AICRP-Weed Management, AAU, Anand 2015

Summary & Results of practical utility

V. Executive Summary
A. Network trials

WS-1: Weed surveillance and monitoring

WS-1.1a: Monitoring of appearance of new weed species

Celosia argentea was found a severe problem in middle Gujarat, North Gujarat and some part of Saurashtra region in *kharif* crops like soybean, pigeonpea, greengram, blackgram on farmer's field.

WS-1.2: Monitoring of weed shift due to weed management practices, changes in cropping systems and climatic parameters prevailing ecosystems

In some parts of state, farmers growing wheat crop and using continuous 2,4-D and metsulfuron-methyl to control dicot weeds are facing problem of monocot weeds in their fields. AICRP-Weed Management, Anand initiated a state trial in wheat crop to manage complex weed flora in wheat

WS-1.3: Monitoring herbicide resistance/escape in weeds of the dominant cropping system

Escape incidences of *Commelina benghalensis* was observed on farmers field after application of recommended herbicides in different crops and on experimental field. While escape incidences of *Digera arvensis* was observed in pendimethalin applied experimental field.

WS- 2: Weed biology and physiology

WS-2.1a: Biology of important weeds (*Digera arvensis* and *Parthenium hysterophorus)*

Digera and *Parthenium* seed germination was influenced by depth of sowing. Germination was observed in 0 to 5 cm depth, while in 10 cm depth germination recorded 0%. Days to germination, days to first flowering, shoot and root fresh and dry weight and total fresh and dry weight was not influenced by 0 to 5 cm depth of sowing.

WS- 3: Weed management in crops and cropping systems

WS-3.2: Herbicides combinations for control of complex weed flora in wheat

Significantly lower weed density and weed dry biomass of monocot weeds were recorded at 60 DAS in hand weeding carried out at 30 and 60 DAS, pendimethalin (1.0 kg/ha) PE *fb* sulfosulfuron (0.018 kg/ha) PoE, sulfosulfuron + metsulfuron (0.03 + 0.002 kg/ha) premix 5 WAS, pinoxaden (0.06 kg/ha) + metsulfuron (0.004 kg/ha) tank mix 5 WAS, mesosulfuron + iodosulfuron premix (0.012 + 0.0024 kg/ha) 5 WAS, and clodinafop + metsulfuron methyl premix (0.06 + 0.004 kg/ha) 5 WAS. While significantly lower weed density and weed dry biomass of dicot weeds were recorded in the treatments hand weeding carried out at 30 and 60 DAS, pendimethalin (0.75 kg/ha) PE, metribuzin (0.21 kg/ha) PE, pendimethalin (1.0 kg/ha) + metribuzin (0.175 kg/ha) and pendimethalin (1.0 kg/ha) PE *fb* sulfosulfuron (0.018 kg/ha) PoE, respectively.

Weed control efficiency of weed management practices were ranging from 71 to 100 % at 60 DAS and 34 to 96 % at the time of harvest.

Significantly the highest grain (4454 kg/ha) and straw (7035 kg/ha) yield were recorded under hand weeding carried out at 30 and 60 DAS, but it was remained at par with clodinafop + metsulfuron methyl premix (0.06 + 0.004 kg/ha) 5 WAS, sulfosulfuron + metsulfuron premix (0.03 + 0.002 kg/ha) 5 WAS, pinoxaden (0.06 kg/ha) + metsulfuron (0.004 kg/ha) tank mix 5 WAS, pendimethalin (1.0 kg/ha) PE *fb* sulfosulfuron (0.018 kg/ha) 5 WAS, sulfosulfuron (0.025 kg/ha) PoE, clodinafop (0.06 kg/ha) PoE and mesosulfuron + iodosulfuron premix (0.012 + 0.0024 kg/ha) 5 WAS.

WS-3.3: Weed management in turmeric/other vegetables

WS-3.3.2: Integrated control of complex weed flora in garlic

Weed density and weed dry biomass of monocot, dicot and total weeds was recorded at 75 DAS and harvest significantly lower in paddy straw mulch 5.0 t/ha treatment. The weed dry biomass of monocot, dicot and total weeds were the lowest recorded in the manual weeding at 20 and 40 DAP.

Significantly the lowest weed dry biomass of monocot and total weeds were recorded at 75 DAP and harvest in combination of hand weeding carried out at 20 and 40 DAP without straw mulch.

