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On farm assessment of ready mix herbicide combinations for broad-spectrum weed control in wheat

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ABSTRACT

Farmers led on-farm trials were conducted in Morar and Bhitarwar blocks of district Gwalior during *Rabi* seasons of the year 2014-15 and 2015-16 in K.V.K. adopted villages to validate, refine and popularize the technologies recommended by Directorate of Weed Research, Jabalpur for managing grassy and broad-leaf weeds in wheat. Application of clodinafop + metsulfuron (60 + 2 g/ha) caused significant reduction in total weed counts (28.6 and 40.8/m^2) and weed dry weight (3.5 and 4.2 g/m^2) over farmer's practice (2,4-D at 500 g/ha) as it reduced the population of both grassy and broad-leaved weeds and produced the highest weed control efficiency (83 and 82.6%) over application of sulfosulfuron + metsulfuron (30 + 2 g/ha) (70.87 and 76.03%) and farmers' practice during both the year. Recommended practice of clodinafop + metsulfuron (60 + 2 g/ha) gave significantly higher grain yield (4.10 and 4.71 t/ha) over sulfosulfuron + metsulfuron (30 + 2 g/ha) and farmers practice. There were 21.42 and 22.46 and 12.18 and 9.87% increase in grain yield over farmers' practice respectively under clodinafop + metsulfuron (60 + 2 g/ha) and sulfosulfuron + metsulfuron (30 + 2 g/ha) during the year 2014-15 and 2015-16. The highest net returns (₹ 51003 and 65267/ha) and B:C ratio (2.78 and 3.45) were recorded under recommended practice of clodinafop + metsulfuron (60 + 2 g/ha).

Wheat (*Triticum aestivum* L. emend. Fiori and Paol.) is an important winter cereal of Madhya Pradesh. It is grown in 5.91 million hectare area with the production of 18.41 million tone (Anonymous 2015-16).Though the production and productivity of wheat have increased in the state during the last five years, but the present productivity level is still low as compared to other wheat growing states in the country. Weeds are considered as major bottlenecks in realizing potential yield of wheat. Uncontrolled weeds caused 30-80% reduction in wheat grain yield (Waheel *et al.* 2009, Kumar *et al.* 2011, Brar and Walia 2008). Herbicidal weed control has proved efficient in controlling weeds (Kahramanoglu and Uygur 2010). Pre village adoption Participatory Rural Appraisal (PRA) survey of the KVK villages *viz.* Badkisarai, Amrol and Kunarpur in Bhitarwar and Morar blocks, respectively of Gwalior district revealed that farmers of these villages usually apply 2,4-D for the control of broad-leaved weeds in wheat, but grassy weeds, *viz. Phalaris minor*, *Avena ludoviciana* and *Poa annua,* were posing major problems. The present study was therefore planned to carry out assessment of ready mix herbicidal combinations on farmer's fields with the objective to validate, assess and refine the recommended herbicidal weed management technologies over farmer's practice.

A framers led field experiment was conducted during *Rabi* seasons of the year 2014-15 and 2015-16 in K.V.K. adopted villages, *viz.* Kunarpur in Morar block and Badkisarai and Amrol in Bhitarwar blocks of the Gwalior district. The soil of the experimental plots was clay loam in texture, moderately alkaline in reaction (pH.7.8-8.4), low in organic carbon (0.37-0.48%) and available nitrogen (210-235 kg/ha), medium in available phosphorous (12.0-15.5 kg/ha) and available potassium (226-280 kg/ha). The experiment was conducted in a single replicated trial on 10 farmers fields having1000 m^2 area under each broad spectrum herbicide assessed and farmers practice (2,4-D at 500 g/ha). Each location was considered as separate replication and each weed control treatments thus replicated at different locations consisted clodinafop + metsulfuron (60 + 2 g/ha), sulfosulfuron + metsulfuron (30 + 2 g/ha) and farmer's practice (2,4-D at 500 g/ha) all applied at 30-35 DAS stage. Wheat variety '*GW 273*' and

