

Efficacy of isoproturon with and without surfactant on weed suppression in wheat (*Triticum aestivum*)

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ABSTRACT

A field experiment was conducted during the winter seasons of 1999–2000 and 2000–2001 to study the efficacy of Isoproturon with and without surfactant on weed suppression in wheat (*Triticum aestivum* L. emend. Fiori & Paol.) at Pusa, Bihar. Tank mixing of wet wel 2% to isoproturon @ 1.0 kg/ha as post-emergence was as effective as manual weeding, produced lower weed dry weight and higher number of effective tillers/m row length, grains/spike and 1,000-grain weight and hence significantly higher grain yield. Reduced dose of Isoproturon @ 0.75 kg/ha with different surfactants used was also effective in reducing the weed population and their dry weight and in increasing the yield attributes and grain yield significantly over the control. Isoproturon without surfactant was least effective in controlling weeds and had minimum impact on enhancing seed yield compared to Isoproturon with surfactant. Maximum net returns were obtained from weed-free plot, while benefit: cost ratio was maximum with isoproturon @ 0.5 kg/ha with T. pal 2%.

Key words: Weed, Efficacy, Isoproturon, Surfactant

Wheat is highly sensitive crop to weed competition and yield loss due to weeds ranges from 70 to 80%, depending on wheat cultivars, weed species and density. In recent years, grassy weeds particularly *Phalaris minor* Retz. and *Avena fatua* L. have posed serious problems in wheat cultivation. Post-emergence application of Isoproturon is recommended for the effective management of *P. minor*. The use of adjuvants has been found beneficial in various crops (Taylor *et al.* 1982; Varshney, 1984). For the control of such grassy weed the surfactants may need to be mixed with Isoproturon to improve their efficacy. They facilitate better covering and retaining of the solution on plants with poorly wettable leaf surface. As very meagre information on use of surfactant is available with post-emergence herbicides particularly in wheat, a study was therefore carried out to assess the relative efficacy of commonly used herbicide Isoproturon to tank mixing of adjuvants as post-emergence application in controlling the grassy weed *Phalaris minor* in wheat.

MATERIALS AND METHODS

The field experiment was conducted at the Research Farm of Rajendra Agricultural University, Pusa, Bihar, during the winter seasons of 1999–2000 and 2000–2001. The soil of experimental site was sandy loam, calcareous, having pH 8.5 and contained 0.30% organic carbon, 198.3 kg/ha available N, 19.3 kg/ha available P₂O₅ and 111.50 kg/

ha available K₂O. The experiment was laid out in randomized block design with 12 treatment combinations and 3 replications. Wheat cultivar 'HUW 234', was sown on 15 and 20 November during 1999 and 2000, respectively, adopting all recommended package of practices except the treatments. The treatments consisted of post-emergence application of Isoproturon @ 0.75 and 1.0 kg/ha, Isoproturon @ 0.75 kg/ha + urea 2% and 1.0 kg/ha + urea 2%, Isoproturon @ 0.75 kg/ha + wet wel 2% and 1.0 kg/ha + wet wel 2%, Isoproturon @ 0.75 kg/ha + T. pal 2% and 1.0 kg/ha + T. pal 2%, Isoproturon @ 0.75 kg/ha + jaggery 2% and 1.0 kg/ha + jaggery 2%, hand-weeding (30 days) and unweeded control. Herbicide was sprayed as post-emergence at 30 days after sowing with knapsack (check) sprayer fitted with flat-fan nozzle using 800 litres water/ha. Weed data on total weed population and weed dry weight were recorded at 90 days 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 and wheat grain yield were recorded treatment-wise at harvest. The total rainfall received during the crop season was 7.5 mm and 6.8 mm during 1999–2000 and 2000–2001 respectively.

RESULTS AND DISCUSSION

Effect on weed

Grassy weeds *Phalaris minor* Retz. and *Avena fatua* L.

