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Spectrum of Activity of Different Herbicides on Growth and Yield of Wheat (*Triticum aestivum*)

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ABSTRACT

Studies were carried out to evaluate the comparative efficacy of different herbicides in controlling weeds and improving growth and yield of wheat crop. Four herbicides, Alkanak 75.3 wp (Metsulfuron methyl + Isoproturon @1.5 a.i.; kg ha^{-1}), Affinity 50 wg (Carfentrazone ethyl + Isoproturon 1.25 a.i.; kg ha^{-1}), Logran 60 wg (Trisulfuron 0.25 a.i.; kg ha^{-1}) and Buctril-M 40 Ec (Bromoxinal + MCPA 1.25 a.i.; kg ha^{-1}) were used in wheat cv. Oqab-2000. The experiment was designed in randomized complete block design with four replications. All the herbicide treatments decreased the weeds and increased the wheat grain yield by increasing number of tillers per unit area, number of grains $spike^{-1}$ and thousand grains weight and harvest index. Growth parameters such as plant height and spike length were increased with herbicide application because of low competition between weeds and wheat plants for nutrients, light, space, water and also nutrient use efficiency of wheat plants. Alkanak gave maximum grain yield of 4067 Kg ha^{-1}.

Key Words*:* Wheat; Herbicides; Growth; Yield

INTRODUCTION

Weeds are hidden enemies of wheat and cause huge losses to crop yields which amounts to Rs. 115 to 200/- billion per annum (Atta & Khaliq, 2002). They deplete soil of its resources and harbor insects, pests and disease pathogens. Depending upon extent of weed infestation, these cause 18 to 30% loss in yield (Anonymous, 2000) and in more serious cases may lead to complete failure of crop (Gill & Wallia, 1979). It has been reported that crop yield may be increased by about 37% by complete eradication of weeds (Jallis & Shah, 1982). So, remedy of these enemies is of prime importance. Lehlee (*Convolvulus arvensis)*, bathoo (*Chenopodium album*), shahtra (*Fumaria indica*) and piazi (*Asphodelus tenuifolios*) were the most common weeds of pre green revolution period and dumbi sitti (*Phalaris minor*) and jangli jai (*Avena fatua*) came after green revolution and became major weeds constituting more than half of weed population of our wheat fields (Jallis, 1986).

Weed control at early tillering with Granstar (tribenuron) reduced weed density by 78 to 92%, increased grain yield up to 81% and reduced dry weight of weed seeds in grains by 90 to 99% (Aitounejjar & Tanji, 1997). Agrawal and Jair (1998) reported that population of *Medicago denticulata, Chenopodium album, Cyperus rotundus, Digitaria adscendens and D. ciliaris* was reduced significantly by Isoproturon applied post emergence @ 1.0 and 1.5 kg ha^{-1}. Tewari *et al.* (1998) checked the efficiency of Metsulfuron methyl on associated weeds in wheat and observed that Metsulfuron methyl at 4 g ha^{-1} provided 89.7 and 100% control to *C. album* and *A. arvensis*, respectively, and Isoproturon provided 70 and 100% control of *P. minor* and broad leaf weeds.

Kalsi *et al.* (1998) determined the efficiency of Sulfonyl-urea herbicides for the control of *Rumex spinosus.* All herbicidal treatments i.e., Tribenuron-methyl 20 g (a.i) ha^{-1}, Metsulfuron at 20 g (a.i) ha^{-1}, Isoproturon + Tribenuron at 0.5 + 10 g (a.i) ha^{-1}, Isoproturon + Metsulfuron at 0.5 + 10 g (a.i) ha^{-1} and Isoproturon + 2,4-D at 0.5 + 0.5 kg (a.i) ha^{-1} gave an excellent level of weed control and improved the grain yield. The highest crop yield was recorded for Isoproturon + Tribenuron (41.9%). Different concentrations and combinations of Isoproturon, Fluroxypyr and 2,4-D were used by Kotru *et al.* (1999). Post emergence application of Isoproturon + 2,4-D amine at 0.75 + 0.4 kg ha^{-1} was found to be the best treatment combination in reducing dry matter of weeds to 43.5 g m^{-2} and producing the greatest straw and grain yield.

