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Efficacy of new herbicides against grass weeds in wheat (*Triticum aestivum*) under mid-hill conditions of Himachal Pradesh

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ABSTRACT

A field experiment was conducted during the winter (*rabi*) seasons of 1997–98 and 1998–99 at Himachal Pradesh Krishi Vishvavidyalaya, Palampur. Clodinafop-propargyl 0.15 kg/ha being at par with diclofop-methyl 0.80 kg/ha, produced significantly lower weed dry weight and higher number of effective tillers/m row, grains/spike and 1,000-grain weight and hence significantly higher grain yield. Clodinafop-propargyl 0.10 kg/ha, tralkoxydim 0.40 kg/ha and phenoxaprop-p-ethyl 0.10 kg/ha were also effective in reducing the weed population and dry weight and in increasing yield attributes and grain yield significantly over the remaining treatments. Metribuzin 0.25 kg/ha though controlled all the grassy and broad-leaf weeds effectively, caused higher toxicity to the crop particularly during the first year and resulted in the lower values of yield attributes and the grain yield. Sulfosulfuron did not control grass weeds effectively and hence resulted in the lowest yield compared with all the other weed-control treatments

Key words : Herbicide, Grass weeds, Wheat

Among many reasons of low yield of wheat in Himachal Pradesh, weed infestation is of major importance. Grass weeds, particularly *Phalaris minor* Retz., *Avena fatua* L. and *Lolium temulentum* L. constitute major weed flora which cause enormous losses in wheat grain yield (Saini and Angiras, 1991). Isoproturon is one of the most effective herbicides for controlling these grass weeds in wheat. However, continuous use of one herbicide may develop resistance in weed species. Malik and Singh (1993) and Walia *et al.* (1997) reported *Phalaris minor* resistance to Isoproturon due to its continuous use in wheat since 1982 in Haryana and Punjab. In view of this problem, new herbicides are being felt essential for safe, effective and economical control of grass weeds in wheat and hence the present investigation was undertaken in wheat.

MATERIALS AND METHODS

The field experiment was conducted during winter (*rabi*) seasons of 1997–98 and 1998–99 at the Agronomy Farm, Himachal Pradesh Krishi Vishvavidyalaya, Palampur. The soil of experimental site was silty clay loam in texture, acidic in reaction (5.8), medium in available nitrogen (292.0 kg/ha) and phosphorus (14.5 kg/ha) and high in available potash (312.0 kg/ha)

The experiment was laid out in randomized block design with 12 treatment combinations and 3 replications. Wheat 'HPW 89' was sown on 5 and 18 November during 1997 and 1998, respectively, adopting all recommended package of practices except the treatments. The treatments consisted of Clodinafop-propargyl @ 0.10 and 0.15 kg/ha, Phenoxaprop-p-ethyl @ 0.08 and 1.0 kg/ha, Sulfosulfuron @ 0.04 and 0.05 kg/ha, Metribuzin @ 0.25 kg/ha, Tralkoxydim @ 0.40 kg/ha, Diclofop-methyl @ 0.80 kg/ha, Isoproturon @ 1.50 kg/ha and hand weeding twice (40 and 70 days after sowing) and unweeded control. All the herbicides were sprayed as post-emergence at the 2–4 leaf stage of weeds with knapsack-sprayer fitted with flat-fan nozzle using 700 litres water/ha. Weed data on total weed population and total weed dry weight were recorded at 150 days after sowing by using 0.5 m × 0.5 m random quadrat at 2 places and analysed after subjecting the original data to square-root transformation. The yield attributes, viz. effective tillers/m^2, grains/spike and 1,000-grain weight, and wheat grain yield were recorded treatment-wise at harvest. The total rainfall received during the crop season was 469 mm and 97.3 mm during 1997–98 and 1998–99 respectively. During the first year the rainfall was well distributed throughout the crop season, whereas during the second year more than 70% of the total rainfall occurred only in January and rest of the months were almost dry.

RESULTS AND DISCUSSION

Phalaris minor Retz. and *Avena fatua* L. were the major weed species infesting the experimental field and constituted 42.4% and 39.6% of the total weed population. The other weed species were *Lolium temulentum* L., *Alopecurus myosuroides* Huds., *Vicia sativa* L. and *Anagallis arvensis* L.