Interaction effect of mulching and weed management practices on weed density of monocot and total weeds and weed dry biomass of monocot, dicot and total weeds were found significant. Significantly the lowest weed density of monocot and total weeds were recorded in combination of paddy straw mulch with manual weeding but remained at par with manual weeding without mulching treatment combination and application of oxyfluorfen PE with mulching at harvest.

Significantly the lowest weed dry biomass of weeds were recorded in the manual weeding with no mulch treatment combination, but remained at par with manual weeding with 5 t /ha paddy straw mulch treatment combination.

Significantly the highest plant dry biomass was recorded at 90 DAP and harvest in hand weeding carried out at 20 and 40 DAP, but remained at par with pre-emergence application of oxyfluorfen.

Interaction effect of mulching and weed management practices was significantly influenced and the highest plant dry biomass of garlic recorded in hand weeding carried out at 20 and 40 DAS without mulching.

Significantly the highest bulb (8.15 t/ha) yield of garlic was recorded in paddy straw mulch 5.0 t/ha. Bulb yield of garlic was significantly influenced by weed management practices and highest bulb yield of garlic (10.46 t/ha) was obtained in manual weeding at 20 and 40 DAP.

Interaction effect of mulching and weed management practices was found significant and the highest bulb yield of garlic was obtained in the combination of manual weeding carried out at 20 & 40 DAP and without mulching, but it was remained at par with the combination of mulching with manual weeding at 20 & 40 DAP and mulching with oxyfluorfen.

Benefit cost ratio of different treatments was calculated and the highest B:C ratio was obtained with mulching (5.04), hand weeding at 20 and 40 DAP (6.46) and interaction of paddy straw mulch 5.0 t/ha and hand weeding at 20 and 40 DAP (6.51).

WS-3.4: Weed management in pulses and oilseed crops

WS-3.4.1: Studies on time of application of imazethapyr and its ready mix combination with imazamox (Odyssey) against weeds in greengram

Significantly the lowest density and weed dry biomass of monocot and total weeds were recorded at 40 DAS in pre-emergence application of imazethapyr + pendimethalin RM (1000 g/ha) and remained at par with hoeing at 20 & 40 DAS, whereas significantly the lowest weed density and weed dry biomass of dicot weeds were recorded in post emergence application of imazethapyr + imazamox RM (80 g/ha). Weed control efficiency recorded at 40 DAS varied between 80 to 93 % by different treatments.

Seed yield of greengram recorded significantly higher (1466 kg/ha) in application of imazethapyr PoE (80 gm/ha), but remained at par with all pre or post emergence application of herbicides and hoeing at 20 and 40 DAS except post emergence application of imazethapyr + imazamox (RM) POE (80 g/ha).

Haulm yield of greengram recorded significantly the highest (2275 kg/ha) in application of imazethapyr + pendimethalin (RM) PE (1000 g/ha), but remained at par with all pre or post emergence application of herbicides and hoeing at 20 and 40 DAS except post emergence application of imazethapyr + imazamox (RM) PoE (80 g/ha) and pre-emergence application of pendimethalin (1000g/ha)

Phytotoxic effect was observed on greengram in application of imazethapyr PoE and imazethapyr + imazamox (RM) PoE after 7 and 14 days after herbicide application.

Succeeding crop mustard

There was no any carry over/residual phytotoxic effect observed on succeeding mustard crop.

WS-3.5: Integrated weed management in cotton

Total weed dry biomass of weeds were recorded the lowest in pre-emergence application of pendimethalin 1000 g/ha *fb* hand weeding carried out at 20 and 50 DAS treatment, which was at par with application of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* manual weeding at 50 DAS.

Weed control efficiency of different treatments was varies between 9 to 92 % at 90 DAS and 35 to 74 % at harvest by different treatments.

Significantly higher seed cotton yield was recorded in pre-emergence application of pendimethalin (1000 g/ha) PE *fb* hand weeding carried out at 20 and 50 DAS treatment, which found at par with application of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate (2000 g/ha) at 60 DAS.

Stalk yield of cotton was higher in these both treatments but found at par with application of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat

600 g/ha) at 60 DAS and application of pendimethalin (1000 g/ha) PE *fb* pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE.

Benefit cost ratio was the highest (2.57) in pre-emergence application of pendimethalin (1000 g/ha) *fb* hand weeding carried out at 20 and 50 DAS followed by post-emergence application of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate (2000 g/ha) at 60 DAS (2.47), pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of paraquat (600 g/ha) at 60 DAS (2.31) and pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* manual weeding at 50 DAS (2.16).

