
- In long term herbicide trial in rice-rice system, weed shift from BLW *Ludwigia parviflora* to grasses (*E. crus-galli*) and sedges (*C. difformis*); rotational herbicides use recorded lowest weeds and highest grain yield; continuous butachlor + 2,4-D for 26 years did not show any build up in the post harvest soil or grain and straw.
- In turmeric, integrated use of metribuzin/pendimethalin/atrazine *fb* PSM *fb* HW recorded lowest weeds and highest turmeric yield.
- In tobacco, plant hole application of neem cake 200 kg/ha on 30 DAT and imazethapyr 30 g/ha on 55 DAT reduced *Orobanche* shoot density & increased the tobacco leaf yield.
- In sugarcane, atrazine *fb* HW *fb* earthing up *fb* 2,4-D+ urea *fb* trash mulching reduced *Striga asiatica* and increased sugarcane yield.
- Herbicides were not detected in ground water at farmers' fields; not detected in plant matrices and soils collected from the farmers field grown with potato, groundnut, onion and tea at harvest.
- Pyrazosulfuron and bispyribac movement was detected up to 30 and 45 cm depth; adsorption of pyrazosulfuron was high in sandy clay loam soil; bispyribac sodium was high in peat soil.
- Tribal sub plan considered >200 farmers from Salem and Dharmapuri districts; BLW dominated the weed flora followed by grass weeds; farmers in Salem district have followed only cultural method of weed control while > 60% farmers in Dharmapuri district have used chemical method for the control of weeds.

Comments made during discussion

- Overall work done by the centre was relatively better with respect to weed surveillance and weed biology and physiology.
- Water hyacinth experiment was not done. Water hyacinth infested pond in their jurisdiction should be searched to release the bioagent.
- More intensive efforts are required to give a concrete recommendation to control *Orobanche* by neem cake 200 kg/ha on 30 DAT and imazethapyr 30 g/ha on 55 DAT.
- TNAU should come up with suitable recommendations for the management of *Striga* in sugarcane.
- Data presented should be statistically analyzed and then reported.
- The work of the economist is not visible in the report.
- Publication record is satisfactory but they should make more efforts to publish paper in higher NAAS rating journals.

Dr. Ramesh Babu, Principal Investigator, presented the salient findings of UAS, Dharwad Centre:

- Incidence of *Solanum* in Gadag district was reported.
- In long term tillage and CA trial in maize-chickpea system, CT was superior over ZT; ZT recorded higher soil microflora than CT while herbicides temporarily reduce the soil microbial activities.

- In long term herbicide trial, atrazine fb 2,4-D in maize and pendimethalin fb HW in chickpea were superior.
- Application of atrazine/metribuzin/diuron/oxyfluorfen fb 2,4-D fb mulching effectively controlled *Striga*; *Glomus macrocarpus* suppressed *Striga* growth than any other fungi.
- The centre conducted station trials on DSR, sunflower, cotton and conducted 10 FLDs and On-farm trials.

Comments made during discussion

- Adequate work was not done under weed biology; not enough work has been done for weed surveillance.
- Work on survey and incidence of *Striga* in sorghum and maize and *Orobanche* in sunflower should be undertaken.
- Publication record is poor. PI has been asked to publish good quality papers in reputed Journals.
- Observations on management of water hyacinth and *Parthenium* by bioagents were not taken as per the format.
- PI has been asked to follow the guidelines for Annual Report.

TECHNICAL SESSION – III

Presentation of salient findings by Principal Investigators of AICRP-WC Centres in East Zone:

- Chairman** : Dr. R.S. Sharma, Former Head, Department of Agronomy, JNKVV, Jabalpur
- Rapporteurs** : Dr. D.K. Pandey, DWSR, Jabalpur
Dr. S.K. Guru, GBPUAT, Pantnagar

Dr. D.K. Pandey, Nodal Officer presented an overview of research highlights, constraints and suggestions of the centres under East Zone. Centre-wise specific observations were as follows:

General observations

- Weed biology studies need to be done in detail.
- Centres who are working on weedy rice can send specimen seed samples to DWSR, Jabalpur for further characterization at molecular level.
- There seems to be a problem in transportation of *Neochetina* weevil, as dead insects were received. The centres should try again in case dead weevils are received. This issue must be discussed in detail with Dr. Sushil Kumar and resolved.
- Uniformity should be observed in reporting the results.

Assam Agricultural University (AAU), Jorhat

- WS1.2: Monitoring of herbicide resistance is not done.
- Experiments are broad based, and it is difficult to achieve objectives with the staff and within time frame. Focused objectives and intensive investigations would facilitate better work and quality output.
- Annual report was not well written as per the format, there is scope of improvement in it.
- *Zygomma bicolorata* could not be established due to heavy rains.
- WS 4.2c – It should have been attended more responsibly by getting the bio-agent again.

Visva-Bharati (VB), Sriniketan

- Herbicide residue studies in long-term herbicide trial were not done.

- Experiments are broad based and difficult to achieve objectives with the staff and within time frame, fewer focused objectives and intensive investigations would facilitate better work and quality output.
- There is scope for improvement of annual report by making presentation more succinct.
- While reporting, data must be given in standard units only instead of locally preferred units.
- Consistent high number of research papers (17) and students guided is appreciable.

Orissa University of Agriculture & Technology (OUAT), Bhubaneswar

- WS 2.1d - Biology of *Orobanche* is not done.
- WS 3.5: Long-term trial on tillage in different cropping systems is not done.
- WS 5.3: Characterization of leaching behaviour of herbicide in soil is not done.

Rajendra Agricultural University (RAU), Pusa

- WS 5.1: Herbicide residues in long-term herbicide trial are not done.
- Experiments are broad-based, and it is difficult to achieve objectives with the staff and within time frame. Fewer focused objectives and intensive investigations would facilitate better work and quality output.
- There is scope for improvement of Annual Report by making presentation more succinct.
- WS 3.7 and WS 5.1 were not undertaken.

Birsa Agricultural University (BAU), Ranchi

- WS1.2: Monitoring of herbicide resistance is not done.
- WS 4.2c: Biological control of water hyacinth is not done.
- WS 5.1: Herbicide residues in long-term herbicide trial are not done.
- The infestation of weedy rice is severe in Jharkhand. The yield losses of main rice range from 10 to 45 %, hence, biology and management of weedy rice is required to be studied.
- There is scope for improvement of annual report by making presentation more succinct.
- WS 1.2 - Needs to be undertaken.
- WS 4.2c (control of water hyacinth) - Needs to be undertaken as proposed.
- WS 5.1 Needs to be undertaken as proposed.

