

COMPARATIVE EFFICACY OF POST EMERGENCE HERBICIDES AGAINST BROAD LEAVED WEEDS IN WHEAT (*TRITICUM AESTIVUM* L.) UNDER RICE-WHEAT CROPPING SYSTEM

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ABSTRACT

A study was carried out at Adaptive Research Farm, Sheikhpura, Pakistan during the year 2008-09 to investigate the effect of various post emergence herbicides and/or hand hoeing treatment on broad leaved weeds in wheat. Layout system was randomized complete block design with three replications. Four post emergence herbicides such as Bromoxynil + MCPA (1250 ml/ha), Bromoxynil + MCPA (1850 ml/ha), Starane M (741 ml/ha) and Strive M (1482 ml/ha) were compared with two hand hoeings (after 1st and 2nd irrigation) and weedy check. The results revealed that application of Strive M herbicide resulted in the highest reduction of weed population (90.86%) and biomass (92.14%). It increased the tillers per unit area, spike length, grains per spike which ultimately enhanced 37.72 percent wheat grain yield over control.

KEYWORDS: *Triticum aestivum*; *Oryza sativa*; weeds; herbicides; agronomic characters; Pakistan.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important winter cereal crop of Pakistan. It was grown on an area of 8.414 million hectares with an annual production of 21.749 million tons and average yield of 2.585 tons per hectare (2). The per hectare wheat yield in rice-wheat cropping system is still very low as compared to potential yields of these areas. Among a number of factors responsible for this reduction, weed infestation is severe one (12). Weeds compete with wheat plants for radiation, water, nutrients and space, resulting in considerable reduction in crop yield. The critical period of weed-crop competition has been reported between 30-50 days after crop sowing (13, 18). Grain yield loss in wheat by weeds is estimated at 25-30 percent (6, 11, 12).

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Broad leaved weeds is a serious problem in many wheat growing areas in Pakistan where 84 percent wheat fields are being infested by weeds. In Pakistan, control of broad leaved weeds in winter wheat has been relied almost on herbicide application (8). Chaudhary *et al.* (5) reported that foliar spray of Affinity, Sencor and Proton herbicides mixed with urea fertilizer gave good control of broad leaved weeds in wheat. The availability of selective herbicides during the last 30 years has enabled farmers to successfully grow high-yielding wheat varieties to achieve optimal yields in weed-free conditions (14). Nonetheless, full-season control of broad leaved weeds is difficult to obtain. Some weeds are not controlled with the broad leaved herbicides because of herbicide resistance and a change in weed flora due to repeated application of these herbicides (20). Currently, broad leaved herbicides used in wheat in Pakistan include the post-emergence applications of tribenuron methyl, dichloprop-p plus, mecoprop-p plus MCPA and 2, 4-D plus MCPA, and some dual purpose herbicides such as sulfosulfuron, mesosulfuron plus idosulfuron, and imazamethabenz methyl (12). However, none of these options currently provide adequate full-season control of broad leaved weeds. It warrants the need to identify new winter post-emergence application herbicide options. Bromoxynil is often combined or tank mixed with MCPA and/or dicamba. Bromoxynil inhibits photosynthesis, respiration, and causes uncontrolled cell division and growth in sensitive weeds (10). Starane M and Strive M are among the new registered broad leaved herbicides. These herbicides provide much better control of a wide spectrum of annual, biennial, and perennial broad leaved weeds.

This study was conducted to evaluate the efficacy of prevailing and some new herbicides against broad leaved weeds for getting higher wheat yields under rice-wheat cropping system.

MATERIALS AND METHODS

This study was conducted at Adaptive Research Farm, Sheikhpura (31°N and 73.5°E), Pakistan during rabi 2008-09. The experiment was laid out in randomized complete block design with three replications in plots measuring 5 m x 10 m. The treatments comprised Bromoxynil + MCPA (1250 ml/ha) (T₁), Bromoxynil + MCPA (1850 ml/ha) (T₂), Starane M (741 ml/ha) (T₃), Strive M (1482 ml/ha) (T₄), two hand hoeings (after 1st and 2nd irrigation) (T₅) and weedy check as control (T₆). Wheat variety Seher-2006 was planted on November 14, 2008 using a seed rate of 100 kg per hectare with single row hand drill in 25 cm apart rows. The seedbed was prepared using a disk harrow followed by cultivation and smoothing with land leveler. Based on soil chemical analysis and recommendation of Soil and Water Testing

