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Weed control in wheat *(Triticum aestivum)* sown by zero-tillage

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ABSTRACT

An investigation was carried out during the winter seasons of 2001–02 and 2002–03 at Rice Research Station, Kaul (Kaithal), to study the effect of weed-control treatments in wheat (*Triticum aestivum* L. emend. Fiori & Paol.) sown by zero-tillage method. Significantly higher grain yield was recorded with the use of Glyphosate + Sulfosulfuron and Glyphosate + Sulfosulfuron + Metsulfluron (each applied at different time) during both the years. Glyphosate and or Metsulfuron was also required to supplement Sulfosulfuron or Clodinafop for better weed management. The highest net returns over the control and benefit : cost ratio were observed with the application of Glyphosate + Sulfosulfuron, followed by Glyphosate + Sulfosulfuron + Metsulfuron. The lowest dry weight of weeds (55.6 to 62.2 and 31.2 to 55.7 g/m^2 for first and second year respectively) was observed with Glyphosate + Clodinafop + Metsulfuron, Glyphosate + Sulfosulfuron and Glyphosate + Sulfosulfuron + Metsulfuron treatment. The highest weed-control efficiency was recorded with Glyphosate + Sulfosulfuron + Metsulfuron application (89.2%), followed by Glyphosate + Sulfosulfuron (86.9%). Metsulfuron was effective in controlling *Rumex* spp. and other broad-leaf weeds.

Key words : Herbicide, Productivity, Weed dynamics, Zero-tillage

No-till drilling system seems to be more energy efficient with higher value of benefit : cost ratio than conventional method of mechanized wheat cultivation (Yaduraju and Mishra, 2002). Moreover, zero tillage carries special significance in rice–wheat system when late harvesting of rice often delays wheat sowing. Zero tillage has gained importance owing to reduced production cost besides ensuring timely sowing of wheat (Malik *et al.,* 1998). But success of zero tillage is largely dependent on solving the key issues of weed management with economic crop yields while maintaining soil health. The major problem in zero tillage system lies with the weeds that emerge before the sowing of wheat crop or as a residue of the previous crop (Dhiman *et al.,* 2001). There is tendency of multiplication of perennial weed species at the cost of annuals, which are difficult to control.

Application of pre-sowing irrigation before zero tillage sowing enhances the germination of many weed species, which can be controlled by using non-selective herbicide before sowing of wheat crop. Therefore, present study was conducted to evaluate the requirement of suitable herbicide or herbicidal combinations for raising wheat crop with zero-till drill method.

MATERIALS AND METHODS

The field experiment was conducted at Rice Research Station, CCS Haryana Agricultural University, Kaul (Kaithal), during 2001–02 to 2002–03. The soil was clay loam, low in available nitrogen (174 kg/ha), medium in available phosphorus (14 kg/ha) and rich in available potassium (402 kg/ha). Experiment was laid out in randomized block design with 3 replications. Four herbicides, viz. Glyphosate 500 g/ha, Clodinafop 60 g/ha, Sulfosulfuron 25 g/ha and Metsulfuron 4 g/ha, were applied with 8 different combinations to wheat crop sown by zero-till drill (ZTD). Glyphosate was applied after harvesting of rice crop and other herbicides were applied after first irrigation, i.e. 25–35 days after sowing. Variety 'HD 2687' was drilled on 15 November 2001 and 3 November 2002 with seed rate of 125 kg/ha. Fertilizer dose of 150 kg N + 60 kg P_2O_5 + 25 kg $ZnSO_4$/ha was applied to crop, and irrigations were applied as and when needed. Density of various weeds and their dry weight at heading stage of the crop growth were recorded from 2 randomly selected quadrates (0.25 m^2) in each plot and expressed as number and g/m^2 respectively. Data on weed density were pooled species-wise.

RESULTS AND DISCUSSION

Weed management through herbicides improved the yield and yield attributes of wheat significantly. During the first year, significantly higher grain yield was recorded with the use of Glyphosate and Sulfosulfuron over the others, except Glyphosate + Sulfosulfuron + Metsulfuron

(each applied at separate time), with a grain yield of 4.78 tonnes/ha. But during the second year, significantly higher grain yield was recorded with Glyphosate + Sulfosulfuron + Metsulfuron (each applied at separate time) over the others except Glyphosate + Clopdinafop + Metsulfuron and Glyphosate + Sulfosulfuron, with the grain yield of 5.33 and 5.28 tonnes/ha, respectively. Mahajan *et al.* (2002) reported significantly higher grain yield of wheat with the application of different herbicides over weedy check. He further reported that sequential application of Glyphosate at 0.50 kg/ha significantly out–yielded all other herbicidal treatments. It was observed that there is need to apply Glyphosate, if there are weeds in the field at the time of wheat sowing. Higher productivity was observed with the application of Sulfosulfuron over Clodinafop, owing to better control of braod-leaf weeds in addition to *Phalaris minor.* There was a setback to the wheat crop after application of Metsulfuron, though there was good control of broad-leaf weeds including *Rumex* spp. Higher values of ears/m^2, grains/ear and test weight were recorded with these 3 treatment combinations (treatments 2, 5 and 6), which ultimately resulted in higher productivity (Table 1). With the past years experience of weed management under zero-tillage drill, it is realized that the dependence on herbicides has increased, i.e. Glyphosate and Metsulfuron are also required in addition to Sulfosulfuron/ Clodinafop for obtaining better weed management. Glyphosate may not be required where water is managed efficiently in rice crop and wheat is sown within 1 week of rice harvesting. The delay in wheat sowing after rice harvesting encourages germination of weeds even before the sowing of wheat crop (Dhiman *et al.,* 2003). Such weeds grow vigorously and result in poor weed-control efficacy of herbicides (Hari Om *et al.,* 2003). Poor water-management conditions in rice crop encourage the growth of perennial weeds like *Paspalum distichum* and

