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Manipulation of Sowing Techniques and Weed Management on Weed Dynamics and Yield of Wheat (*Triticum aestivum*)

I. B. Pandey and K. Kumar
Department of Agronomy
Rajendra Agricultural University, Pusa, Samastipur-848 125 (Bihar), India

ABSTRACT

A field experiment was conducted during winter seasons of 2000-01 and 2001-02 to study the effect of sowing techniques and weed management on weed dynamics and yield of wheat [*Triticum aestivum* (L.) emend. Fiori and Paol]. Criss-cross sowing significantly reduced weed dry biomass and produced 19.93% more grain yield than broadcast method of sowing. Weed control treatments significantly reduced weed density and weed dry biomass than weedy check. Among the weed control treatments, sulfosulfuron was found most effective herbicide and it significantly reduced the total weed population and density of *Phalaris minor* and *Avena fatua* to the tune of 87.3 and 92.9%, respectively, over control. However, isoproturon 0.75 kg/ha controlled *P. minor* and *A. fatua* only to the extent of 67.8 and 78.6%. Hand weeding recorded similar grain yield to that of sulfosulfuron and significantly outyielded isoproturon and 2, 4-D.

INTRODUCTION

Usually the intensity of weeds in wheat remains higher in rice-wheat cropping system. Weeds compete with the crop plants for nutrient and other growth factors and in the absence of an effective control measure remove applied nutrients from the soil and cause yield reduction to the tune of 15-50% or sometime more depending upon the weed density and type of weed flora present (Malik *et al.,* 1989). Grassy weeds like *Phalaris minor* and *Avena fatua* constitute major weeds in wheat, which pose a serious threat to its successful cultivation in north Bihar. Among the existing herbicides, isoproturon is being used for the last 15 years for the control of these weeds. Continuous use of isoproturon has developed resistance to this herbicide (Walia *et al.,* 1997). To overcome this problem under agro-climatic condition of north Bihar, it was felt necessary to evaluate new herbicide against weeds in wheat to avoid continuous use of isoproturon. Uniform and optimum distribution of crop plants per unit area by manipulating the sowing technique even with the same seed rate has been reported to decrease initial competition with weeds due to better crop canopy development at early stages (Teich *et al.,* 1991). A judicious combination of crop geometry and weed management may act synergistically to control the weeds which may ultimate increase grain yield. Keeping these facts in view, the present experiment was, therefore, undertaken.

MATERIALS AND METHODS

The field experiment was conducted at Research Farm of Rajendra Agricultural University, Pusa (Samastipur) during **rabi** seasons of 2000-01 and 2001-02. The soil of the experimental plot was clay loam in texture and calcareous in nature, low in organic carbon (0.36%), available nitrogen (217.8 kg/ha), medium in phosphorus (21.8 kg/ha) and low in potassium (103.5 kg/ha) with pH 8.7. The experiment was laid out in split-plot design, comprising three sowing techniques in main plots and five weed control treatments in sub-plots and was replicated thrice (Table 1). Wheat variety HD-2733 was sown on 9 and 14 December in 2000 and 2001, respectively. The recommended package was adopted to raise the crop. Post-emergence application of sulfosulfuron and 2, 4-D was done 30 days after sowing, using the knapsack sprayer fitted with flat fan nozzle.

RESULTS AND DISCUSSION

Effect on Weeds

The weeds observed in the experimental plots included *Chenopodium album* L., *Fumaria parviflora* L., *Oxalis corniculata* L., *Convolvulus arvenis* L., *Anagallis arvensis* L., *Lipia nudiflora, Melilotus indica* L., *Launea pinnatifida* L., *Cannabis sativa* L., *Nicotiana plumbginifolia* L., *Spergula arvensis* L., *Phalaris minor*

Table 1. Effect of sowing techniques and weed management on density of different weed species and total weed dry weight in wheat at harvest

Treatment	Density of weeds (No./m^2)											
	C. album		*F. parviflora*		*P. minor*		*A. fatua*		Total weed density		Dry weight of total weed (g/m^2)	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
Seeding methods												
Broadcasting	6.63 (52.0)	6.81 (53.3)	5.0 (27.8)	5.24 (30.3)	4.75 (24.8)	4.90 (26.2)	2.78 (8.5)	2.69 (7.90)	12.93 (179.2)	13.19 (188.4)	8.54 (77.6)	8.75 (82.6)
Normal line sowing	6.34 (46.8)	6.59 (49.7)	4.61 (23.7)	4.94 (26.0)	4.64 (23.6)	4.66 (23.8)	2.71 (8.1)	2.50 (6.8)	12.21 (159.9)	12.61 (171.3)	7.91 (68.0)	8.35 (73.6)
Criss-cross sowing	6.16 (44.0)	6.33 (46.0)	4.31 (20.9)	4.57 (23.1)	4.51 (22.5)	4.52 (22.5)	2.68 (7.8)	2.40 (6.2)	11.49 (145.5)	12.18 (158.2)	7.59 (62.9)	7.98 (68.6)
LSD (P=0.05)	NS			0.55					0.77		0.69	0.57
Weed control treatments												
Weedy check	11.44 (130.9)	11.49 (131.9)	7.86 (61.9)	8.07 (64.9)	6.48 (41.8)	6.35 (40.2)	4.0 (15.8)	3.71 (13.7)	19.02 (361.7)	19.26 (372.6)	12.51 (156.2)	12.80 (163.6)
Hand weeding	6.37 (40.2)	6.54 (42.6)	4.69 (21.6)	4.94 (24.2)	4.65 (21.2)	4.65 (21.7)	2.66 (6.6)	2.38 (5.4)	11.95 (142.8)	12.55 (157.6)	6.31 (39.6)	6.67 (44.3)
Isoproturon at 0.75 kg/ha	5.38 (28.7)	5.41 (29.2)	4.25 (17.9)	4.93 (19.5)	3.58 (12.5)	3.75 (13.9)	1.94 (3.3)	1.86 (3.0)	10.12 (102.5)	10.64 (113.6)	7.35 (53.8)	7.77 (60.1)
Sulfosulfuron at 33.3 g/ha	3.72 (13.9)	4.28 (17.9)	2.89 (8.0)	3.30 (10.4)	2.29 (4.9)	2.42 (5.5)	1.25 (1.0)	1.28 (1.1)	8.57 (73.7)	9.39 (88.0)	6.08 (36.8)	6.42 (40.8)
2, 4-D at 0.8 kg/ha	4.97 (24.5)	5.18 (26.7)	3.50 (11.2)	3.84 (14.7)	6.17 (37.8)	6.29 (39.5)	3.77 (13.9)	3.42 (11.5)	11.38 (127.0)	11.44 (131.2)	7.83 (61.1)	8.14 (65.8)
LSD (P=0.05)	0.59	0.61	0.50	0.52	0.41	0.54	0.44	0.45	0.65	1.02	0.76	0.64