Dr. J. Deka, Principal Investigator, presented the salient findings of AAU, Jorhat Centre:

- AAU, Jorhat Centre reported increased infestation of *Parthenium*, *Cuscuta campestris* and *Ludwigia peruviana*.
- Identification of 14 taxa of *Echinochloa* and key for weed seedling identification has been developed.
- In transplanted rice, pretilachlor *fb* ethoxysulfuron gave higher grain yield while in direct-seeded rice, mechanical weeding was most effective.
- In turmeric, metribuzin or pendimethalin *fb* hoeing is most effective for weed management.
- In long-term trial in rice-wheat cropping system, treatments of one season had no effect on the next crop.
- In the long-term trial in rice-rice cropping system, butachlor *fb* 2,4-D in rotation with pretilachlor was most effective for weed management.
- In the station trial, the centre has identified leaf orientation as a trait in rice for smothering effect.

Comments made during discussion

- Annual report is of 180 pages, 1 ½ spacing, several digits after decimal, quality of printing poor, guidelines not followed.
- Overall work done by the centre was relatively better with respect to WS 1.0 and WS 2.0.

- Focussed work should be done on the incidence of *Loranthus* and *Chromolaena*. A systematic survey should be conducted to find out the current status of *Loranthus* in the region.

Mr. A. Hossain, Assistant Agronomist, presented the salient findings of V.B. Sriniketan Centre:

- V.B., Sriniketan reported *C. rotundus*, *Oxalis* spp, and *Paspalum* as major weeds while *Sagittaria* and *Oldenlandia* are reported to be disappearing.
- No resistance to butachlor by *E. glabrescens* was noticed even after consecutive use for 4-5 years.
- Biology of *E. glabrescens*, *E. crus-galli* and *Oryza rufipogon* have been studied by the centre.
- In rice, mixture of Bispyribac sodium and Almix was most effective for weed management.
- Premix of imezathapyr and pendimethalin or pendimethalin alone was most effective for weed management in black gram, but had toxic effects on succeeding mustard crop. Toxicity of imezathapyr was discussed at length in the house and various factors such as pH, microbial activity, and rainfall were reported as affecting the toxicity.

Comments made during discussion

- Not enough work has been done for weed surveillance.
- Administrative issues regarding payment of CPF, Medical bills, LTC etc. to be taken up with ICAR.
- Annual report – poorly compiled, several proforma are given. Differentiate between research papers, and other presentations / publications.

Dr. M.M. Mishra, Principal Investigator, presented the salient findings of OUAT, Bhubaneswar Centre:

- OUAT, Bhubaneswar centre has characterized weed species for different agro-climatic zones of the state. Problematic weed species reported include *Phragmites karka*, *Panicum repens*, *Paspalum scorbiculatum* and weedy rice.
- No cases of herbicide resistance have been reported from the centre in *Echinochloa glabrescens*.
- Post-emergence application of bispyribac-Na @ 20 g/ha + Almix @ 4 g/ha recorded lowest weed density, weed biomass and significantly higher yield in transplanted rice.
- In direct seeded rice for control of complex weed flora, application of pendimethalin @ 1000 g/ha PE followed by bispyribac-Na @ 25 g/ha with one hand weeding at 45 DAS gave the best result among all other treatments.
- In long-term herbicide trial, use of butachlor + 2,4-DEE rotated with pretilachlor without OM in rice along with application of alachlor in groundnut recorded significantly the lowest weed density in groundnut during initial stages of crop growth and resulted in highest B: C ratio in the cropping system. A shift of *Celosia argentea* from alachlor treatment to hand weeding and butachlor treated plots was observed in *rabi* groundnut.
- In niger, germination of *Cuscuta* was less in stale seedbed *fb* pendimethalin 1.0 kg/ha – pre-emergence which resulted in the highest seed yield of niger.
- Persistence of herbicides of butachlor and pretilachlor in respective treatments were of same pattern. Addition of organic matter decreased the persistence of both the herbicides. No residue could be detected from 60 days after application. No residue was detected in post harvest rice and ground nut plant parts. Herbicides like pretilachlor and butachlor could not be detected in water samples collected from water bodies nearby the fields sprayed with them. In OFTs and FLDs, performance was better in recommended herbicides as compared to farmers' practice.

Comments made during discussion

- Improper numbering of headings, tables and figures in annual report.
- Adequate work was not done under weed biology.
- No work was done on *Orobanche* management because of the destruction of crops by cyclone last year. Intensive survey should be done for the incidence of *Orobanche* and *Cuscuta*.

- No publications were made during the year.

Dr. R.R. Upasani, Principal Investigator, presented the salient findings of BAU, Ranchi Centre:

- BAU, Ranchi centre has reported *Ludwigia parviflora*, *Fimbristylis miliacea*, as problematic weeds of transplanted rice, whereas in finger millet, *Digitaria sanguinalis* and in turmeric, *Ageratum conyzoides* were the major problematic weeds.
- No cases of herbicide resistance were observed by the centre.
- Weedy rice infestation ranged between 10-90% in Ranchi area.
- In long - term herbicide trial, continuous use of 2,4-D in rice crop either in combination with butachlor or with Almix reduced density of broad leaved weeds.
- In long-term tillage trials, weed density decreased in CT-CT as compared to ZT-ZT or ZT-CT.
- In direct seeded rice pendimethalin *fb* bispyribac-Na *fb* hand weeding reduced weed dry weight and gave highest yield. In turmeric crop, application of metribuzin 0.7 kg/ha *fb* straw mulch 10 t/ha *fb* one HW was better than rest of the treatments.
- In niger, pre-emergence application of pendimethalin @ 1.0 kg/ha gave effective control of *Cuscuta*.

Comments made during discussion

- Annual report is very poorly compiled. Poor data presentation, no page numbering, non-uniformity in units, improper numbering of headings, tables and figures.
- Survey for incidence of *Cuscuta* in field crops and *Loranthus* on forest trees should be undertaken.
- Research papers of the reporting period should only be mentioned.

Dr. D.K. Roy, Principal Investigator, presented the salient findings of RAU, Pusa Centre:

- In RAU, Pusa, total sixteen weed species were observed in the fields of direct seeded rice, which included *Cynodon dactylon*, *Echinochloa colona*, *Echinochloa grabernalum*, *Dactyloctenium aegyptium*, *Setaria glauca*, *Cyperus rotundus* and *Cyperus difformis*. Biology of *Echinochloa* and weedy rice were also studied.
- In turmeric, highest rhizome yield was recorded with atrazine 0.75 kg/ha *fb* fenoxaprop at 67 g/ha+ metsulfuron 4 g/ha and atrazine 0.75 kg/ha *fb* straw mulch 10 t/ha *fb* one HW.
- In conservation agriculture, in rice-wheat- green gram cropping system, IWM gave better weed control. Biological control of *Parthenium* was most effective by replacement with *Casia tora*. The centre conducted OFTs in direct seeded rice, lentil and *rabi* maize.