All the weed-control treatments reduced the total weed population and weed dry weight significantly compared with the unweeded control. Among herbicides, Clodinafop-propargyl 0.15 kg being at par with Clodinafop-propargyl 0.10 kg, Metribuzin 0.25 kg, Diclofop-methyl 0.80 kg and Tralkoxydim 0.40 kg/ha resulted in significantly lower total weed population compared with other treatments. Similarly, Clodinafop-propargyl 0.15 kg/ha resulted in the lowest weed dry weight; however, it was at par with Clodinafop-propargyl 0.10 kg and diclofop-methyl 0.80 kg/ha in the first year and with Metribuzin 0.25 kg, Tralkoxydim 0.40 kg/ha and hand-weeding during the second year in producing significantly lower weed dry weight compared with the rest of the treatments. These treatments were closely followed by

Metribuzin 0.25 kg, Tralkoxydim 0.40 kg and Isoproturon 1.5 kg/ha during first year and Clodinafop-propargyl 0.10 kg, Diclofop-methyl 0.80 kg and Phenoxaprop-p-ethyl 0.10 kg during the second year in reducing the weed dry weight significantly compared with the remaining treatments. These results are in agreement with those of Dhaliwal *et al.* (1998) and Walia *et al.* (1998), who reported all these herbicides to be the most effective against grasses, particularly *Phalaris minor*. Metribuzin and Tralkoxydim were also reported effective herbicides for grasses control in wheat by Brar *et al.* (1997) and Singh *et al.* (1998) respectively. Though Sulfosulfuron 0.04 kg and 0.05 kg/ha produced significantly lower total weed population and dry weight of weeds than the unweeded control this was observed to be the poorest herbicide because it resulted in significantly highest weed population and total weed dry weight compared to all other weed-control treatments, probably because the doses of sulfosulfuron

Table 1. Effect of herbicidal treatments on population and dry weight of weeds infesting wheat

Treatment	Dose (kg/ha)	Total weed population/m²		Total weed dry weight (g/m²)	
		1997–98	1998–99	1997–98	1998–99
Clodinafop-propargyl	0.10	4.9 (22.6)	5.7 (31.0)	4.6 (20.2)	5.5 (29.8)
Clodinafop-propargyl	0.15	4.3 (16.6)	4.2 (17.3)	3.9 (14.1)	4.1 (15.7)
Fenoxaprop-p-ethyl	0.08	7.6 (57.7)	7.8 (61.0)	8.1 (64.5)	6.2 (37.5)
Fenoxaprop-p-ethyl	0.10	6.7 (39.6)	6.1 (36.2)	8.4 (59.6)	5.8 (33.8)
Sulfosulfuron	0.04	7.6 (58.1)	7.9 (61.2)	12.4 (152.3)	6.7 (44.1)
Sulfosulfuron	0.05	8.6 (72.7)	7.7 (58.7)	12.9 (167.8)	5.9 (33.8)
Metribuzin	0.25	4.8 (23.0)	3.9 (14.2)	5.6 (30.0)	3.5 (11.3)
Tralkoxydim	0.40	5.2 (26.4)	4.7 (21.1)	5.4 (28.2)	4.7 (21.4)
Diclofop-methyl	0.80	4.3 (18.5)	5.5 (29.7)	4.7 (20.3)	5.5 (29.5)
Isoproturon	1.50	5.8 (32.7)	6.1 (35.8)	6.4 (47.6)	6.0 (35.1)
Hand-weedings DAS	40, 70	4.8 (23.1)	3.4 (10.7)	8.3 (67.4)	3.2 (9.6)
Unweeded control		9.3 (85.0)	8.7 (74.2)	18.0 (325.1)	12.8 (162.4)
CD (P=0.05)		1.6	1.8	1.2	1.1

DAS, Days after owing; $\sqrt{x+1}$ transformations used; Figures in the parentheses are the means of the original values