Zewdie and Turner (1999) observed that treatment with Pendimethalin + Bromoxynil + MCPA (330+240+240 gl^{-1}) was very effective in controlling major grass weeds. Singh *et al.* (2000) used Isoproturon at 1.0 kg ha^{-1} (post emergence) and Pendimethalin at 1.0 kg ha^{-1} for dicotyledonous weeds (76%) and monocotyledonous weeds (22%). The experiments conducted by Kurchania *et al.* (2000) revealed that Metsulfuron methyl @ 2 and 4 g ha^{-1} was effective in controlling major grass weeds. The efficiency was improved with addition of 2,4-D and isoproturon. Although different reports are available on the efficacy of different herbicides in wheat (Tanveer *et al.*, 1999, Khan *et al.*, 1999; Khan *et al.*, 2001), the herbicide use in Pakistan is not widely practised as in agriculturally advanced nations. So, keeping in view, the importance of weed problem, present studies were under taken to select suitable herbicide is capable of controlling weeds and their effect on growth and yield of wheat.

MATERIALS AND METHODS

The study to evaluate the comparative efficacy of different herbicides in controlling weeds and its impact on different growth and yield parameters was carried out at University College of Agriculture, Bahauddin Zakariya. University, Multan, during rabi, 2001-2002. A commercial wheat variety "Oqab-2000" was used as a test crop and was sown on 10th of November with the help of a single row hand drill in 22.5 cm apart rows using a seed rate of 125 kg ha^{-1}. The recommended cultural practices were followed except different herbicidal treatments. Normally 250 L of water is used ha^{-1} for herbicide spray, then herbicide doses and water required was converted into net plot size and were sprayed with knap sack sprayer which were used after first irrigation at proper moisture conditions. The experimental treatments are shown in Table I.

Table I. Detail of herbicidal treatments on spectrum of activity of different herbicides on growth and yield of wheat

Treatments		
Trade name	**Common name**	**Dose (a. i.; kg ha^{-1})**
T_0 = control	----	---
T_1 = Alkanak 75.3wp	Metsulfuron methyl + Isoproturon	1.5
T_2 = Affiniuty 50 wg	Carfentrazone ethyl + Isoproturon	1.25
T_3 = Logran 60 wg	Trisulfuron	0.25
T_4 = Buctril-M 40 Ec	Bromoxinal + MCPA	1.25

The experiment was laid down in randomized complete block design (RCBD) with four replications using a net plot size of 2 m x 8 m. Total number of seedlings emerged in a randomly selected area of 1 m^2 were counted at completion of germination in each plot. Ten plants from each plot were randomly selected at maturity and their height was measured from base to top of spikes and their averages were calculated. Number of tillers was counted at harvest from a unit of 1 m^2 in each plot at random. Ten randomly taken spikes were threshed separately from each plot and numbers of grains were counted and average number of grains per spike was calculated. Thousand grains were obtained from each plot and weighed in grams. After crop harvest biological yield was taken and then by threshing grain yield and straw yield was taken and harvest index was calculated.

The data collected were analysed statistically by using Fisher's analysis of variance technique and least significant difference (LSD) test was used to test the level of significance among treatment means at 5% probability level (Hoshmand, 1994.)

RESULTS AND DISCUSSION

It is clear from the Table II that the maximum control of weeds was observed in Alkanak (85.5%) and Affinity (83.4%) against control; whereas, Logran and Buctril-M control 50 and 59.5%, respectively. This is due to the reason that Alkanak and Affinity controls both broad and narrow leaves weeds while Logran and Buctril-M are used to control broad leaves weeds only.