Comments made during discussion

- Annual report is not well compiled having improper numbering of headings, tables and figures.
- No publications made during the year.

13 February, 2014

TECHNICAL SESSION – IV

Presentation of salient findings by Principal Investigators of AICRP-WC Centres in West Zone

Chairman : Dr. N.T. Yaduraju, Former Director, DWSR, Jabalpur
Rapporteurs : Dr. Shobha Sondhia, DWSR, Jabalpur
 Dr. J. Deka, AAU, Jorhat

Dr. Shobha Sondhia, Nodal Officer presented an overview of research highlights, constraints and suggestions of the centres under West Zone. Centre-wise specific observations were as follows:

- Annual Reports are in general not properly written except Anand, Dapoli and Parbhani. Centres have not followed the network numbering as mentioned in the Technical Programme 2012-14. Dapoli and Parbhani centres have not followed the guidelines for Annual Report.
- The constraints of lack of residue laboratory at Parbhani and non-functioning of GC at Anand were reported.

Status of experiments conducted:

Approved experiments		Dapoli	Anand	Bikaner	Parbhani
WS 1.1	Monitoring of weed shift / appearance of new weeds due to weed management practices, changes in cropping systems and climatic parameters	Reported	Reported	Reported	Reported
WS 1.2	Monitoring of herbicide resistance / escapes in weeds of the dominant cropping system	Reported	Reported	Reported	Not allotted
WS 1.4	Special survey on <i>P. minor</i> in wheat	Not allotted	Reported		Not allotted
WS 2.2	Viability / regeneration potential of glyphosate-treated <i>Cyperus rotundus</i>	Not allotted	Reported	Not allotted	Not allotted
WS 2.3	Physiological studies in long-term trials on tillage and herbicide	Not reported	Reported	Reported	Not allotted
WS 3.2	Herbicides combinations for control of complex weed flora in direct-seeded rice	Reported	Not allotted	Not allotted	Not allotted
WS 3.3	Weed management in turmeric	Not allotted	Not allotted	Not allotted	Reported
WS 3.4	Weed management in blackgram / greengram and its residual effect on succeeding mustard crop	Not allotted	Reported	Reported	Not allotted
WS 3.5	Permanent trial on tillage in different cropping system	Reported	Reported	Not reported	Not allotted
WS 3.6	Weed management in conservation agriculture systems	Reported	Reported	Not reported	Reported
WS 3.7	Long-term herbicide trial in different cropping system	Reported	Reported	Reported	Reported
WS 4.1c	Management of <i>Cuscuta</i> in lucerne	Not allotted	Reported	Not reported	Reported
WS 4.2a	Biological control of <i>Parthenium</i> by <i>Zygogramma bicolorata</i>	Reported	Reported	Reported	Reported
WS 4.2b	Biological control of <i>Parthenium</i> by competitive replacement through <i>Cassia tora</i>	Reported	Reported	Not reported	Not reported
WS 5.1	Herbicide residues in long-term herbicide trial	Not allotted	Reported	Not allotted	Reported
WS 5.2	Studies on herbicide persistence in water	Not allotted	Reported	Not allotted	Reported
WS 5.3	Characterization of leaching behaviour of herbicide in soil	Not allotted	Reported	Not allotted	Reported
WS 5.4	Testing of persistence of herbicides in the farmers' field (Soil and crop produce)	Not allotted	Reported	Not allotted	Reported
WS 5.5	Studies on secondary metabolites of herbicides	Not allotted	Reported	Not allotted	Not allotted
WS 5.6	Adsorption and desorption behavior of herbicides	Not allotted	Reported	Not allotted	Not allotted
WS 6.1	On-Farm trial (OFT)	Reported	Reported	Reported	Reported
WS 6.2	Frontline demonstration	Reported	Reported	Reported	Reported

Dr. A.S. Jadhav, Principal Investigator, presented the salient findings of MAU, Parbhani Centre:

- Increasing problem of certain weeds like *Euphorbia geniculata* was reported. There was complete replacement of *Parthenium* by *Cassia tora* on road sides. Seventy six per cent control of *Parthenium* by *Zygogramma* beetle was achieved.
- ATR on ARM at Palampur and QRT was presented. The PI was advised to check the B:C ratio of the treatments and follow the guideline already circulated. In regards to microbiology study, it was pointed out that dehydrogenase activity should be studied.
- The Chairman suggested that the issue should be discussed during discussion on Technical Programme. He also mentioned that stakeholders should be involved in context of participatory research.
- It was also suggested that weed survey should be conducted based on certain benchmark and same sites should be visited to monitor the weed shifts and correlate with definite reasons for this. Therefore, weed survey and surveillance protocol should be revisited.
- The Director, DWSR remarked that all soil parameters need not be studied in the very first year itself in long term trials.

Comments made during discussion

- Annual report was not in good shape. PI has been asked to follow the guidelines for Annual Report.
- Network numbering as mentioned in the Technical Programme should be followed.
- Physiological studies in long-term trials on tillage and herbicide were not done.
- Presentation and quality of slides were not good.
- In regards to microbiology study, it was pointed out that apart from microbial population study, dehydrogenase activity should also be studied.
- It has been suggested to report only those publications, which have come from this project.

Dr. Y.R. Govekar, Jr. Microbiologist, presented the salient findings of DBSKKV, Dapoli Centre:

- Dr. M.J. Mane, Principal Investigator could not attend the meeting due to personal problems.
- In orchards of mango and coconut, *Themeda quadrivolvris*, *Celosia argentea*, *Urena lobata* and *Blumea lacera* were dominant weeds
- In direct seeded drilled rice application of oxyfluorfen fb 2,4-D was recommended.
- Awareness and training programmes were organized in Raigad district under TSP in which 250 tribal farmers were benefitted by providing weeding tools, sprayers etc.

Comments made during discussion

- The recommendation of oxyfluorfen fb 2,4-D in direct seeded drilled rice was questioned as oxyfluorfen is very toxic. Director pointed out the delayed submission of Annual Report, lack of publication and network trials not being conducted completely by the centre. It was decided that ATR should be incorporated in the Annual Report.
- Physiological studies in long-term trials on tillage and herbicide was not done.
- PI has been asked to follow network numbering as mentioned in the Technical Programme.
- OFT details were not clear in annual report.
- Presentation and quality of slides need improvement.
- Presentation in annual reports was not up to mark. It needs improvement.
- PI has been asked to follow the guidelines for Annual Report.
- PI has been asked to submit the report in both soft and hard copy well before or on the last date of submission.
- Publication record was not good.
- PI has been asked to strictly follow the network trail and recheck application of oxyfluorfen followed by 2,4-D post em in direct seeded drilled rice.
- Not enough work has been done for weed surveillance.