Table 1. Yield attributes and yield of zero-tillage drill wheat as affected by weed management

Treatment*	Ears/ m^2		Grains/ ear		Test weight (g)		Grain yield (q/ha)		Net returns ('000 Rs/ha)	Benefit : cost ratio
	2001–02	2002–03	2001–02	2002–03	2001–02	2002–03	2001–02	2002–03		
Glyphosate 500 g + Clodinafop 60 g	226.2	283.2	47.5	40.7	36.6	40.5	34.4	51.7	15.34	1.35
Glyphosate 500 g + Clodinafop 60 g + Metsulfuron 4 g	254.2	315.2	49.0	48.4	36.9	42.4	42.3	53.3	17.91	1.53
Clodinafop 60 g	171.5	239.5	45.6	36.2	34.7	39.3	30.0	42.2	11.43	1.04
Clodinafop 60 g + Metsulfuron 4 g	266.0	252.2	44.9	45.9	35.5	40.9	38.2	43.9	14.15	1.25
Glyphosate 500 g + Sulfosulfuron 25 g	288.2	347.0	52.6	46.8	37.6	39.9	50.2	52.8	20.71	1.84
Glyphosate 500 g + Sulfosulfuron 25 g + Mestsulfuron 4 g	273.2	362.5	52.2	45.9	37.2	41.1	47.8	55.9	20.57	1.78
Sulfosulfuron 25 g	223.5	339.0	48.4	42.3	35.4	38.2	33.5	49.3	14.89	1.38
Sulfosulfuron 25 g + Metsulfuron 4 g	250.7	307.0	46.1	44.9	35.8	40.7	37.2	49.9	15.85	1.42
Unweeded check	161.5	175.7	35.5	34.6	34.5	33.6	23.3	36.2	9.44	1.04
CD (P=0.05)	28.2	15.2	4.6	3.9	1.4	2.7	5.8	3.7		

*Each herbicide applied at different time

Table 2. Effect of weed-control treatments on weed density, weed dry weight and weed-control efficiency

Treatment*	Weed dry weight (g/m^2)		Weed population/m^2 (pooled)			Weed-control efficiency (%)
	2001–02	2002–03	*Phalaris minor*	*Rumex* spp.	Other spp.	
Glyphosate 500 g + Clodinafop 60 g	228.7	209.9	35	21	86	48.5
Glyphosate 500 g + Clodinafop 60 g + Metsulfuron 4 g	193.6	142.5	54	2	3	60.5
Clodinafop 60 g	246.2	295.6	34	40	95	36.4
Clodinafop 60 g + Metsulfuron 4 g	62.2	74.5	20	6	4	83.9
Glyphosate 500 g + Sulfosulfuron 25 g	55.6	55.7	38	16	11	86.9
Glyphosate 500 g + Sulfosulfuron 25 g + Metsulfuron 4 g	60.5	31.2	22	2	2	89.2
Sulfosulfuron 25 g	222.4	161.2	62	28	24	55.0
Sulfosulfuron 25 g + Metsulfuron 4 g	175.0	148.7	63	6	9	62.0
Unweeded check	416.9	434.7	86	34	77	
CD (P=0.05)	47.9	45.0	22	7	12	

*Each herbicide applied at different time

Cynodon dactylon which cause hindrance in wheat sowing with zero tillage drill. It is obvious that sufficient irrigation water is not available with Haryana farmers during rice season.

Weeds

The lowest dry weight of weeds was observed with Glyphosate + Clodinafop + Metsulfuron, Glyphosate + Sulfosulfuron and Glyphosate + Sulfosulfuron + Metsulfuron treatments, which was reflected on wheat productivity (Table 2). Application of Clodinafop + Metsulfuron had significantly lowest population of *Phalaris minor* and it was closely followed by Glyphosate + Sulfosulfuron + Metsulfuron. Significantly lowest population of *Rumex* spp. was noticed with the application of Glyphosate + Clodinafop + Metsulfuron and Glyphosate + Sulfosulfuron + Metsulfuron. There was good control of *Rumex* spp. and other broad-leaf weeds with the application of Metsulfuron. Application of Glyphosate + Sulfosulfuron + Metsulfuron had the lowest population of other weed spp. followed by Glyphosate + Clodinafop + Metsulfuron and Clodinafop + Metsulfuron. The highest weed-control efficiency (WCE) was recorded with Glyphosate + Sulfosulfuron + Metsulfuron application (89.2%), followed by Glyphosate + Sulfosulfuron (86.9%). In wheat sown by zero tillage drill application of non-selective herbicide (before sowing) besides the use of post-emergence herbicides is required for the control of grassy and non-grassy weeds to achieve better weed control and higher productivity.

Economics

The highest net returns over the control and benefit : cost ratio (1.84) were observed with the application of Glyphosate 500 g + Sulfosulfuron 25 g followed by Glyphosate + Sulfosulfuron + Metsulfuron.

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