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Chemical weed management to increase productivity of wheat

Balkaran Singh Sandhu* and Nirmaljit Singh Dhaliwal
Krishi Vigyan Kendra, Sri Muktsar Sahib, Punjab 152 026

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ABSTRACT

Pinoxaden 50 g/ha reduced *P. minor* weeds, significantly which was statistically at par with clodinafop 60 g/ha, sulfosulfuron 24.5 g/ha but significantly superior over pendimethalin 750 g/ha, isoproturon 937 g/ ha. Numbers of effective tillers/m^2 were higher among pinoxaden, clodinafop and sulfosulfuron treatment from the isoproturon, pendimethalin and unweeded check. All other herbicide treatments failed to produce any significant effect on the plant height, ear length, number of grains/ear and 1000- grain weight of wheat crop. Pinoxaden 50 g/ha produced higher average grain yield (4.9 t/ha), which was statistically at par with clodinafop 60 g/ha (4.80 t/ha), sulfosulfuron 24.5 g/ha (4.76 t/ha) but significant superior from the isoproturon 937 g/ha (4.52 t/ha), pendimethalin 750 g/ha (4.18 t/ha) and unweeded check (3.98 t/ha). The increase in yield was due to less weed competition among these treatments. Benifit: cost ratio was higher in case of clodinafop (1.83:1) followed by pinoxaden (1.82:1), sulfosulfuron (1.82:1) and isoproturon (1.70:1) and pendimethalin (1.46:1) but lower B:C ratio was obtained with unweeded check (1.45:1).

Key words: B:C ratio, Chemical control, Herbicide, Weed density, Wheat, Yield

Wheat (*Triticum aestivum* L.) occupies about 17% of the total world's cropped land and contributes 35% of staple foods (Shamsi *et al.* 2006). In India wheat is grown on 29.64 mha area with total production of 92.46 mt and average productivity of 3.12 t/ha (Anon. 2013). In 2025, the estimated food requirement is around 300 million tonnes, which can be elevated from present 230.67 mt through proper management of weeds, insect-pests, diseases and nutrient (Gill and Singh 2009). Among the various factors responsible for low productivity, wheat is infested with several broad as well as narrow-leaved weeds resulting in the yield loses varying from 7 - 50% depending on their densities (Walia and Brar 2001) hence, better grain yield is not possible without proper weed control (Chhokar *et al*. 2012). Chemical method for controlling weeds is most effective, efficient, up-to-date and time saving. In view of above, the present experiment was undertaken to study the efficacy of different herbicides against narrow leaved weeds in wheat under irrigated condition and to study the economics.

MATERIALS AND METHODS

A field experiment was conducted at Krishi Vigyan Kendra, Sri Muktsar Sahib. (30°.26'56" N, 74°.30'28" E) during the *Rabi* 2013 and 2014 to find out the best herbicide for controlling *P. minor* in wheat crop. The annual rainfall of the area was 430.7 mm, most of which is received during July to September (Anonymous 2011). The soil was sandy loam, slightly alkaline in reaction (pH 7.79), high EC (0.980 dS/m), low in available organic carbon (0.24 %), medium in available phosphorus (17.5 kg/ha) and high in available potassium (736 kg/ha).The experimental field had been in a cotton-wheat rotation for the last two years. The experiment was laid out in randomized complete block design with three replications having 4 x 10 m plot sizes. Wheat variety '*HD 2967*' was sown in 20 cm apart lines with single row hand drill having a seeding rate of 100 kg per hectare during both the years. All P, K and half of N applied at sowing while remaining half of N was applied at first irrigation. Recommended fertilizer dose of 125- 62.5-30 kg NPK per hectare was applied and irrigations were applied according to the requirement of the crop. All other practices were kept normal and uniform for all experimental units.

The field experiment was done with six herbicides. Among different herbicide, five herbicide namely isoproturon 937 g/ha, clodinafop 60 g /ha, pinoxaden 50 g/ha, sulfosulfuron 24.5 g/ha and pendimethalin 750 g/ha and one check plot was left unweeded. Pendimethalin was applied 1day after sowing and all other herbicides were sprayed at 4-6 leaf stage of weeds (35 days after sowing) in moist field after first irrigation with hand operated knapsack sprayer. Weed count was recorded at 60 days. The crop was harvested in the last week of April during

***Corresponding author:** balkaransandhu@gmail.com

both the years. Observations on plant height, number of effective tiller/m^2, number of grains per ear, ear length, 1000-grains weight, grain yield and straw yield were recorded. Collected data were further analyzed by using appropriate statistical tools. Economic analysis was carried out on the basis of extra income obtained from the enhanced yield by extra cost incurred for each treatment and prevailing market prices.