Table 1. Effect of Isoproturon with and without surfactant on weed indices and yield attributes of wheat

Treatment	Weed count (no./m ²)		Weed dry weight (g/m ²)		Weed-control efficiency (%)		Effective tillers/m row		Grains/spike		1,000-grain weight (g)	
	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001	1999–2000	2000–2001
T ₁ , Isoproturon 0.75 (post-emergence)	4.5 (21)	4.4 (20)	3.8 (15)	4.3 (18)	37.0	38.5	50.8	48.5	36.5	35.7	34.5	34.5
T ₂ , Isoproturon 1.0 (post-emergence)	4.2 (18)	4.2 (18)	3.7 (14)	4.0 (16)	38.0	43.0	52.0	49.2	36.0	836.0	34.6	34.4
T ₃ , Isoproturon 0.75 + urea 2% (post-emergence)	4.4 (20)	4.6 (22)	2.8 (8)	4.0 (16)	43.0	43.0	56.1	48.7	39.2	35.8	36.9	34.2
T ₄ , Isoproturon 1.0 + urea 2% (post-emergence)	3.7 (14)	4.3 (19)	3.4 (12)	3.2 (11)	53.0	54.0	57.0	54.4	40.9	37.4	37.8	34.5
T ₅ , Isoproturon 0.75 + wet wel 2% (post-emergence)	3.4 (12)	3.9 (16)	2.7 (7)	2.9 (9)	55.0	58.0	58.9	56.5	40.8	36.8	36.8	37.7
T ₆ , Isoproturon 1.0 + wet wel 2% (post-emergence)	3.2 (10)	3.6 (13)	2.2 (5)	2.7 (7)	63.3	61.0	58.2	58.3	41.0	37.2	37.2	37.9
T ₇ , Isoproturon 0.75 + T. pal 2% (post-emergence)	3.7 (12)	3.9 (16)	2.9 (8)	3.2 (10)	52.0	54.0	59.1	55.1	40.8	37.1	37.1	34.7
T ₈ , Isoproturon 1.0 + T. pal 2% (post-emergence)	3.7 (15)	3.5 (13)	2.2 (5)	3.0 (9)	63.3	57.0	58.3	55.4	46.9	38.1	38.1	37.7
T ₉ , Isoproturon 0.75 + jaggery 2% (post-emergence)	4.8 (23)	4.0 (17)	3.9 (15)	4.1 (17)	35.0	41.0	56.5	50.3	36.8	34.9	34.6	34.5
T ₁₀ , Isoproturon + jaggery 2% (post-emergence)	4.4 (20)	3.9 (16)	3.4 (12)	4.0 (16)	43.0	43.0	57.5	51.2	39.2	36.0	36.9	34.5
T ₁₁ , Hand-weeding (30 DAS)	2.2 (6)	3.1 (10)	1.5 (2)	2.5 (7)	75.6	64.0	65.8	59.3	43.1	39.2	39.2	37.2
T ₁₂ , Weedy check	5.8 (34)	7.2 (52)	6.0 (36)	7.0 (50)			40.6	39.3	30.2	32.8	32.8	32.6
CD (P=0.05)	1.4	0.9	1.2	1.2			3.1	2.7	2.3	2.7	1.4	1.7

were the most dominant weed species infesting the experimental field. The other weed species were *Chenopodium album* L., *Anagallis arvensis* L., *Cirsium arvense* L., *Melilotus indica* L. and *Fumaria parviflora* Lam. among the broad-leaf weeds. Sedge *Cyperus rotundus* L. was also present in the experimental field.

All the weed-control treatments proved effective in reducing the weed population and their dry weight significantly compared with weedy check (Table 1). Higher number of weeds and weed dry weight were recorded in weedy check which was significantly more than all other weed-control treatments, whereas the minimum weed population and weed dry biomass were noted with hand-weeding 30 days after sowing which followed in increasing order by both lower (0.75 kg/ha) and higher (1.0 kg/ha) doses of Isoproturon tank mixed with surfactant. Urea, wet-wel, T-pal and jaggery each at 2% used as surfactant tank mixed to Isoproturon @ 0.75 and 1.0 kg/ha was more effective in reducing the weed population and their dry weight, but failed to attain significance with re-

spect to both lower and higher doses of Isoproturon without surfactant. Weed-control efficiency of different treatments varied from 37 to 75% and 38 to 64% in first and second year of experimentation respectively. The highest weed-control efficiency was found under hand-weeding, followed by tank mixing of urea, wet-wel, T. pal and jaggery each at 2% as surfactant to Isoproturon @ 1.0 kg/ha. The lowest weed-control efficiency was recorded with both lower and higher doses of Isoproturon without surfactant.