Dr. R. S. Yadav, Principal Investigator presented the salient findings of SKRAU, Bikaner Centre:

- Water hyacinth has been noticed in the water bodies near the canals passing through the *Thar* Desert.
- Phytotoxicity of atrazine on pearl millet was seen due to rainfall received 4 days after sowing.

Comments made during discussion

- Annual Report was not properly written and need drastic changes. PI has been asked to follow the guidelines for Annual Report.
- Management of *Cuscuta* in lucerne was not conducted.
- Presentation of slides was not up to mark.
- Publication record was poor. It was also suggested to report only those publications, which have come from this project.

Dr. B. D. Patel, Principal Investigator presented the salient findings of AAU, Anand Centre:

- Weed survey was conducted on 10 crops in 4 districts. Infestation of *Phalaris* in wheat is increasing. He also reported that minimum disturbance of soil reduced weed emergence. Application of sand mix application of pendimethalin and imazethapyr was not safe for Lucerne to manage *Cuscuta*. However, application of pendimethalin @ 0.5 kg/ha 10 days after sowing is already recommended and it is safe. Besides application of paraquat after 1st cut of Lucerne was also good and Lucerne regrowth occurred after 10 days.

Comments made during discussion

- Annual Report was in good shape.
- Residue data was not presented in theme 5.0. PI informed about non-functioning of GC. He informed that now GC is running well and he will send all residue data very soon.
- Presentation and quality of slides was adequate.
- As such no research paper was published.
- PI has been asked to publish good quality paper in reputed Journals.
- Last year it was instructed by DWSR to AAU (Anand) that *Orobanche* management in tobacco should be studied in collaboration with their Tobacco regional station. However, it was not done due to lack of communication with the regional station.

TECHNICAL SESSION–V

Presentation of salient findings by Principal Investigators of AICRP-WC Centres in Central Zone

Chairman : Dr. J. P. Tiwari, Former Dean, College of Agriculture, JNKVV, Jabalpur
Rapporteurs : Dr. R.P. Dubey, DWSR, Jabalpur
Dr. M. Yakadri, ANGRAU, Hyderabad

Dr. R.P. Dubey, Nodal Officer presented an overview of research highlights, constraints and suggestions of the centres under Central Zone. Centre-wise specific observations were as follows:

RVSKVV, Gwalior

- Annual report was received in time.
- Quality of Annual Report is better than previous year but needs improvement.
- WS 1.2: Monitoring of herbicide resistance / escapes in weeds of the dominant cropping system was not conducted.
- WS 2.1b: Biology of weedy rice was not reported.
- WS 2.1c: Biology of *Phalaris minor* was not reported.
- WS 2.1d: Biology of *Orobanche* was not reported.
- WS 2.3: Physiological studies in long-term trials on tillage and herbicide were not conducted.

- WS 3.6: Weed management in conservation agriculture system was not conducted.
- WS 5.2: Studies on herbicide persistence in water was not conducted.
- Centre has published 04 research papers and 7 research papers were presented in seminars/ symposia during the period under report.

CSAUAT, Kanpur

- Annual Report was received too late.
- Quality of Annual Report is better than previous year but needs improvement.
- WS 1.2: Monitoring of herbicide resistance / escapes in weeds of the dominant cropping system was not conducted.
- WS 2.3: Physiological studies in long-term trials on tillage and herbicide were not conducted.
- WS 5.1: Herbicide residues in long-term herbicide trial were not conducted.
- WS 5.2: Studies on herbicide persistence in water was not conducted.
- WS 5.4 : Testing of persistence of herbicides in the farmers' field (Soil and crop produce) was not conducted.
- The centre has published 2 popular articles; 1 research paper was presented in seminar/ symposia and 1 book chapter during the period under report.

IGKV, Raipur

- Annual report was received in time.
- Quality of Annual Report is better than previous year but still needs considerable improvement.
- Centre has published 02 research papers; 1 popular article; 3 research papers presented in seminar/ symposia and 14 lectures were delivered during training programmes.

Dr. J.P. Dixit, Principal Investigator, presented the salient findings of RVSKVV, Gwalior Centre:

- Maximum seed yield of blackgram was recorded by two hand weeding at 20 and 40 DAS followed by pre mix herbicide i.e. imazethapyr + imazamox @ 50 g/ha as post em. and prendimethalin + imazethapyr 1000 g/ha as PE application.
- Under long- term herbicidal trial on pearl millet-wheat cropping system (five years), hand weeding twice at 30 and 60 DAS (weed free) treatment gave maximum grain yield 4586 kg/ha but higher net return was obtained with isoproturon+ one hand weeding treatment at 60 DAS (Rs. 49816/ha) as compared to other treatments. Herbicide isoproturon and atrazin applied to wheat and pearl millet both persisted in soil up to 45 days and no residues were left after harvest of crop.
- On the basis of six years data it was concluded that 2 hand weeding at 30 & 45 DAS or pre emergence application of atrazin at 0.5 kg/ha + one hand weeding at 30 DAS followed by atrazin @ 0.5 kg/ha + FYM 10 t/ha provides effective and profitable control of broad spectrum weeds in pearl millet under pearl millet-wheat cropping system.
- Early post emergence application of pendimethalin @ 500 g/ha or isoproturon @ 750 g/ha, butachlor @ 500 g/ha and one hand weeding at 25 DAS were found effective for control of weeds and getting higher yield of berseem.
- Metribuzin leached in soil upto 25-30 cm at 0.5 kg/ha and 35-40 cm at 1.0 kg/ha at 2.5 cm irrigation/day up to 7 days. At 7.5 cm irrigation the herbicide leached up to 35-40 cm at 0.5 kg/ha and 40-45 cm at 1.0 kg/ha. While butachlor leached in soil up to 20-25 cm at 1.0 kg/ha and 25-30 cm at 2.0 kg/ha at 2.5 cm irrigation/day upto 7 days. At 7.5 cm irrigation the herbicide leached up to 25-30 cm at 1.0 kg/ha and 30-35 cm at 2.0 kg/ha.

Comments made during discussion

- Irrigation applied to blackgram at 7.5 cm was very high.
- Several mistakes were pointed out in the presentation and results were not synthesized properly before presentation.
- Improper numbering of headings, tables and figures in annual report.
- No information given on collaboration and linkages with various stakeholders.

- More systematic work is needed on the management of *Orobanche*. They have not analyzed the soils as requested earlier during discussions.
- PI was told to take the help of DWSR or other centres where such facility exists for residue analysis. But no efforts have been made. The centre should follow the protocol distributed by DWSR for residue studies.
- *Orobanche* trial was not satisfactory.
- Herbicide residues were analysed by bioassay method which is not acceptable.
- Crop yields which are lower than state average should not be reported.
- Centre has not taken up any activity under TSP which is highly objectionable.