RESULTS AND DISCUSSION

Weed density

All the weed controlling treatments significantly reduced the weed population over the control treatment during both the years (Table 1). During 2013 pinoxaden 50 g/ha reduced *P. minor* weeds (1.4/m^2) significantly, which was statistically at par with clodinafop 60 g/ha (1.8/m^2), sulfosulfuron 24.5 g/ha (2.6/m^2), over pendimethalin 750 g/ha (3.4/m^2), and isoproturon 937 g/ha (3.7/m^2). Higher weed density was observed with the unweeded check (7.1/ m^2). However, during 2014, lesser weed population was recorded with pinoxaden 50 g/ha (2.6/m^2), which was statistically at par with clodinafop 60 g/ha (2.7/m^2), sulfosulfuron 24.5 g/ha (3.4/m^2) and significant superior weed control over isoproturon 937 g/ha (4.1/m^2), pendimethalin 750 g/ha (7.6/m^2), (Table 1). Similar results were also obtained by Bahart and Kachroo (2010) in which application of pinoxaden produced reduction of weeds in wheat crop.

Yield attributes and yield

During 2013, pinoxaden 50 g/ha produced the higher (355.7/m^2) number of effective tillers/m^2, which was statistically at par with clodinafop 60 g/ha (355.5/m^2), sulfosulfuron 24.5 g/ha (354.5/m^2) and isoproturon 937 g/ha (353.8/m^2) but significantly superior from pendimethalin 750 g/ha (336.9/m^2) and unweeded check (326.1/m^2). Whereas, during 2014, higher number of effective tillers were produced from sulfosulfuron (356.6/m^2), which was statistically at par with pinoxaden (354.6/m^2), clodinafop (353.2/m^2), and isoproturon (352.7/m^2) but significantly superior over pendimethalin (334.9/ m^2) and unweeded check (325.6/m^2). All the different herbicide treatments failed to produce any significant effect on plant height ear length, number of grains/ear and 1000- grain weight of wheat crop during both the years (Table 2).

During 2013, pinoxaden produced higher grain yield (5.11 t/ha), which was statistically at par with clodinafop (5.01 t/ha), sulfosulfuron (4.95 t/ha) but significantly superior from isoproturon (4.76 t/ha), pendimethalin (4.29 t/ha) and unweeded check (4.05 t/ha). Similar results were obtained during 2014. Pinoxaden produced higher grain yield (4.90 t/ha), which was statistically at par with clodinafop (4.80 t/ ha), sulfosulfuron 75 WG (4.76 t/ha) but significant superior from the isoproturon (4.52 t/ha), pendimethalin (4.18 t/ha) and unweeded check treatment (3.98 t/ha). Punia *et al.* (2006), also reported the similar results.

Table 1. Effect of different herbicides on weed density, plant height and effective tillers of wheat

Treatment	No. of weeds/m^2			Plant height (cm)			No. of Effective tillers/m^2		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
Isoproturon 937 g/ha	3.7	4.1	3.9	98	96	97	354	353	353
Clodinafop 60 g/ha	1.8	2.7	2.2	100	94	97	355	353	354
Pinoxaden 50 g/ha	1.4	2.6	2.0	99	95	97	356	355	355
Sulfosulfuron 24.5 g/ha	2.6	3.4	3.0	97	95	96	354	357	355
Pendimethalin 750 g/ha	3.4	7.6	5.5	99	95	97	337	335	336
Unweeded check	7.1	9.5	8.3	98	97	97	326	326	326
LSD (P=0.05)	1.3	1.6	1.8	NS	NS	NS	13	12	12

Table 2. Effect of different herbicides on ear length, grain/ear and 1000-grain weight of wheat crop

