

COMPARISON OF DIFFERENT HERBICIDAL APPLICATION METHODS FOR WEED CONTROL IN WHEAT

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ABSTRACT

A study was conducted at Adaptive Research Farm, Gujranwala, Pakistan during Rabi, 2004-05 to 2006-07 to determine the most effective method of herbicidal application for weed control in wheat. Three herbicides i.e. Affinity (isoproturon + carfentrazone) @ 2.00 kg Sencor (metribuzin) @ 0.250 kg and Proton (isoproturon) @ 2.00 kg per hectare mixed with urea and broadcast just after first irrigation. These herbicides were also sprayed in moist field after first irrigation. All herbicides and methods of application reduced weed density and biomass significantly over weedy check. However, Affinity, Sencor and Proton when mixed with urea fertilizer and broadcast just after first irrigation showed significant reduction of grassy weeds i.e. 97.18, 96.15 and 95.25 percent, respectively. However, spray of these weedicides gave good control of broad leaved weeds. Number of tillers, grain weight, grains per spike and grain yield were significantly higher in treated plots as compared to untreated ones. Significantly higher grain yield was obtained by broadcasting of Affinity (4.53 t/ha), Sencor (4.44 t) and Proton (4.37 t) after mixing with urea just after first irrigation with net return of Rs. 19358, 19274 and 17798 per hectare, respectively. Broadcasting of these herbicides in combination with urea proved to be an efficient and more economical method than spray application.

KEYWORDS: *Triticum aestivum*; weeds; herbicides; urea; efficacy; Pakistan.

INTRODUCTION

Application of herbicides for weed control in wheat is recommended through spray after first irrigation. It has been observed that first irrigation is generally delayed in rice tract due to excessive moisture and unexpected rains, consequently weeds attain excessive growth and biomass. So the efficacy of herbicides is reduced and duration of weed crop competition is also increased. Chaudhary *et al.* (4) reported that when weeds were allowed to grow beyond 50 days after sowing of crop, a significant reduction in grain yield and yield attributes was noted. Moreover, most of the farmers do not

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have adequate spray machinery. Shad *et al.* (11) found that application of chlortoluron, MCPA, 2,4-D, isoproturon, pendimethalin and Bromoxynil + MCPA by sand and fertilizer mix broadcast methods was as effective as sprayer application to reduce weed density and biomass in wheat. Khan *et al.* (7) and Razzaq *et al.* (10) reported that Dicuran-MA was the most cost effective herbicide mixed in urea where *Phalaris minor* was a serious problem. Herbicide application by dusting proved to be as an efficient and more economical than spray application and gave maximum net benefit. Nazir *et al.* (9) obtained maximum wheat grain yield (4.17 t/ha) with chlortoluron + MCPA (1.2 kg a.i./ha) + 65-65 kg NP per hectare. Lal *et al.* (8) applied isoproturon powder mixed with soil 35 days after sowing. It was as effective as its spray application for weed control and grain yield was also significantly increased. Azad and Singh (3) advocated that when isoproturon mixed with 75 kg nitrogen per hectare gave significantly higher yield than other treatments. Tanveer *et al.* (13) evaluated different herbicides and found that these herbicides controlled 87.2 to 90.8 percent weeds in wheat and caused 10.29 to 15.98 percent increase in grain yield over weedy check. These herbicides when applied with 3 percent urea solution, gave 92.6 to 95 percent weed control and 19.24 to 25.74 percent increase in grain yield over weedy check. Idrees *et al.* (6) recorded 88.47 percent weed control and minimum weed biomass (7.35 g/m²) with Tribunil (2 kg/ha) + 0.2 percent surfactant. This treatment also gave maximum grain yield (5.56 t/ha), fertile tillers, grains per spike, 1000-grain weight and net benefit. Virender *et al.* (14), Hussain *et al.* (5) and Alvi *et al.* (2) compared different herbicides and observed that all herbicides decreased weed population and significantly increased the number of tillers per meter square, number of grains per spike, 1000-grain weight and grain yield in treated plots as compared to control. Ali *et al.* (1) found that all methods and times of application of isoproturon decreased *Phalaris minor* population significantly over weedy check. However, isoproturon mixed with urea and broadcast after first irrigation gave more yield (4796 kg/ha) with maximum benefit (Rs. 13777/ha) and CBR (1:8.83) as compared to control.

The present study was undertaken to determine the efficiency, economics and alternative method of herbicides application in wheat crop under rice-wheat cropping system of Gujranwala.