Dr. R.A. Yadav, Principal Investigator, presented the salient findings of CSAUAT, Kanpur Centre:

- Weed surveillance conducted in Etawah, Auraiya and Fatehpur district observed that *Convolvulus arvensis*, *Chenopodium album*, *Phalaris minor* and *Avena ludoviciana* were major weeds in wheat crop. In Fatehpur district, pigeon pea crop was severely infested by *Vernonia cinerea*.
- In direct-seeded rice, the maximum yield (3.75 t/ha), net income (Rs. 31477/ha) and B:C (2.31) were recorded with the application of pendimethalin *fb* bispyribac and manual weeding.
- In long-term study on tillage in rice-wheat cropping system, conventional- conventional tillage gave higher grain yield, net income and B: C ratio *fb* zero-zero tillage, among the weed control practices highest net income and B:C ratio was recorded with the application of pendimethalin (1.0 kg/ha) *fb* Almix (20 g/ha). Whereas, in wheat it was observed that conventional-conventional; system of tillage gave maximum grain yield, net income and B:C ratio while application of sulfosulfuron (25 g/ha) was most economical.
- In conservation agriculture in rice-wheat cropping system, transplanted rice resulted in highest grain yield, net income and B:C ratio under conventional- conventional tillage management. Whereas, integrated weed management practices resulted in to highest grain yield, net income and B:C ratio in rice crop. Similar result was reported in wheat crop also.

Comments made during discussion

- The presentation was full of mistakes.
- PI was asked to specify the ICTs used for disseminating weed management technology.
- Annual report compilation is of very poor quality. Improper numbering of headings, tables and figures in annual report.
- The work of the residue chemist is not given in the report.
- No research paper has been published during the year and also in the previous years.

Dr. A.P. Singh, Principal Investigator, presented the salient findings of IGKV, Raipur Centre:

- *Alternanthera triandra* has heavily infested cropped field's especially direct seeded rice, road sides, bunds etc. Other weeds on increase in the non-cropped area are *Malwa pusila*, *Cenchrus ciliaris* and *Chromolaena odorata*; however, *Parthenium hysterophorus* is getting replaced by them.
- In Chhattisgarh, no incidence of herbicide resistance has yet been reported or observed at on and off-farm.
- The benefit-cost ratio was highest under the treatment of pretilachlor (6%) + bensulfuron (0.6%) 6.6% GR@ 660 g/ha narrowly followed by bispyribac + (chlorimuron + metsulfuron) @ 25 + 4 g/ha in transplanted rice.
- The benefit-cost ratio was highest under the treatment of pendimethalin *fb* bispyribac -Na @ 1000 *fb* 25 g/ha and three mechanical weedings (rotary weeder 20,40,60 DAS) in direct seeded rice.
- Bioagent *Zygotyphlocyba bicolorata* for management of *Parthenium hysterophorus* was released in the *Parthenium* infested site in the month of August but could not establish due to heavy and continuous rains.
- In an area of 435 acres, front line demonstrations on weed management in maize, wheat and rice were laid down in 26 tribal villages in districts of Bastar, Kondagaon, kanker, Dhamtari, Balod, Bilaspur, Balrampur, Korea, Sarguja and Mahasamund.

- Combinations of sulfosulfuron + metribuzin @ 25 + 105 g/ ha and clodinafop + metribuzin @ 60 + 105 g/ ha, pinoxaden + carfentrazone @ 50 + 20 g/ ha and pinoxaden + metsulfuron @ 50 + 4 g/ ha are effective herbicides for the control of mixed weed flora in wheat.

Comments made during discussion

- Annual report is poorly compiled – not concise, lot of blank pages, several photographs.
- The centre was complimented for good work undertaken in TSP.
- Document susceptible and resistant weeds while undertaking weed survey.

TECHNICAL SESSION–VI

Presentation of salient findings by Principal Investigators of volunteer centres and ICAR institutes

Chairman : Dr. S.P. Kurchania, Former Head, Department of Agronomy, JNKVV, Jabalpur
Rapporteurs : Dr. M.L. Kewat, JNKVV, Jabalpur
 Dr. Ramesh Babu, UAS, Dharwad

In this session, there were four presentations from the volunteer centre and one net work programme on parasitic weed management.

Dr. Anil Kumar, Principal Investigator, SKUAST, Jammu volunteer centre presented the research highlights

- In maize-wheat cropping system, in maize during *kharif* 2013, weed control treatments showed significant variations in weed population, weed dry matter and grain yield of maize. Significantly highest grain yield to the tune of 4087 kg/ha was recorded with two hand weedings which was followed by statistically similar maize grain yield attained with the application of atrazine @ 1.0 kg/ha.
- In wheat, during *rabi* 2012-2013, weed control measures showed significant variations in weed population, dry weed weight and grain yield of wheat. Significantly highest grain yield of 3782 kg/ha was recorded in the treatment with isoproturon @1.0 kg/ha and was at par with the treatments where 0.75 kg isoproturon +1% tank mix urea or 0.1 % surfactant were applied.
- In rice-wheat cropping system, in rice, the lowest weed population was recorded at 30 and 60 days after transplanting, respectively where application of butachlor @ 1.5 kg/ha was made (which was previously treated with isoproturon 1.0 kg/ha in wheat crop. Highest rice grain yield was observed with herbicidal application of butachlor @1.5 kg/ha followed by two mechanical weedings (30 and 60 DAS) recording 69.7 and 51.7 per cent higher grain yield, respectively over weedy check treatment.

Dr. Purushotam Singh, Principal Investigator, SKUAST, Srinagar volunteer centre presented the research highlights

- In saffron incidence of star Bethlehem (*Orinitho galum umbalatum*) is of great concern because of tubers with sap which resist all types of herbicides.
- Brown sarson extracts (100%) of 36 hrs sprayed at 5 DAT was more effective resulting in higher rice yields over the application at 10 DAT.

Dr. J.P. Deshmukh, Principal Investigator, PDKV, Akola volunteer centre presented the research highlights

- In IWM in soybean and cotton, in soybean imazethapyr at 0.100 kg/ha + quizalofop ethyl at 0.075 kg/ha as post-emergent application (tank mix) at 15 DAS was found better in controlling weeds with higher WCE, yield and B:C ratio.

- In cotton, one hoeing at 20 DAS *fb* application of glyphosate 41SL at the rate of 1.0 kg/ ha or tank mixture of pyriproxyfen sodium at 0.062 kg/ha+ quizalofop ethyl at 0.075 Kg/ha applied at 20-25 DAS with one hoeing proved better in terms of yield and monetary returns.

Dr. P. Saravane, Principal Investigator, PAJANCOA, Puduchery volunteer centre presented the research highlights

- In transplanted rice, pyrazosulfuron+ HW/pretilachlor gave better weed control with higher yields.

Dr. C. Kannan, Sr. Scientist, DWSR presented the network programme on *Orobanche* management

- It was suggested to give conditional recommendations after compiling the results of *Orobanche* management and suggested to submit the same to ICAR.