Effect on crop

The seed yield in 1999–2000 was more than in 2000–2001, owing to favourable weather condition at active reproductive stage and also due to less weed infestation. Minimum grain yield of 24.2 and 23.7 q/ha was recorded in weedy check (Table 2). Compared to weed-free condition, season-long weed-crop competition reduced the grain yield by 31.6 and 29.2% in first and second year respectively. It was because of severe weed-crop competi-

Table 2. Effect of Isoproturon with and without surfactant on grain and straw yields and economics of wheat

Treatment	Grain yield (q/ha)			Straw yield (q/ha)		Weed index (%)		Cost of cultivation (Rs/ha)*	Net returns (Rs/ha)	Benefit: cost ratio*
	1999–2000	2000–2001	Pooled	1999–2000	2000–2001	1999–2000	2000–2001			
T ₁ , Isoproturon 0.75 (post-emergence)	29.7	28.7	29.2	41.5	40.1	16.1	14.3	12,980	8,620	1.66
T ₂ , Isoproturon 1.0 (post-emergence)	30.5	29.2	28.9	42.0	40.9	13.8	12.9	13,140	8,880	1.67
T ₃ , Isoproturon 0.75 + urea 2% (post-emergence)	31.6	28.9	30.2	44.0	46.4	10.7	13.7	12,987	9,353	1.72
T ₄ , Isoproturon 1.0 + urea 2% (post-emergence)	31.8	29.7	30.8	44.5	41.5	10.5	11.3	13,147	9,633	1.73
T ₅ , Isoproturon 0.75 + wet wel 2% (post-emergence)	32.5	31.4	31.9	45.8	43.7	8.2	6.3	13,060	10,550	1.84
T ₆ , Isoproturon 1.0 + wet wel 2% (post-emergence)	33.2	31.9	32.5	46.2	44.5	6.2	4.8	13,220	10,810	1.81
T ₇ , Isoproturon 0.75 + T. pal 2% (post-emergence)	33.2	31.8	32.5	45.8	43.4	6.2	5.1	13,030	10,930	1.84
T ₈ , Isoproturon 1.0 + T. pal 2% (post-emergence)	32.8	31.2	32.0	46.0	43.6	7.3	6.9	13,190	10,490	1.79
T ₉ , Isoproturon 0.75 + jaggery 2% (post-emergence)	30.6	28.5	30.1	43.1	41.3	13.5	14.9	12,990	9,290	1.71
T ₁₀ , Isoproturon + jaggery 2% (post-emergence)	31.7	29.4	31.0	44.5	42.6	16.4	12.2	13,140	9,810	1.75
T ₁₁ , Hand-weeding (30 DAS)	35.4	33.5	34.4	4.5	46.6			14,645	10,745	1.73
T ₁₂ , Weedy check	24.2	3.7	23.9	36.5	33.9	31.6	29.3	12,300	5,560	1.45
CD (P=0.05)	3.5	3.6	3.9	3.7	3.9					

*Average of 2 years
DAS, Days after sowing

tion in weedy check, as evident from the data on weed population and their dry weight. Severe infestation of weeds resulted in lower number of effective tillers/m row length, number of grains/spike and 1,000-grain weight and consequently significant reduction in seed and straw yields. The present findings support the result of Kumar *et al.* (1997).

Weed-control treatments had significant effect on the yield attributes and grain yield of wheat. All the weed-control treatments resulted in significantly higher number of effective tillers/m row length, number of grains/spike and 1,000 grain weight and hence significantly higher grain and straw yields over the unweeded control. Maximum grain and straw yields were recorded in hand-weeded plot. This might be attributed to more number of effective tillers/m row length, number of grains/spike, 1,000-grain weight under weed-free treatments. Tank mixing of surfactant, wet wel and T. pal each at 2% to isoproturon @ 0.75 and 1.0 kg/ha was equally effective and exhibited the grain and straw yields at par with hand-weeding during

both the years. The reason for higher yields may be owing to its better weed-control efficiency, which in turn provided a favourable environment for growth and development of the crop. This treatment was highly effective, persistent and not phytotoxic to wheat. Bhardwaj (1980) also reported similar findings. Isoproturon @ 0.75 and 1.0 kg/ha mixed with urea and jaggery each at 2% and without surfactant recorded significantly lower grain and straw yields compared to hand-weeding but remained at par with tank mixing of wet wel and T. pal each with 2% to Isoproturon @ 0.75 and 1.0 kg/ha).

Economics

All the weed-control treatments were superior in terms of monetary returns to unweeded control. Among the surfactant used, mixing of wet wel and T. pal each at 2% to Isoproturon @ 0.75 and 1.0 kg/ha had more monetary advantages than other respective dose of Isoproturon with and without surfactant. Among all the weed-control measures, hand-weeding recorded the highest net return while

the benefit:cost ratio was high under Isoproturon @ 0.75 kg/ha mixed with T. pal at 2%.

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