MATERIALS AND METHODS

This study was conducted at Adaptive Research Farm, Gujranwala, Pakistan during rabi 2004-05 to 2006-07. The experiment was laid out in RCBD with three replications, having plot size of 5 x 15 meter and row to row distance of 22.50 cm. Wheat variety Uqab-2000 (125 kg seed/ha) was sown during first

fortnight of November in each year. The herbicides were mixed with urea and broadcast just after first irrigation at 3-4 leaf stage and same herbicides were sprayed at 4-6 leaf stage of weeds in moist field after first irrigation with hand operated knapsack sprayer in a spray volume of 300 litre per hectare. All other practices were kept uniform. The detail of treatments is as under:-

Trade name of herbicide	Chemical name of herbicide	Dose (kg/ha)	Methods and time of herbicides application
Control (untreated plot)		-	-
Proton (50 WP)	Isoproturon	2	Sprayed in moist field after first irrigation.
Proton (50 WP)	Isoproturon	2	Broadcasted by mixing with urea just after first irrigation.
Affinity (50 WP)	Isoproturon + carfentrazone	2	Sprayed in moist field after first irrigation.
Affinity (50 WP)	Isoproturon + carfentrazone	2	Broadcasted by mixing with urea just after first irrigation.
Sencor (75 DF)	Metribuzin	0.25	Sprayed in moist field after first irrigation.
Sencor (75 DF)	Metribuzin	0.25	Broadcasted by mixing with urea just after first irrigation.

Data on weed population and fresh weight were taken from randomly selected three places with a quadrant measuring one square meter before herbicidal application. Weed biomass was taken at earing stage in control and dry weight was recorded after drying the samples in an oven at 70°C for 48-hours. Weeds mortality data were recorded after four weeks of herbicidal application. The data on yield and yield parameters were recorded at the time of harvesting. CBR was computed on the basis of prevailing rates of labour, herbicides and the produce. Data were analyzed statistically by using Fisher's analysis of variance technique and LSD test was applied at 5 percent probability level to compare treatment means (12).

RESULTS AND DISCUSSION

Weed density

All herbicides and methods of application provided good control of narrow and broad leaved weeds, causing significant reduction in their density as compared to control (Table 1). The highest mortality of grassy weeds i.e. 97.18, 96.15 and 95.25 percent was obtained when Affinity, Sencor and Proton were mixed with urea fertilizer and broadcast just after first irrigation, respectively whereas spray of these herbicides provided 95.01, 92.37 and 88.10 percent control of broad leaved weeds. Application of these herbicides

Table 1. Effect of different herbicides and application methods on mortality of weeds (pooled data of rabi 2004-05 to 2006-07).

Treatments	Narrow leaved weeds population/m ²			Broad leaved weeds population./m ²		
	Before spray	Four weeks after spray	Mortality of weeds (%)	Before spray	Four weeks after spray	Mortality of weeds (%)
Control	102.00	105.11a	-	29.56	29.33a	-
Proton sprayed in moist field after first irrigation	94.33	17.34b	81.62	28.00	3.33cd	88.10
Proton broadcasted by mixing with urea just after first irrigation	109.89	5.22c	95.25	32.11	8.6b	73.00
Affinity sprayed in moist field after first irrigation	100.56	13.33b	86.74	28.89	1.44d	95.01
Affinity broadcasted by mixing with urea just after first irrigation	102.44	2.89c	97.18	29.22	5.22bcd	82.13
Sencor sprayed in moist field after first irrigation	98.45	15.56b	84.20	27.67	2.11d	92.37
Sencor broadcasted by mixing with urea just after first irrigation	103.78	4.00c	96.15	30.44	7.56bc	75.16
LSD < 0.05	-	6.623	-	-	3.337	-

Means sharing the same letter do not differ significantly ($P < 0.05$) using LSD test.

in combination with urea fertilizer broadcast just after first irrigation gave significantly higher weed control due to less weed crop competition than spray of same herbicides. These results agree to the previous studies (1, 2, 5, 8, 11, 13, 14).

Fresh and dry weight of weeds

The data (Table 2) revealed that all treatments significantly produced lower fresh and dry weight of weeds as compared to control plot. Fresh weed biomass was recorded just before application of herbicides in all treated plots. However, in case of control weed biomass was taken at earing stage. Application of Sencor, Affinity and Proton when mixed with urea and applied just after first irrigation produced minimum dry weight of weeds (7.88, 7.92 and 10.83 g/m²) and these were significantly at par with each other. In case of spray of these weedicides, statistically higher dry weight of weeds (32.97, 28.75 and 31.70 g/m²) was noted which may be due to increase in weed crop competition. However, untreated plot gave the highest fresh (1261.70 g/m²) and dry weight of weeds (265.48 g/m²). Idress *et al.* (6) and Shad *et al.* (11) also reported similar results.