14 February, 2014

TECHNICAL SESSION–VII

Presentation of Network Technical Programme by Nodal Officers

- Chairman** : Dr. N.T. Yaduraju, Former Director, DWSR, Jabalpur
Co-chairman : Dr. L.S. Brar, Former Head, Division of Agronomy, PAU, Ludhiana
 : Dr. A.R. Sharma, Director, DWSR, Jabalpur
Rapporteurs : Dr. R. P. Dubey, DWSR, Jabalpur
 Dr. M.M. Mishra, OUAT, Bhubaneswar

The following specific suggestions were made:

- It was suggested to follow the recommendations of QRT and RAC for formulation of technical programme.
- Research done in the past should be the basis for formulating the new technical programme.
- It was suggested to do less but quality work. The research programme should be problem solving.
- The weed survey should be taken in some fixed site so as to record the change instead of taking from different areas in a routine manner. It may be conducted on farmer's field having ½ or 1 acre of land holding and done in a repeated manner so as to record the changes in weed shift. Survey work may be conducted on 5-10 major weeds under each agro-ecosystem, preferably one district under each agro-ecosystem and in each year 5 farmers should be surveyed.
- The information generated under weed survey should be computerized.
- Hyderabad centre suggested monitoring the weed shift in maize-based cropping system.
- Coimbatore centre is of the view to conduct the survey work in different ecosystems and record the change in weed flora under the changing management practices, cropping system and climate etc.
- Technical programme under WS 1.2 should be continued as done before.
- Varietal evaluation for crop-weed competition should be undertaken.
- Management of weedy rice should be the priority in problem areas.
- Major focus should be on biology and management of 5 problem weeds identified under cropped and non-cropped lands in each state / region. The biology of 5 major weeds of the respective centre should be studied in relation to associated crops and the effects of different biotic and abiotic factors on these weeds. Studies conducted over 5 years should be critically analyzed and continued only, if required.
- In view of labour scarcity, work on HRCs should be initiated after obtaining necessary clearance from all concerned.
- The long-term trial on tillage (WS 3.5) should be replaced with the trial on conservation agriculture (WS 3.6). This trial should be conducted in at least 200 m² plot size without replications by ensuring

the running of zero-seed drill machines. The long-term trials under WS 3.7 completing 10 years may be stopped with valid documentation. In one year the scientists of each centre should compile the data and bring out good publications.

- It was decided to discontinue the trials which have completed 5 years or more and valid recommendations should be brought out for testing at farmers fields.
- Mass multiplication of Mexican beetle for control of *Parthenium* should only be carried out at AICRP-WC Centres and not at DWSR.
- In order to assess biodiversity loss due to *Parthenium*, satellite imagery of *Parthenium* infestation may be obtained from NRSA.
- ICAR institutes/ SAUs may be given awards / incentives for making their campus *Parthenium* free.
- Trials on brown manuring in DSR should be conducted in FLDs/OFTs.
- The OFR trials should be conducted in a scientific manner with farmer's participation. Exclusive reliance on herbicides in such trials should be avoided.
- The losses caused due to weeds should be estimated in a scientific manner and a concrete report should be brought out by the DWSR.

Due to shortage of time, the complete details of network technical programme 2014-16 could not be finalized. Dr. A. R. Sharma, Director informed that a draft on technical programme will be prepared by the Nodal Officers at DWSR based on the inputs received from the PIs of AICRP-WC Centres. After compilation by the Nodal Officers, it will be sent to the experts and RAC for their suggestions. The final draft will again be sent to PIs for their comments before finalization.

PLENARY SESSION

Chairman	:	Dr. S.K. Rao, Dean, Faculty of Agriculture, JNKVV, Jabalpur
Co-Chairman	:	Dr. A.R. Sharma, Director, DWSR, Jabalpur
External Experts		Dr. N. T. Yaduraju, Former Director, DWSR, Jabalpur Dr. L.S. Brar, Former Head, Division of Agronomy, PAU, Ludhiana Dr. R.K. Malik, Chairman, RAC, DWSR, Jabalpur
Convener	:	Dr. R.P. Dubey, DWSR, Jabalpur

1. In this session, the customary presentations by rapporteurs of different sessions could not be made due to paucity of time.
2. Dr. R. Devendra, Principal Investigator, UAS, Bengaluru and Dr. C.T. Abraham, Principal Investigator, KAU, Thrissur, who are due to retire from service during the year, were felicitated.
3. Dr. N.T. Yaduraju complemented the PIs and scientists of the project for the good work being done. He stressed to introspect their record of publication and documentation. He suggested to bring out success stories, brochures, videos for the use of policy makers.
4. Dr. L.S. Brar appreciated the good work done in the project. The conservation agriculture trial should include the inputs from various disciplines so that quality research papers could be brought out.
5. Dr. R.K. Malik emphasized for creation of human capital resources around the science. He stressed upon a strong component of monitoring and evaluation of the activity of the project preferably by third party.
6. Dr. S.K. Rao urged upon the scientists to organize special days for creating awareness on weeds in the society. Improving efficiency with limited budget is a matter of concern. He emphasized on bringing out quality publications as well as effective monitoring and evaluation of the project.

At the end, Dr. Yogita Gharde, Scientist, DWSR, Jabalpur proposed the vote of thanks.

General recommendations

1. The recommendations of QRT and RAC should be complied seriously.
2. Information generated over the years on weed survey and surveillance is required to be compiled, documented and uploaded in the DWSR website before the next Review Meeting.
3. Benchmark survey must be done before starting weed survey/surveillance programme in a particular location.
4. Biology and management of five major weeds of crop and non-crop situations should be documented.
5. Services of statistician at DWSR may be utilized for data analysis and drawing inferences.
6. Herbicide residue work through bioassay should be avoided.
7. Station trials proposed by the centres should also be discussed in the review meeting.
8. Yield levels in some trials are not up to accepted levels, which should not be reported.
9. Weed management in organic farming systems should be given less priority as per the recommendation of RAC.
10. Weed management in vegetable, horticulture and plantation crops should receive priority.
11. The experiment on conservation agriculture needs more refinement, mechanical weeding as a component of IWM should be made as manual weeding.
12. It was noted that a common format for economic analysis of the experiments is still not being followed by the Centres. Dr. P.K. Singh, Nodal Officer was requested to prepare a uniform methodology for economic analysis in consultation with economists at JNKVV.
13. All the Coordinating Centres will compile data on herbicides consumption in their respective states and provide the information to the Coordinating Unit.
14. Annual report of most centres is not prepared as per the prescribed format. Detailed guidelines in this regard will be refined further.
15. PIs should give information on contract research trials pertaining to herbicide testing and resource generation in the Annual Report.
16. It was emphasized to improve data analysis and annual report for some of the centres.
17. Action taken report on the previous ARM should be included in the Annual Report of the Centre.
18. Centres should timely send the information required for RFD.
19. In spite of providing guidelines, the presentation of most centres was not up to the mark.
20. From next year the number of slides to be presented for every centre should not exceed 10 slides per scientist per centre for timely conclusion of all the technical sessions so that sufficient time is available for discussion. While making presentation in the Review Meeting, only the salient findings need to be presented and that too be discussed with reasons. The results should be synthesized before presentation.
21. All the centres should publish quality research papers in reputed journals.
22. Monitoring of Coordinating centres is lacking in AICRP-WC, which should be made more effective. Performance of the centres will be judged based on the reports of the monitoring teams, implementation of approved technical programme, quality of data in the Annual Report, presentation made in the AGM, research publications, OFTS / FLDs conducted, timely submission of AUC, staff position, expenditure statement and other information sought by the HQ, budget utilization, extension activities, awards / recognitions etc.
23. Coordinating centres should organize awareness programmes like quiz contest among the students, for which, funds can be provided by the ISWS.
24. Technology generated at different centres of AICRP-WC should be documented.