Laboratory, Sheikhpura fertilizers were applied @ 128 kg N, 114 kg P₂O₅ and 60 kg K₂O per hectare in the form of urea, diammonium phosphate (DAP) and sulphate of potash (SOP), respectively. The whole P, K and one third of N was applied at sowing and remaining two third of N was applied with first irrigation. Four irrigations excluding rauni were applied at crown root initiation, boot, anthesis and grain development stages. All other agronomic practices except those under study were kept normal and uniform for all the treatments. Weed flora appeared in the experimental field mainly comprised broad leaved weeds such as field bindweed (*Convolvulus arvensis* L.), creeping thistle (*Cirsium arvense* Scop.), lambsquarter (*Chenopodium album* L.), grass pea (*Lathyrus sativus* L.) and few plants of grassy weeds i.e. wild oat (*Avena fatua* L.) and canary grass (*Phalaris minor* Retz.). All weeds other than broad leaved emerged in the experimental plots were hand removed. All the herbicides were applied as post-emergence four weeks after sowing (WAS) using a Knapsack hand sprayer fitted with flat-fan nozzle in 300 litre per hectare spray volume.

Percent weed population reduction was measured separately for each weed species by counting the number of broad leaved weeds at 50 days after sowing within a fixed 1 m² quadrat in each plot. Then total weed density and weed biomass was calculated. All broad leaved weeds were cut at ground level, separated by species, and oven dried at 70°C for 72 hours and then their totals were calculated by adding all individual weed population and biomass. Wheat grain yield was measured at economic maturity. The crop was harvested on April, 23, 2009 and threshed mechanically with mini thresher. From each experimental unit, an area of one square meter was taken at random and observations on plant height, number of productive tillers per unit area, spike length, number of grains per spike, 1000-grain weight and grain yield were recorded by using standard procedures. Then the data were subjected to Fisher's analysis of variance technique and LSD test at 5 percent probability level was applied to compare the differences among treatments means using MSTAT-C statistical package (3, 19).

RESULTS AND DISCUSSION

Total weed density

All treatments significantly affected total weed density as compared with control (Table 1). Herbicide Strive M excelled in reducing total weed density (90.86%) as compared with control and was statistically at par with Bromoxynil + MCPA @ 1850 ml (84.57%), Starane M (82.87%) and hand hoeing (80.57%).

Table 1. Effect of various weedicides and hand weeding on total weed density and weed dry weight in wheat.

Treatments	Total weed density/m ²	Total weed dry weight (g/m ²)
T ₁ = Bromoxynil + MCPA @ 1250 ml/ha	12.00 b (-79.43)	16.89 b (-78.26)
T ₂ = Bromoxynil + MCPA @ 1850 ml/ha	9.00 bc (-84.57)	9.92 bc (-87.23)
T ₃ = Starane M @ 741 ml/ha	10.00 bc (-82.87)	12.99 bc (-83.29)
T ₄ = Strive M @ 1482 ml/ha	5.33 c (-90.86)	6.11 c (-92.14)
T ₅ = Hand hoeing (two)	11.33 bc (-80.57)	13.97 bc (-82.03)
T ₆ = Control (weedy check)	58.33 a (-)	77.72 a (-)
LSD _{0.05} P	6.19	10.59

Means within each column followed by same letter do not significantly differ at 0.05 probability level according to Fischer's protected LSD test. Figures in parenthesis indicate percent decrease over control.

Total weed dry weight (g/m²)

A significant difference among treatments was also observed for weed dry weight suppression as compared with control (Table 1). Strive M (T₄) resulted in the highest reduction in weed biomass (92.14%) over control. Other treatments i.e. T₂ (87.23%), T₃ (83.29%) and T₅ (82.03%) were statistically at par and comparable to one other. These results agree to those of Zand (21) who observed that Bromoxynil + MCPA was generally better in controlling broad leaved weeds than tribenuron methyl, 2,4-D + MCPA and dichloprop-p + mecoprop-p + MCPA.

Number of fertile tillers/m²

All treatments significantly affected the number of fertile tillers as compared with control (Table 2). Maximum fertile tillers (405.7/m²) were recorded in the plots treated with Strive M (T₄) followed by Bromoxynil + MCPA at 1850 ml (T₂) (364.7) and hand hoeing (T₅) (361.0). T₃ (Starane M) and T₁ (Bromoxynil + MCPA at 1250 ml) were also statistically at par with T₂ and T₄. So all herbicidal treatments and hand hoeing were statistically comparable with one another. Minimum number of fertile tillers (272/m²) was recorded in weedy control. Higher number of fertile tillers for different herbicidal treatments was due to better weed control of broad leaved weeds which reduced their competition with wheat crop. These results are in line with the findings of Cheema and Akhtar (7) who reported better control of weeds in wheat with herbicides and observed more number of tillers per unit area.