Yield attributes

All weed control treatments provided significantly higher number of tillers per meter square, number of grains per spike and 1000-grain weight as compared to control (Table 2). Maximum values of yield components were recorded in case of Affinity, Sencor and Proton when mixed with urea and broadcasted just after first irrigation as compared to their spray in moist field after first irrigation. The adverse effect might be due to the competitive stress for available resources to be shared by the crop and weeds. However, weedy check plot produced significantly minimum tillers, grains per spike and 1000-grain weight. Similar results have been reported earlier (1, 2, 5, 6, 7, 10, 14).

Table 2. Effect of different herbicides and application methods on weed growth, yield and yield components of wheat crop (pooled data of rabi 2004-05 to 2006-07).

Treatments	Fresh weight of weeds (g/m ²)	Dry weight of weeds (g/m ²)	No. of tillers/m ²	No. of grains/spike	1000-grain weight (g)	Yield (t/ha)
Control	1261.70a	265.48a	352.11c	42.80c	37.49c	2.91c
Proton sprayed in moist field after first irrigation	243.15b	31.70b	371.34b	45.21b	39.56b	3.86b
Proton broadcasted by mixing with urea just after first irrigation	56.83c	10.83c	391.55a	48.85a	41.31a	4.37a
Affinity sprayed in moist field after first irrigation	216.83b	28.75b	375.44b	46.04b	40.10b	4.04b
Affinity broadcasted by mixing with urea just after first irrigation	46.34c	7.92c	397.33a	49.83a	41.56a	4.53a
Sencor sprayed in moist field after first irrigation	279.99b	32.97b	371.89b	45.39b	39.86b	3.97b
Sencor broadcasted by mixing with urea just after first irrigation	46.25c	7.88c	394.22a	49.01a	71.19a	4.44a
LSD < 0.05	114.941	13..664	4.612	1.002	0.954	0.303

Grain yield

Wheat grain yield in treated plots was significantly higher than untreated one (Table 2). The highest yield was obtained from the plots treated with Affinity (4.53 t/ha), Sencor (4.44 t/ha) and Proton (4.37 t/ha) when mixed with urea fertilizer and broadcasted just after first irrigation with non-significant differences. However, spray of these herbicides gave statistically lower yield (4.04, 3.97 and 3.86 t/ha). Minimum yield (2.91 t/ha) was recorded from weedy check plot. Broadcasting of herbicides after mixing in urea fertilizer

just after first irrigation increased their efficiency and also grain yield which is attributed to decrease in duration of weed crop competition and reduced uptake of nutrients by weeds. These results confirm the findings of earlier workers (1, 2, 3, 5, 7, 8, 9, 10, 13, 14).

Economic analysis

The economic analysis showed that all herbicidal treatments proved economical as compared to control (Table 3). Affinity, Sencor and Proton when mixed in urea fertilizer and broadcasted just after first irrigation gave higher net return (Rs. 19358, 19274 and 17798/ha) with CBR of 1:12.90, 1:45.35 and 1:17.80, respectively. Spray of Sencor, Affinity and Proton gave less net return i.e. Rs. 13098, 12924 and 11106 per hectare with a CBR of 1:23.81, 1:7.95 and 1:9.87, respectively. CBR given by Sencor (1:45.35) was much higher than that of other herbicides, which was due to its lower cost and good weed control. CBR for these herbicides is comparable to those reported earlier (1, 2, 6, 7, 10).

Table 3. Economic analysis of different herbicides application methods for weed control in wheat crop (pooled data of rabi, 2004-05 to 2006-07) .

Treatments	Yield (t/ha)	Yield increased over check (t/ha)	*Additional income (Rs/ha)	Additional expenditure (Rs/ha)	Net income (Rs/ha)	Cost benefit ratio (CBR)
Control	2.91	-	-	-	-	-
Proton sprayed in moist field after first irrigation	3.86	0.95	12231	1125	11106	1: 9.87
Proton broadcasted by mixing with urea just after first irrigation	4.37	1.46	18798	1000	17798	1: 17.80
Affinity sprayed in moist field after first irrigation	4.04	1.13	14549	1625	12924	1: 7.95
Affinity broadcasted by mixing with urea just after first irrigation	4.53	1.62	20858	1500	19358	1: 12.90
Sencor sprayed in moist field after first irrigation	3.97	1.06	13648	550	13098	1: 23.81
Sencor broadcasted by mixing with urea just after first irrigation	4.44	1.53	19699	425	19274	1: 45.35

*Average rate of 3 years of wheat bhoosa @ Rs. 2550 per ton was also included in additional income.

CONCLUSION

Our findings lead to the conclusion that broadcasting of Affinity, Sencor and Proton after mixing with urea fertilizer and broadcasted just after first irrigation proved to be an efficient and more economical method of herbicide

application than spray and gave maximum net return under wheat-rice cropping system in Gujranwala.

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