25. Funds under TSP will be allotted to those states having tribal districts as per classification of the Planning Commission. These funds should be effectively utilized for On-Farm Research Trials / FLDs, training and capacity building, and for development of physical assets as per guidelines.
26. Several proposals have been included in the XII plan SFC for strengthening of coordinating centres, which are pending with the ICAR.
27. All the centres should follow a common nomenclature, for example AICRP-WC Anand Centre, and not as DWSRC Anand.
28. The coordinating centres should not send their annual report or any other document to DDG (NRM) or the ADG (Agronomy & Agro-forestry) in the Council. However, copies of the annual report may be shared with other coordinating centres.
29. General recommendations of QRT and specific recommendations for each centre should be effectively implemented. Centres identified as 'Average' and 'Below average' need to do serious introspection and improve their performance considerably.

**All India Coordinated Research Project on Weed Control
12-14 February, 2014**

Venue: Directorate of Weed Science Research, Jabalpur (M.P.)

LIST OF PARTICIPANTS

DIRECTORATE OF WEED SCIENCE RESEARCH, JABALPUR

- | | | |
|-----|--------------------|------------------------------------|
| 1. | Dr. A.R. Sharma | Director |
| 2. | Dr. R. P. Dubey | Pr. Scientist (Agronomy) |
| 3. | Dr. V.P. Singh | Pr. Scientist (Agronomy) |
| 4. | Dr. Sushilkumar | Pr. Scientist (Entomology) |
| 5. | Dr. P.K. Singh | Pr. Scientist (Agri. Extension) |
| 6. | Dr. D.K. Pandey | Pr. Scientist (Plant Physiology) |
| 7. | Er. H.S. Bisen | Pr. Scientist (Agril. Engineering) |
| 8. | Dr. Shobha Sondhia | Sr. Scientist (Residue Chemistry) |
| 9. | Dr. C. Kannan | Sr. Scientist (Plant Pathology) |
| 10. | Dr. Bhumesh Kumar | Sr. Scientist (Plant Physiology) |
| 11. | Dr. K.K. Barman | Pr. Scientist (Plant Physiology) |
| 12. | Dr. P.J. Khankhane | Sr. Scientist (Soil Science) |
| 13. | Dr. P.P. Choudhury | Sr. Scientist (Plant Physiology) |
| 14. | Dr. Yogita Gharde | Scientist (Agril. Statics) |
| 15. | Sri O.N. Tiwari | Technical Officer |
| 16. | Sri Pankaj Shukla | Technical Officer |
| 17. | Sri Sandeep Dhagat | Sr. Technical Officer |

EXTERNAL EXPERTS

- | | | |
|-----|-------------------|--|
| 18. | Dr. L. S. Brar | Former Head, Division of Agronomy, PAU, Ludhiana |
| 19. | Dr. N.T. Yaduraju | Former Director, DWSR, Jabalpur |

OTHER INVITIES

- | | | |
|-----|---------------------|---|
| 20. | Dr. Jay G. Varshney | Former Director, DWSR, Jabalpur |
| 21. | Dr. R.K. Gupta | Head of Research Station Developments, BISA, Jabalpur |

JNKVV, JABALPUR

- | | | |
|-----|--------------------|---|
| 22. | Dr. S.K. Rao | Dean, Faculty of Agriculture, JNKVV, Jabalpur |
| 23. | Dr. M. L. Kewat | Professor, Division of Agronomy, JNKVV, Jabalpur |
| 24. | Dr. Girish Jha | Professor & Head, Division of Agronomy, JNKVV, Jabalpur |
| 25. | Dr V.K. Shukla | Principal Investigator, AICRP on IFS, JNKVV, Jabalpur |
| 26. | Dr. S.P. Kurchania | Former Head, Department of Agronomy, JNKVV, Jabalpur |
| 27. | Dr. J. P. Tiwari | Former Dean, College of Agriculture
JNKVV, Jabalpur |
| 28. | Dr. R.S. Sharma | Former Head, Department of Agronomy, JNKVV, Jabalpur |

AICRP-WC CENTRES

**ACHARYA N G RANGA AGRICULTURAL UNIVERSITY, RAJENDRANAGAR,
HYDERABAD**

- | | | |
|-----|----------------|--|
| 29. | Dr. M. Yakadri | Principal Scientist (Agro.) & Principal Investigator |
|-----|----------------|--|