Table 2. Effect of herbicidal treatments on yield attributes and yield of wheat

Treatment	Dose (kg/ha)	Effective tillers/m row		Grains/ spike		1,000-grain weight (g)		Grain yield (q/ha)	
		1997–98	1998–99	1997–98	1998–99	1997–98	1998–99	1997–98	1998–99
Clodinafop-propargyl	0.10	68.4	60.8	41.8	38.2	55.4	47.2	37.1	28.7
Clodinafop-propargyl	0.15	75.2	64.2	43.4	41.3	56.2	50.5	39.6	32.5
Fenoxaprop-p-ethyl	0.08	66.5	59.2	38.5	37.2	51.9	46.0	34.5	28.4
Fenoxaprop-p-ethyl	0.10	65.7	61.5	38.8	36.8	49.6	45.0	34.9	29.6
Sulfosulfuron	0.04	56.4	52.8	33.3	31.7	46.4	44.1	27.4	24.8
Sulfosulfuron	0.05	55.8	52.3	34.0	32.5	43.8	42.6	27.1	23.6
Metribuzin	0.25	66.8	60.2	39.5	37.3	55.1	46.4	36.4	29.7
Tralkoxydim	0.40	65.8	62.5	38.3	37.6	54.6	47.8	36.0	31.0
Diclofop-methyl	0.80	74.5	62.6	71.4	42.0	55.5	48.2	38.1	28.5
Isoproturon	1.50	65.8	60.2	37.1	39.0	49.8	45.0	33.6	29.0
Hand-weedings	40,70 DAS	65.8	59.8	38.8	38.8	49.5	46.0	35.0	28.5
Unweeded control		47.5	43.7	32.8	29.7	40.1	37.5	22.2	18.1
CD (P = 0.05)		2.7	4.2	2.5	2.8	1.1	2.8	2.2	3.1

DAS, Days after sowing

under study were not sufficient to control grass weeds effectively and may require still higher dose under the present climatic conditions. Similarly, the poor and inconsistent performance of Phenoxaprop-p-ethyl compared with other herbicides may be attributed to the same reason, as has also been reported by Singh *et al.* (1998) that Phenoxaprop-p-ethyl provided effective control of *Phalaris minor* at 140 g/ha compared with its lower doses.

Effect on crop

In general, the yield attributes, viz. effective tillers/m^2, grains/spike and 1,000-grain weight, were higher during 1997–98 than 1998–99, irrespective of the weed-control treatments. This may be attributed to the better crop growth owing to the normal and well-distributed rainfall throughout the crop season during 1997–98 compared with 1998–99. During the second year more than 70% of the total rainfall occurred only during the third week of January and rest of the months had negligible rainfall. This ultimately resulted in the higher wheat grain yield during the first year than the second year (Table 2).

Weed-control treatments had significant effect on the yield attributes and yield of wheat. All the weed-control treatments resulted in significantly higher effective tillers/m row length, grains / spike, 1,000-grain weight and hence significantly higher grain yield over the unweeded control. Clodinafop-propargyl 0.15 kg being at par with Diclofop-methyl 0.50 kg/ha resulted in significantly higher values of almost all the yield attributes and grain yield compared with other treatments during both the years. During the second year however, Clodinafop-propargyl 0.15 kg/ha was also at par with Tralkoxydim 0.40 kg, Phenoxaprop-p-ethyl 0.10 kg and Metribuzin 0.25 kg/ha and resulted in significantly higher wheat grain yield which was attributed to significantly lower weed population and weed dry weight and more effective tillers/m row, grains/spike and 1,000-grain weight in these treatments compared with the remaining treatments. However, during the first year Phenoxaprop-ethyl 0.10 kg/ha, Metribuzin 0.25 kg/ha and Tralkoxydim 0.40 kg/ha being at par with each other in recording yield attributes and yield were the next best treatments. All of these 3 treatments were also at par with Clodinafop-propargyl 0.10 kg/ha, hand-weedings and Isoproturon 1.5 kg/ha during both the years. These results are in line with those of Walia *et al.* (1998), who reported that post-emergence application of Clodinafop 120 g/ha and Fenoxaprop-p-ethyl 80 ml/ha being at par with Diclofop-methyl 0.90 kg/ha and Tralkoxydim 0.35 kg/ha provided good control of *Phalaris minor* L. and increased the wheat grain yield significantly. Metribuzin provided effective control of grass weeds but the yield was reduced because of its irrecoverable phytotoxicity particularly during the first year, whereas some recovery was observed during the second year. Similar results with metribuzin were also reported by Brar *et al.* (1997). Sulfosulfuron though resulted significantly higher yield attributes and wheat grain yield over the unweeded control, the lowest yield attributes and grain yield compared with other treatments because of the poor control of grassy weeds at the given doses.

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