'*Raj 4037*' were sown in lines 20 cm apart by using double chamber seed cum fertilizer seed drill with 100 kg/ha seed rate during last week of November and first week of December during both the year. Recommended dose of fertilizers (120 kg N, 60 kg P_2O_5 and 40 kg K_2O) was uniformly applied to all the three weed control treatments. Full dose of phosphorous and potassium and half dose of nitrogen were applied basal at the time of sowing and rest of nitrogen in two equal splits was top dressed at first and second irrigation stage during both the crop seasons. The crop was grown with all other similar package of practices under all the herbicidal weed control measures under taken for investigation.

The herbicides were sprayed with knapsack sprayer fitted with flat fan nozzle using spray volume of 500 L/ha. Weed counts (no./m^2) and dry weight (g/m^2) were recorded by putting a quadrate (0.25 m^2) at two randomly selected spots in each plot at 60 DAS stage of the crop. Weed biomass was recorded by weighing the dried weeds from the treatment plots. Weed control efficiency was estimated on the basis of reduction in weed weight in comparison with farmers practice (2,4-D at 500 g/ha). The least significant difference (LSD) was calculated by multiplying standard error with 't' value (p=0.05) at error degree of freedom to compare the means of the treatments for valid inference. The different impact indices were worked out after Walia (2014).

Effect on weeds

The major weed flora of experimental fields was different in command and non-command villages. Weed flora in command area village consisted of *Phalaris minor* (58.6%), *Avena ludoviciana* (12.8%) and *Poa annua* (3.2%) with sporadic infestation of broad leaved weeds, *viz*. *Anagalis arvensis* (12.4%), *Rumex dentatus* (6.8%) and *Chenopodium album* (6.2%) in village Badkisarai under Harsi canal command area in Bhitarwar block in 2015-16 whereas in other non command area villages (Amrol and Kunarpur) the mixed weed flora, *viz*. *Chenopodium album*, (45.2%) *Chenopodium murale* (4.5%), *Anagalis arvensis* (18.2%), *Melilotus indica* (12.4%), *Phalaris minor* (5.3 %), *Rumex dentatus* (4.7%), *Melilotus alba* (6.5%) and *Avena ludoviciana* (3.2%) was observed during the year 2014-15.

The highest density for grassy weeds was found under farmer's practice (2,4-D at 500 g/ha) whereas ready mixed products of herbicides gave significant control of grassy and broad-leaved weeds (**Table 1**). Singh *et al*. (2002) also reported that clodinafop provides effective control of *Phalaris minor* biotypes. Application of clodinafop + metsulfuron (60 + 2 g/ha) gave significant reduction in total weed counts and weed dry weight over farmer's practice at 60 DAS stage of wheat. Sulfosulfuron + metsulfuron (30+2 g/ha) gave similar effect over mixed weed flora. This may be because it also has broad spectrum effect on prevailing weed species in wheat fields, however comparatively low performance was observed on *Phalaris minor*, *Avena ludoviciana* and *Poa annua* in command area village *i.e. Badkisarai*. Similar findings were reported by Kumar *et al*. (2013). The highest total weed density and weed dry weight was recorded under farmers practice. Application of clodinafop + metsulfuron (60 + 2 g/ha) gave the highest WCE (83.0 and 82.60%) during both the years *fb* sulfosulfuron + metsulfuron (30 + 2 g/ ha). Higher weed control efficiency to the extent of 95% was also obtained by Malik *et al.* (2013) with application of clodinafop + metsulfuron (60 + 2 g/ha) against complex weed flora in wheat crop.