WS-3.6: Weed management in conservation agriculture systems under pearlmillet-mustard cropping system (Non-rice based cropping system)

Kharif Pearlmillet

Among weed management practices, grain and straw yield were significantly higher recorded with atrazine @ 0.50 kg/ha as PE *fb* IC at 30 DAS. Significantly lower weed dry biomass was recorded with zero tillage (ZT) which was at par with zero tillage (T_3). Among weed management practices significantly the lowest weed dry biomass was recorded with atrazine 0.50 kg/ha as PE *fb* IC at 30 DAS.

Grain and straw as well as weed dry bio mass recorded at harvest were significantly influenced by interactive effect of tillage and weed management practices in Pearlmillet crop. Grain yield was significantly higher recorded in conventional tillage with integration of atrazine @ 0.50 kg/ha *fb* IC at 30 DAS while, straw yield was significantly higher recorded in conventional tillage with integration of atrazine @ 0.50 kg/ha *fb* IC at 30 DAS. Weed dry biomass recorded at harvest was significantly higher with pre emergence application of atrazine @ 0.50 kg/ha *fb* IC at 30 DAS with zero tillage with incorporation of residues.

Weed dry biomass recorded at 30 DAS were significantly influenced by tillage practices and significantly lower monocot, dicot and total weed dry weight recorded with conventional tillage (T_1) while, in case of weed management practices significantly lower weed dry weight of monocot, dicot and total were recorded with application of atrazine @ 0.50 kg/ha as PE *fb* IC at 30 DAS with conventional tillage. Same trend was noticed at 60 DAS.

Mustard

Plant height recorded at 60 DAS and at harvest was significantly influenced by tillage practices. In case of weed management practices plant stand and plant dry matter accumulation were found non significant, while, plant height recorded at 30 and 60 DAS was influenced significantly. Significantly the highest plant height was recorded with application of pendimethalin 0.50 kg/ha. Interactive effect was found significant. Dry matter accumulations recorded at 30 DAS were found non significant. Interactive effect was found non significant.

Seed and straw yield were also not significantly influenced by tillage and as well as weed management practices. Seed and straw yield of mustard were recorded higher in integrated approach among weed management practices.

Weed count and weed dry biomass recorded at 30 DAS was found non significant in respect of tillage practices. Weed count and weed dry biomass recorded at 30 & 60 DAS were significantly lower recorded in pendimethalin @ 0.5 0kg/ha *fb* IC at 30 DAS.

Monocot, dicot and total weed counts and dry weed biomass of monocot were significantly influenced by interactive effect of tillage and weed management practices at 30 DAS.

WS-3.7: Long term herbicidal trial in different cropping system (Maize-Wheat)

1. Maize

Plant height recorded at harvest was not significantly influenced by weed management practices. Grain yield of maize during the year 2014-15 was significantly influenced by the weed management practices. Significantly the higher grain yield was recorded in pendimethalin 0.25 kg/ha + atrazine 0.50 kg/ha (tank mix) applied as PE. Straw yield also significantly influenced by weed management practices. Atrazine 1.0 kg/ha applied as PE recorded significantly higher straw yield which was at par with $T_{2,}$ T_3 and T_5.

Succeeding wheat crop

Plant height recorded at 30 DAS was significantly influenced by the treatments imposed in maize.

Interactive effect of weed management carried out in *Kharif* maize as well as done in the *Rabi* wheat crop showed non-significant.

Grain yield was significantly influenced by the weed management practices imposed in preceding maize crop. Weed management practices imposed during the crop period in wheat showed significant effect on grain yield of wheat. Grain yield of wheat recorded in hand weeding carried out at 30 DAS was significantly at par with pre emergence application of pendimethalin @ 500 g/ha. Straw yield was not significantly influenced by the treatments imposed in maize. Weed management practices carried out in wheat during the crop period in wheat showed significant effect on straw yield of wheat. Straw yield of wheat recorded in farmers practices (HW at 30 DAS) was significantly at par with pre emergence application of pendimethalin @ 500 g/ha and application of MAS @ 4.0 g/ha as PoE (25-30 DAS). Interactive effect of M x W was found significant on straw yield (Table W_3).

Effect of weed management practices carried out in maize showed significant effect on weed counts as well as weed dry biomass recorded at 30 and 60 DAS and at harvest. Significantly the lower dicot weed dry biomass was recorded in pre-emergence application of atrazine @ 1.0 kg/ha. Weed management practices carried out in wheat showed significant effect on weed counts and weed dry biomass recorded at 30 and 60 DAS and at harvest. At 30 DAS, HW carried out at 30 DAS showed significantly the lowest weed count and weed dry biomass. At harvest, HW carried out at 30 DAS showed significantly the lowest weed counts and weed dry biomass.