Treatment	Ear length (cm)			Grains/ear			1000 grain wt. (g)		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
Isoproturon 937 g/ha	10.3	10.1	10.2	61.0	61.0	61.0	42.9	42.6	42.7
Clodinafop 60 g/ha	10.5	10.3	10.4	61.8	62.3	62.0	42.6	41.9	42.2
Pinoxaden 50 g/ha	10.6	10.8	10.7	61.7	64.8	63.2	43.5	43.2	43.3
Sulfosulfuron 24.5 g/ha	10.4	10.1	10.2	61.6	58.8	60.2	43.2	42.4	42.8
Pendimethalin 750 g/ha	10.5	10.9	10.7	60.3	61.8	61.0	43.7	43.0	43.3
Unweeded check	10.1	10.4	10.2	58.1	59.9	59	42.5	42.2	42.3
LSD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. Effect of different herbicides on grain, straw and biological yield of wheat crop

Treatment	Grain yield (t/ha)			Straw yield (t/ha)			Biological yield (t/ha)		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
Isoproturon 937 g/ha	4.76	4.28	4.52	6.96	7.03	6.99	11.7	11.3	11.5
Clodinafop 60 g/ha	5.01	4.60	4.80	7.39	7.58	7.48	12.4	12.2	12.3
Pinoxaden 50 g/ha	5.11	4.69	4.90	7.47	7.50	7.48	12.6	12.2	12.4
Sulfosulfuron 24.5 g/ha	4.95	4.58	4.76	7.34	7.45	7.39	12.3	12.0	12.2
Pendimethalin 750 g/ha	4.29	4.07	4.18	6.36	7.09	6.72	10.6	11.2	10.9
Unweeded check	4.05	3.92	3.98	5.99	6.74	6.36	10.0	10.7	10.3
LSD (P=0.05)	0.30	0.24	0.22	0.47	0.45	0.32	0.77	0.58	0.52

Table 4. Effect of different herbicides on economics and benefit cost ratio of wheat crop

Treatment	Gross returns ($x10^3$ `/ha)			Input cost ($x10^3$ ` /ha)			Net returns ($x10^3$ ` /ha)			Benefit: cost ratio		
	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average	2013-14	2014-15	Average
Isoproturon 937 g/ha	66.68	62.06	64.37	23.45	24.27	23.86	43.23	37.79	40.51	1.84:1	1.56:1	1.70:1
Clodinafop 60 g/ha	70.09	66.70	68.40	23.80	24.54	24.17	46.29	42.15	44.22	1.94:1	1.72:1	1.83:1
Pinoxaden 50 g/ha	71.47	68.00	69.74	24.33	25.15	24.74	47.14	42.86	45.00	1.94:1	1.70:1	1.82:1
Sulfosulfuron 24.5 g/ha	69.35	66.41	67.88	23.70	24.52	24.11	45.65	41.89	43.77	1.93:1	1.71:1	1.82:1
Pendimethalin 750 g/ha	60.11	59.01	59.56	23.86	24.67	24.27	36.25	34.34	35.29	1.52:1	1.39:1	1.46:1
Unweeded check	56.63	56.84	56.73	22.80	23.63	23.22	33.83	33.21	33.52	1.48:1	1.41:1	1.45:1

In both the years average straw yield was higher in pinoxaden (7.48 t/ha) and clodinafop (7.48 t/ha), which was statistically at par with sulfosulfuron (7.39 t/ha) but significant superior from the isoproturon (6.99 t/ha), pendimethalin (6.72 t/ha) and unweeded check (6.36 t/ha). Bharat and Kachroo (2010) also revealed the similar results that these treatments produced significantly higher grain and straw yield. Similarly biological yield was also higher in pinoxaden and statistically equal with clodinafop and sulfosulfuron but significant superior from the isoproturon, pendimethalin and unweeded check treatment. Higher biological yield among these treatments was due to higher grain yield among these treatments. Similar results were also obtained by Bahart and Kachroo (2010) in which application of pinoxaden produced the higher grain and straw yield.

Economics and benefit: cost ratio

Average gross return was higher in treatment pinoxaden (` 69738) followed by clodinafop (` 68397) followed by sulfosulfuron (` 67878) than isoproturon (` 64369) and pendimethalin (` 59561) but lower gross return was obtained with unweeded check (` 56735). Similarly, net return was also higher in these treatments. Benifit: cost ratio, was higher among the clodinafop (1.83:1) followed by pinoxaden (1.82:1) and sulfosulfuron (1.82:1) than isoproturon (1.70:1) and pendimethalin (1.46:1) but lower B: C ratio was obtained with unweeded check treatment (1.45:1). Higher B:C ratio among these treatments was only due to lower input cost in these treatments.

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