Effect on crop

Application of clodinafop + metsulfuron (60 + 2 g/ha) resulted in significantly maximum number of spikes, spike length and grain yield (21.42 and 22.46% respectively) of wheat over farmer's practice and sulfosulfuron + metsulfuron (30 + 2 g/ha) during both the year (**Table 1** and **2**). Both the ready mix herbicide combinations were observed significantly superior over farmers practice during both the year, due to less crop weed competition for nutrients, water, space and light because of effective control of weeds. This in turns might have resulted in greater photosynthesis besides larger sink and stronger reproductive phase. These results are in close conformity with those reported by Punia *et al.* (2004) and Malik *et al.* (2013). The significantly lower values of yield attributes, *viz*. no. of spikes (per m^2), spike length and grain yield in farmer's practice might be due to no control of grassy weeds due to 2,4-D at 500 g/ha. Kumar *et al.* (2013) also observed non-significant differences among various herbicides studied with respect to test weight of wheat grains.

Weed persistence index was also observed the lowest under application of clodinafop + metsulfuron (60 + 2 g/ha) during both the year (**Table 1**).

Economics

Maximum values of net returns *i.e.* ₹ 51003 and 65267/ha and B:C ratio of 2.78 and 3.45 were recorded with clodinafop + metsulfuron (60 + 2 g/ha) followed by sulfosulfuron + metsulfuron (30 + 2 g/ha). The lowest net returns and B:C ratio were however observed with farmers practice during both the years.

Table 1. Weed density, weed dry weight and impact assessment indices as influenced by application of ready mix herbicides in wheat crop

Treatment	Weed density (no./m^2)		Weed dry weight (g/m^2)		Impact assessment indices							
					Herbicide efficiency index (%)		Weed persistence index		Weed control efficiency (%)		% increase in yield over farmers practice	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
2,4-D 500 g/ha (Farmer's practice)	118.5	178.6	20.6	24.2	-	-	-	-	-	-	-	-
Clodinafop + metsulfuron (60 + 2 g/ha) 400 g/ha	28.6	40.8	3.5	4.2	1.26	1.29	0.70	0.74	83.0	82.6	21.42	22.46
Sulfosulfuron + metsulfuron (30 + 2 g/ha) 40 g/ha	60.5	54.5	6.0	5.8	0.42	0.41	1.36	0.79	70.87	76.03	12.18	9.87
LSD (p=0.05)	3.02	3.16*	1.36	1.15	-	-	-	-	-	-	-	-

Table 2. Effect of application of ready-mix herbicides on yield attributes, grain yield and economics of wheat on farmer's fields

Treatment	Spikes (no./m^2)		Spike length (cm)		1000- grain weight (g)		Grain yield (t/ha)		Gross cost of cultivation (x103 ₹/ha)		Gross income (x103 ₹/ha)		Net income (x103 ₹/ha)		B:C ratio	
	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16	2014-15	2015-16
2,4-D 500 g/ha (farmer's practice)	325	340	9.7	10.2	45.9	46.5	3.40	3.85	27.56	26.78	65.19	75.07	37.63	48.29	2.36	2.80
Clodinafop + metsulfuron (60 + 2 g/ha) 400 g/ha	448	452	11.2	12.6	46.6	47.6	4.10	4.72	28.61	27.67	79.61	91.94	51.00	65.27	2.78	3.45
Sulfosulfuron + metsulfuron (30 + 2 g/ha) 40 g/ha	396	406	10.5	11.5	45.8	46.8	3.80	4.23	28.31	27.54	74.78	82.48	46.47	54.95	2.64	2.99
LSD (p=0.05)	8.30	4.99	0.34	0.83	NS	NS	0.13	0.20	-	-	-	-	-	-		

On the basis of two years farmers led field assessment of ready mix herbicide combinations for weed control in wheat, it may be concluded that post emergence application of clodinafop + metsulfuron (60 + 2 g/ha) at 30-35 DAS could be a effective weed control practice for realizing higher productivity of wheat crop under mixed weed flora. The use of traditional herbicide with narrow spectrum weed control efficiencies could be avoided as they do not control the wide range of weed flora consist of broad-leaved weeds and grassy weeds like *Phalaris minor* and *Avena ludoviciana* in rice- wheat system.

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