WS-4: Management of problematic weeds

WS-4.1a: Management of *Orobanche* in tobacco

The visual phyto-toxicity of post emergence application herbicides was observed on tobacco. The leaves of tobacco was severely affected by the application of imazethapyr 30 g/ha at 40 DATP. The plant was stunted and the affected leaves were not recovered.

Number of *Orobanche* shoots emerged at 60, 90 DATP and harvest of tobacco were not influenced by the treatments. There was no any positive effect of applied herbicides or combination of organic and fungicides on the emergence of *Orobanche* observed. *Orobanche* shoots were emerged after 70 DATP of tobacco crop.

The lowest plant height was recorded in the application of imazethapyr 30 g/ha at 40 DATP. Yield of tobacco leaves was recorded the lowest in application of imazethapyr 30 g/ha at 40 DATP followed by application of glyphosate 0.2g/l at 20 DATP of tobacco indicated that these herbicides showed phyto-toxic effect on tobacco leaves as tobacco crop is very sensitive.

WS-4.1b: Management of *Cuscuta* in lucerne

Plant stand was severely affected by pre-emergence application of pendimethalin 0.5 kg/ha as sand mix due to phytotoxic effect on the germination (16.9 %). Number and length of *Cuscuta* twines recorded at 30, 45 and 60 DAS revealed that no *Cuscuta* twine was germinated in pre-emergence application of pendimethalin 0.5 kg/ha as sand mix. Post emergence application of imazethapyr 40 g/ha at 20 DAS was also found effective for the suppression of *Cuscuta* twine compared to weedy check but other treatments were not found effective for the control of *Cuscuta*.

Green and dry fodder biomass of lucerne recorded at 45 and 60 DAS were influenced by different treatments and the highest green biomass of lucerne was recorded in the application of imazethapyr 40 g/ha at 20 DAS followed by pre-emergence application of butachlor *fb* foliar spray of metalaxyl MZ 0.2% at 20 DAS.

WS-4.1c: Intensive survey on the incidence of Orobanche/*Striga* / *Cuscuta*/*Loranthus*

Parasitic weed survey was carried out in Saurashtra region and infestation of *Loranthus* on orchard of mango and *Cuscuta* on *kharif* pulses crops were observed. Heavy infestation of *Orobanche* on bidi tobacco at later stage of crop was recorded in middle Gujarat.

WS-4.2: Making *Parthenium* free campus

AICRP-Weed Management initiated to remove *Parthenium* in experimental field of the project and nearby research farm area of different departments under Agronomy farm. Anand Agricultural University has initiated a movement to remove *Parthenium* from main campus as well as from all the research stations and farms of the university jurisdiction under the guidance of Agronomist and PI of this project.

WS-4.3: Biological control of water hyacinth by *Neochetina bruchi*

The water hyacinth density of the selected pond where weevil released was 17.3 /m^2. Total 500 adult of *Neochetina bruchi* were released on the water hyacinth infested pond. The data recorded on quarterly basis showed that there were no built up of the population of the weevil on the water hyacinth. No any feeding scars were observed on the water hyacinth plant. No any dieback symptoms were recorded on the water hyacinth plants (0 scale) by the weevil.

WS-5: Herbicide residues and environmental quality

No any research activity conducted due to Jr. Residue Chemist post vacant during report period.

WS-6: On-farm research and impact assessment

WS-6.1: On Farm Research

OFT conducted on farmers field showed that IC *fb* HW carried out at 20 and 40 DAS is more effective for weed management as compared to post emergence application of quizalofop-ethyl in soybean crop.

WS-6.2: Front Line Demonstration (FLD)

FLD conducted at farmer's field showed that B:C ratio 1.98 achieved by adopting modern weed management practices.