Table 2. Effect of various weedicides and hand weeding on yield and yield components of wheat.

Treatments	Tillers/m ²	Plant height (cm)	Spike length (cm)	Number of grains/spike	1000-grain weight (g)	Grain yield (kg/ha)
T ₁ = Bromoxynil + MCPA @ 1250 ml/ha	356.0 a +	103.0 a	9.2 d	40.5 cd	40.00 bc	3043 ab (15.72)
T ₂ = Bromoxynil + MCPA @ 1850 ml/ha	364.7 a	105.3 a	10.0 b	43.2 ab	43.33 a	3293 a (25.22)
T ₃ = Starane M @ 741 ml/ha	359.3 a	102.7 a	9.5 c	41.3 bc	42.33 ab	3230 a (22.81)
T ₄ = Strive M @ 1482 ml/ha	405.7 a	110.7 a	10.6 a	43.5 a	41.33 abc	3491a (37.72)
T ₅ = Hand hoeings (two)	361.0 a	106.0 a	9.9 b	43.0 abc	38.33 c	3130 ab (19.01)
T ₆ = Control (weedy check)	272.0 b	92.00 b	8.9 e	40.3 cd	34.00 d	2630 b (-)
LSD _{0.05} P	65.71	8.49	0.29	2.01	3.04	567.4

Means within each column followed by same letter do not significantly differ at 0.05 probability level according to Fischer's protected LSD test. Figures in parenthesis indicate percent increase over control.

Plant height (cm)

Plant height was also significantly affected by all treatments as compared with control (Table 2). The highest plant height (110.7 cm) was observed in T₄ (Strive M) followed by T₅ (hand hoeings) (106 cm). All treatments except control were statistically at par with one another. The shorter plants (92 cm) were observed in weedy check. The higher plant height could be attributed to better weed control in these plots as compared with control. Shah *et al.* (18) also reported higher plant height in chemical weed control method.

Spike length (cm)

All herbicides significantly affected the spike length as compared with control (Table 2). Strive M (T₄) statistically produced the highest spike length (10.6 cm) followed by T₂ i.e. Bromoxynil + MCPA @ 1850 ml (10 cm) and T₅ (hand hoeings) (9.9 cm) and these were statistically equal to each other. The highest spike length was attributed to better weed control in these treatments which reduced competition with wheat crop. In herbicidal treatments, the lowest spike length (9.2 cm) was observed in T₁ i.e. Bromoxynil + MCPA 1250 ml but it was significantly higher than control (T₆) (8.9 cm).

Number of grains per spike

Significantly more grains were also recorded in T₄ (Strive M) (43.5/spike) (Table 2), followed by T₂ (Bromoxynil + MCPA at 1850 ml) (43.2) and T₅ (hand hoeings) (43.0). These three treatments were statistically at par with one another while Bromoxynil + MCPA at 1250 ml (T₁) could not attain the level of significance over control. The lowest number of grains were obtained in weedy control (40.3) indicating severe weed competition which decreased number of grains per spike. Similar findings have been reported in previous studies (1, 7).

1000-grain weight (g)

This trait was also significantly affected by different treatments as compared with control (Table 2). Maximum 1000-grain weight (43.33 g) was found in T₂ followed by T₃ (42.33 g) and T₄ (41.33 g). However, these were statistically at par with each other. Minimum grain weight (34.0 g) was obtained in weedy check, which indicated that weed density depressed 1000-grain weight. Similar results have also been reported earlier (1, 7).

Grain yield (kg/ha)

All treatments significantly increased grain yield as compared with weedy control (Table 2). The increase was corresponding to weed control spectrum attained with the application of different treatments. Strive M produced maximum grain yield (3491 kg/ha) which was 37.72 percent higher than control (2630kg) and was followed by Bromoxynil + MCPA at 1850 ml (3293g), Starane M (3230 kg), hand hoeings (3130 kg), and Bromoxynil + MCPA at 1250 ml (3043 kg) with 25.22, 22.81, 19 and 15.72 percent increase over control. These results are in conformity with some earlier findings (1, 7, 15) where excellent weed control and 25 percent increase in grain yield was obtained with the application of herbicides.

CONCLUSION

It is concluded that post-emergence application of Strive M at 1482 ml per hectare can be adopted for effective control of broad leaved weeds to obtain higher wheat grain yield under semi arid irrigated conditions of Sheikhpura.

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