DAS–Days after sowing, NS–Not Significant.
Original values given in parentheses were subjected to square root transformation ($\sqrt{X}+0.5$) before analysis.

L. Retz., *Avena fatua* L., *Cynodon dactydon* L. Pers and *Cyperus rotundus* L.

Criss-cross sowing significantly reduced weed dry biomass than broadcast method of sowing in both the years. However, total weed density and density of *F. parviflora* reduced significantly in one season (2001-02 and 2000-01, respectively) than broadcast method of sowing (Table 1). The reduction in weed density and weed dry biomass in criss-cross sowing might be attributed to competition stress created by the canopy of more number of crop plants in a unit area having suppressive effect on weeds.

Weed control treatments significantly reduced the weed density and weed dry biomass than weedy check. Sulfosulfuron 33.3 g/ha was found most effective herbicide for controlling both narrow and broad-leaved weeds and it recorded significantly lower density of *P. minor, A. fatua, C. album, F. parviflora* and of total weeds than isoproturon 0.75 kg/ha, 2, 4-D and hand weeding (Table 1). However, weed dry biomass obtained under sulfosulfuron and hand weeding was at par and both reduced significantly the weed dry biomass than isoproturon and 2, 4-D. Effect of isoproturon and 2, 4-D in terms of total dry weight of weeds was similar.

Effect on Crop

Criss-cross sowing produced significantly more number of spikes than normal line sowing and broadcost method of sowing (Table 2). Similarly, line sowing also produced significantly higher number of spikes than broadcast method of sowing. Weed control treatments produced higher number of spikes/m^2 than weedy check. Hand weeding although produced more number of spikes, but was found to be at par with sulfosulfuron and both produced significantly higher number of spikes than isoproturon and 2, 4-D.

Criss-cross sowing produced maximum grain yield which was 7.29 and 19.93% higher than normal line sowing and broadcast method of sowing (Table 2). Criss-cross and normal line sowing produced significantly higher straw yield than broadcast method of sowing except during second year under normal line sowing and broadcast method of sowing. Gogoi and Kalita (1995) also reported similar results. Higher grain yield under criss-cross and normal line sowing might be due to optimum number of plants per unit land area which reduced intensity of crop-weed competition during the crop growth period and increased uptake of applied nutrients to the crop plant for better growth and development. Contrary to this, plant population was not uniform under broadcast sowing which might have encouraged more growth of weeds resulting in lower yields.

Table 2. Effect of sowing techniques and weed management on number of spikes, grain and straw yield of wheat

Treatment	Spikes (No./m^2) at harvest		Grain yield (kg/ha)		Straw yield (kg/ha)	
	2000-01	2001-02	2000-01	2001-02	2000-01	2001-02
Seeding methods						
Broadcasting	327.1	321.1	3200	2962	4681	4419
Normal line sowing	347.3	339.4	3571	3319	5467	4826
Criss-cross sowing	361.0	351.9	3838	3554	5480	5104
LSD (P=0.05)	10.8	9.2	327	238	379	425
Weed control treatments						
Weedy check	316.5	310.4	2906	2690	4434	4144
Hand weeding (30 DAS)	365.8	356.4	3872	3611	5483	5165
Isoproturon at 0.75 kg/ha	348.7	338.0	3641	3335	5221	4807
Sulfosulfuron at 33.3 g/ha	360.7	349.8	3810	3526	5415	5078
2, 4-D at 0.8 kg/ha	340.0	332.8	3452	3231	4995	4720
LSD (P=0.05)	8.4	7.8	248	202	232	251

Weed control treatments produced significantly higher grain and straw yields than weedy check (Table 2). Hand weeding recorded significantly higher grain and straw yields than isoproturon 0.75 kg/ha and 2, 4-D 0.8 kg/ha but was found to be at par with sulfosulfuron 33.3 g/ha. Among the herbicides, sulfosulfuron significantly outyielded 2, 4-D but was found at par with isoproturon except straw yield in second year. This could be due to better control of weeds by sulfosulfuron compared to other herbicides in question.

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