B. Station trials

WS 7.1 Assessment of premix broad spectrum herbicides for weed management in wheat

Among weed management practices, clodinafop propargyl (60 g/ha) PoE, sulfosulfuron (25 g/ha) PoE, sulfosulfuron + metsulfuron methyl premix (32 g/ha) PoE, clodinafop + metsulfuron methyl (64 g/ha) PoE, mesosulfuron + iodosulfuron premix (14.4 g/ha) PoE showed significantly the lower weed density and weed dry biomass of monocot weeds. While pre-emergence application of pendimethalin (500 g/ha), post-emergence application of 2,4-D (750 g/ha), metsulfuron methyl (4.0 g/ha), sulfosulfuron + metsulfuron methyl premix (32 g/ha), clodinafop + metsulfuron methyl (64 g/ha) PoE, mesosulfuron + iodosulfuron premix (14.4 g/ha) PoE) and sulfosulfuron (25 g/ha) PoE showed significantly lower weed density and weed dry biomass of dicot weeds. Significantly the lowest weed density and weed dry biomass of total weeds were recorded in post-emergence application of sulfosulfuron (25 g/ha), sulfosulfuron + metsulfuron methyl premix (32 g/ha), clodinafop + metsulfuron methyl (64 g/ha) PoE and mesosulfuron + iodosulfuron premix (14.4 g/ga) PoE).

Weed control efficiency of weed management practices were ranging from 11 to 66%, 7 to 100 % and 5 to 100% at 30, 60 DAS and harvest, respectively.

Significantly the highest grain (4346 kg/ha) and straw (6886 kg/ha) yield were recorded under clodinafop + metsulfuron methyl (64 g/ha) PoE but remained at par with sulfosulfuron + metsulfuron methyl premix (32 g/ha), 2 hand weeding carried out at 20 and 40 DAS), mesosulfuron + iodosulfuron premix (14.4 g/ha) PoE), sulfosulfuron (25 g/ha) PoE and clodinafop propargyl (60 g/ha) PoE.

Bioassay

Residual/carry over effect of pre and post emergence herbicides was not observed during bioassay study.

VI. Results of practical utility / recommendation (passed on to state package of practices)

- ✓ *Celosia argentea* was found a severe problem in middle Gujarat, North Gujarat and some part of Saurashtra region in *kharif* crops like soybean, pigeonpea, greengram, blackgram on farmer's field
- ✓ Escape incidences of *Commelina benghalensis* was observed on farmer's field after application of recommended herbicides in different crops and on experimental field. While escape incidences of *Digera arvensis* was observed in pendimethalin applied experimental field
- ✓ Biology of two weeds species *i.e. Digera arvensis* and *Parthenium hysterophorus* was studied and two new weeds viz; *Trianthema monogyna* and *Cyperus rotundus* were also studied
- ✓ Herbicide mixtures were found more effective to manage complex weed flora in wheat crop
- ✓ Mulching of paddy straw 5 t/ha with pre-emergence herbicide produce higher garlic bulb yield
- ✓ Seed yield of greengram recorded significantly higher (1466 kg/ha) in application of imazethapyr 80 g/ha PoE, but remained at par with all pre or post emergence application of herbicides and hoeing at 20 and 40 DAS except post emergence application of imazethapyr + imazamox (RM) at 80 g/ha
- ✓ Phytotoxic effect was observed on greengram by both the post emergence herbicides after 7 and 14 days after herbicide application
- ✓ Significantly higher seed cotton yield was recorded in pre-emergence application of pendimethalin *fb* hand weeding carried out at 20 and 50 DAS treatment, which found at par with post-emergence application of pyrithiobac-sodium + quizalofop-p-ethyl (62.5 + 50 g/ha) PoE *fb* directed spray of glyphosate (2000 g/ha) at 60 DAS
- ✓ Lower weed dry biomass was observed in conventional tillage while pearlmillet grain yield was higher in zero tillage and straw yield was in conventional tillage
- ✓ In maize-wheat cropping system, tank mix of pendimethalin (0.25 kg/ha) with atrazine (0.50 kg/ha) or atrazine alone @ 1.00 kg/ha as pre emergence was equally effective to IC *fb* HW carried out at 20 & 40 DAS in maize. In succeeding wheat crop, pre-emergence application of pendimethalin @ 0.50 kg/ha or post-emergence application of MSM @ 4.0 g/ha or hand weeding at 30 DAS were found effective
- ✓ Post emergence application of imazethapyr @ 30 g/ha at 40 DATP found phytotoxic to tobacco crop for management of *Orobanche*
- ✓ Pendimethalin 0.5 kg/ha as sand mix showed phytotoxicity on lucerne crop but 100% control of *Cuscuta*
- ✓ AICRP-WM initiated to remove *Parthenium* in experimental field of the project and nearby research farm area of different departments under Agronomy farm
- ✓ Tribal Sub Plan (TSP) programme was successfully implemented
- ✓ Ten training programme on Integrated Weed Management in modern agriculture was organized to create the awareness among the farmers

- ✓ Strengthening of linkage between AICRP-Weed Management with PDFSR-IFS and GETCO initiated.