30. Dr. T. Ram Prakash Jr. Residue chemist

ANAND AGRICULTURAL UNIVERSITY, ANAND

31. Dr. B.D. Patel Agronomist & Principal Investigator

32. Mr. D.D. Chaudhari Jr. Agronomist

33. Dr. B.T. Sheta Jr. Residue chemist

N.D. UNIVERSITY OF AGRICULTURE & TECHNOLOGY, FAIZABAD

34. Dr. Ravi Shankar Singh Jr. Agronomist

35. Dr. S.S. Singh Jr. Residue Chemist

36. Dr. Raj Kumar Pathak Jr. Microbiologist

TAMILNADU AGRICULTURAL UNIVERSITY, COIMBATORE

37. Dr. N.K. Prabhakaran Professor & Principal Investigator

38. Dr. N. Sakthivel Jr. Agronomist

39. Dr. K. Govindarajan Jr. Scientist (Economics)

40. Dr. P. Janaki Jr. Residue Chemist

CCS HARYANA AGRICULTURAL UNIVERSITY, HISAR

41. Dr. S.S.Punia Sr. Agronomist & Principal Investigator

42. Dr. Anil Duhan Jr. Residue Chemist

RAJMATA VIJAYARAJE SCINDIA KRISHI VISHWA VIDYALAYA, GWALIOR

43. Dr. J.P. Dixit Agronomist & Principal Investigator

44. Dr. Asha Arora Pr. Scientist (Residue Chemistry)

45. Dr. K.S. Yadav Pr. Scientist (Agronomy)

RAJENDRA AGRICULTURAL UNIVERSITY, PUSA, BIHAR

46. Dr. D. K. Roy Agronomist & Principal Investigator

47. Mr. Dharminder Jr. Agronomist

VISHWA BHARATI, SRINIKETAN

48. Mr. A. Hossain Assistant Agronomist

BIRSA AGRICULTURAL UNIVERSITY, KANKE, RANCHI

49. Dr. R.R. Upasani Professor & Principal Investigator

50. Mr. A. N. Puran Jr. Microbiologist

51. Dr. (Mrs.) Sheela Barla Jr. Agronomist

ODISHA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESHWAR

52. Dr. M.M. Mishra Agronomist & Principal Investigator

53. Dr. R. Dash Jr. Agronomist

54. Mr. M.M. Behera Jr. Residue Chemist

PUNJAB AGRICULTURAL UNIVERSITY, LUDHIANA

- | | | |
|-----|--------------------------|-------------------------------------|
| 55. | Dr. M.S. Bhullar | Agronomist & Principal Investigator |
| 56. | Dr. Simerjeet Kaur | Asstt. Agronomist |
| 57. | Dr. (Mrs) Tarundeep Kaur | Asstt. Agronomist |
| 58. | Dr. (Mrs) Navjyot Kaur | Assistant Plant Physiologist |
| 59. | Dr. (Mrs) Parvinder Kaur | Residue chemist |

G.B. PANT UNIVERSITY OF AGRICULTURE & TECHNOLOGY, PANTNAGAR (U.P.)

- | | | |
|-----|----------------------|---|
| 60. | Dr. V. Pratap Singh | Professor (Agronomy) & Principal Investigator |
| 61. | Dr. Tej Pratap Singh | SRO, Agronomy |
| 62. | Dr. S.K. Guru | Jr. Scientist (Physiology) |
| 63. | Dr. Shishir Tandon | Jr. Scientist (Residue Chemistry) |
| 64. | Dr. S.P. Singh | JRO, Agronomy |

CSK HIMACHAL PRADESH KRISHI VISHVA VIDHYALAYA, PALAMPUR

- | | | |
|-----|-------------------------|-------------------------------------|
| 65. | Dr. Dinesh Badiyala | Agronomist & Principal Investigator |
| 66. | Dr. Suresh Gautam | Agronomist |
| 67. | Dr. (Mrs) Neelam Sharma | Residue Chemist |
| 68. | Dr. Rajinder Kumar | Jr. Microbiologist |

VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH, PARBHANI

- | | | |
|-----|---------------------|-------------------------------------|
| 69. | Dr. A.S. Jadhav | Agronomist & Principal Investigator |
| 70. | Dr. S.V. Pawar | Jr. Agronomist |
| 71. | Mrs. Minakshi Patil | Jr. Microbiologist |
| 72. | Dr. S.T. Shirale | |

CS AZAD UNIVERSITY OF AGRICULTURE & TECHNOLOGY, KANPUR

- | | | |
|-----|-------------------|--|
| 73. | Dr. R.A. Yadav | Assoc. Prof. (Agronomy) & Principal Investigator |
| 74. | Dr. M.Z. Siddiqui | Jr. Agronomist |
| 75. | Dr. K.N. Singh | Jr. Residue Chemist |

KERALA AGRICULTURAL UNIVERSITY, THRISSUR

- | | | |
|-----|--------------------|------------------------------------|
| 76. | Dr. C.T. Abraham | Professor & Principal Investigator |
| 77. | Dr. K.M. Durgadevi | Residue Chemist |
| 78. | Dr. T. Girija | Plant Physiologist |

ASSAM AGRICULTURAL UNIVERSITY, JORHAT

- | | | |
|-----|----------------|--|
| 79. | Dr. J. Deka | Principal Scientist & Principal Investigator |
| 80. | Dr. I.C. Barua | Principal Scientist, Ecology, |

UNIVERSITY OF AGRICULTURAL SCIENCES, BENGALURU

- | | | |
|-----|-------------------|---|
| 81. | Dr. R. Devendra | Professor (Physiology) & Principal Investigator |
| 82. | Dr. G.N. Dhanapal | Agronomist |
| 83. | Dr. G. R. Hareesh | Residue Chemist |
| 84. | Dr. M.T. Sanjay | Jr. Agronomist |

SWAMI KESHWANAND RAJASTHAN AGRICULTURAL UNIVERSITY, BIKANER

85. Dr. R.S. Yadav Agronomist & Principal Investigator
86. Sh. Vikas Sharma Jr. Microbiologist
87. Dr. S.P. Singh Assistant Agronomist

I.G. KRISHI VISHVA VIDYALAYA, RAIPUR

88. Dr. A.P. Singh Principal Scientist & Principal Investigator
89. Dr. Tapas Choudhary Jr. Microbiologist

Dr. BALASAHEB SAWANT KONKAN KRISHI VIDHYA PEETH, DAPOLI

90. Mr. Y.R. Govekar Jr. Microbiologist

UNIVERSITY OF AGRICULTURAL SCIENCES, DHARWAD

91. Dr. Ramesh Babu Professor (Agronomy) & Principal Investigator
92. Dr. P. Jones Nirmalanth Jr. Microbiologist

PRINCIPAL INVESTIGATORS OF AICRP-WC VOLUNTEER CENTRES

SHER-E-KASHMIR UNIVERSITY OF AGRICULTURE AND TECHNOLOGY OF JAMMU, J&K

93. Dr. Anil Kumar Professor of Agronomy
Department of Agronomy

SHER-E-KASHMIR UNIVERSITY OF AGRICULTURE AND TECHNOLOGY - KASHMIR SHALIMAR, SRINAGAR

94. Dr. Purshotam Singh Asstt. Professor (Agronomy)
Department of Agronomy

P.J. NEHRU COLLEGE OF AGRICULTURE & RI, KARAIKAL, U.T. OF PONDICHERRY

95. Dr. P. Saravanane Asstt. Professor (Agronomy),
Dept. of Agronomy

DR. PANJABRAO DESHMUKH KRISHI VIDYAPEETH, AKOLA

96. Dr. J.P. Deshmukh Associate Professor, Department of
Agronomy
97. Dr. P.V. Shingrup Jr. Agronomist

ICAR INSTITUTES

98. Dr. A.R.G. Ranganatha Project Coordinator
AICRP on Sesame & Niger, JNKVV,
Jabalpur
99. Dr. A.K. Vishwakarma Sr. Scientist, IISS, Bhopal
100. Mr. Rakesh Kumar Scientist (Entomology), NCIPM, Pusa, New
Delhi