Table II. Density (m^{-2}) of weeds in wheat (45 days after spray)

Treatments	Herbicides	% increase in weed control over control treatment
T_0	Control	-
T_1	Alkanak	85.5
T_2	Affinity	83.4
T_3	Logran	50.0
T_4	Buctril-M	59.5

Germination mainly depends on seed viability and environmental factors. The data (Table III) indicates that germination for different treatments remained unaffected because conditions were equally suitable for all treatments. The number of tillers in the herbicide treatments significantly differed from control except T_3 (838.5) and T_4 (828.5). The maximum number of tillers m^{-2} (869.8) was recorded in the treatment where Alkanak was used @1.5

Table III. Spectrum of activity of different herbicides on growth and yield of wheat (*Triticum aestivum)*

Treatments	Germination Counts m^{-2}	No of Tillers m^{-2}	Plant height at maturity (cm)	No. of grains $spike^{-1}$	1000-grain Weight (g)	Biological Yield Kg ha^{-1}	Economic Yield Kg ha^{-1}	Straw yield Kg ha^{-1}	Harvest index (%)
To (no herbicide)	343.5ns	827.5^{c}	98.45^{b}	50.92^{c}	36.74^{c}	12710^{b}	2658^{e}	10090^{a}	20.91^{e}
T_1(Alkanak75.3WP)	338.5	869.8^{a}	100.3^{ab}	58.35^{a}	39.56^{a}	13460^{a}	4067^{a}	9267^{b}	30.21^{a}
T_2 (Affinity 50WG)	339.3	855.5^{ab}	100.1^{ab}	53.45^{abc}	38.89^{ab}	12630^{b}	3417^{b}	9208^{b}	27.05^{b}
T_3(Logran 60WG)	337.5	838.5^{bc}	100.4^{ab}	57.60^{ab}	38.21^{b}	11880^{c}	3173^{c}	8702^{b}	26.70^{c}
T_4(Buctril-M 40EC)	342.5	828.5^{c}	104.1^{a}	51.50^{bc}	38.42^{b}	12290^{bc}	2889^{d}	9403^{ab}	23.50^{d}

Means not sharing a letter differ significant at 0.05 probability level.

a.i.; kg ha^{-1}. The minimum number of tillers (827.5) was recorded in control treatment where no herbicide was applied. This was due to high infestation of weeds in those plots. The treatments T_3 and T_4 are broad leaves herbicides so narrow leave weeds were not controlled, hence influenced the tillering capacity from 869.8 to 827.5 because of varying intensities of weeds, different spacing and nutrients available to plants.

All herbicide treatments had significant effect on height of wheat plant. Maximum plant height (104.1 cm) was recorded in plots treated with Buctril-M; whereas, minimum in control where no herbicide was used to control weeds. This may be due to weed crop competition and the increase was statistically significant over all the other treatments. Maximum number of grains $spike^{-1}$ (58.35) was observed in plots treated with Alkanak as against the lowest in case of control that produced 50.92 grain $spike^{-1}$.

It is evident from Table III that application of Alkanak produced the highest 1000-grain weight (39.56 g) and control, treatment where no herbicide was used, produced lowest grain weight (36.74 g). It was the result of the weed control, which produced larger grain size, which resulted in higher grain weight. Maximum biological yield was recorded in treatment where Alkanak was used (13460 kg ha^{-1}) against the lowest yield in treatment where Logran was used (11880 kg ha^{-1}).

Data pertaining to economic yield revealed that there are significant differences among herbicide treatments .The highest yield of 4067 kg ha^{-1} was obtained when Alkanak was used and lowest in control treatment. Higher yield was attributed to less competition between weeds and wheat plants for various growth factors, which ultimately increased number of tillers, number of grains $spike^{-1}$ and 1000 grain weight. Tanveer *et al.* (1999), Khan *et al.* (1999) and Khan *et al.* (2001) also reported a significant increase in wheat grain yield due to varying herbicidal application.

Straw yield is also an important growth parameter. Statistically higher increase in straw yield (10090 kg ha^{-1}) over all the other treatments was recorded in control treatment because of presence of weeds (i.e., jangli jai and dumbi sitti) which are included in final straw yield and due to lodging low grain yield and higher straw yield ha^{-1}.

It is clear from the Table III that different harvest indices ranged from 30.21 to 20.91%. The maximum harvest index (30.21%) was observed in treatment where Alkanak (T_1) was used and the minimum (20.91%) in control treatment (T_0) where no herbicide was used. It was the ultimate result of maximum number of grains $spike^{-1}$, the highest 1000- grain weight and the highest yield.

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