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EFFECT OF HERBICIDES AND WHEAT POPULATION ON CONTROL OF WEEDS IN WHEAT

Shahida Bibi[1], Khan Bahadar Marwat[1], Gul Hassan[1] and Noor Maula Khan[2]

ABSTRACT

Field studies were undertaken at Agricultural Research Farm, NWFP Agriculture University Peshawar during 'Rabi' 2003-04 to investigate the effect of planting density and post-emergence herbicides on wheat. The experiment was laid out in Randomized Complete Block (RCB) design with split-plot arrangements. Four seeding rates viz., 100,120,140 and 160 kg ha^{-1} were assigned to main plots, whereas herbicides to the sub-plots. The herbicides were Topik 15WP (clodinafop-propargyl) @ 0.02, 2,4-D sodium salt 92%@ 0.90,Isoproturon 75EW 0.63, Puma super 75EW (fenoxaprop-p-ethyl)@ 0.75, Agritop (MCPA) 500GL^{-1}@ 0.43 and Affinity 50WDG (carfentrazone-ethyl ester)@ 0.35kg ha^{-1}. Hand weeding and weedy check were also included for comparison. Statistical analysis of the data showed that all the parameters were affected by different herbicides, while seed rates significantly affected the plant height at maturity. The interaction of seed rates with herbicides also showed significant effect on fresh weed biomass. Topik 15WP treated plots exhibited the best performance with minimum weeds density (74.75m^{-2}) and weed fresh biomass (1875kg ha^{-1}) as compared to weedy check (387.3 m^{-2} and 5313 kg ha^{-1}). Maximum grain yield (3656 kg ha^{-1}), number of tillers (215.6 m^{-2}) and plant height (56.53 cm) at maturity were recorded in Topik 15WP. Affinity closely followed the Topik in the studied parameters. Thus Topik 15WP and Affinity 15WDG are recommended for controlling weeds in wheat.

Key word: wheat seed rates, herbicides and hand weeding.

INTRODUCTION

Wheat is a staple food used to make flour for '*roati*', '*nans*', bread, cookies and pasta and other products. It is the cheapest source

[1] Department of Weed Science, NWFP Agricultural University Peshawar 25130, Pakistan E-mail:kbmarwat@yahoo.com.
[2] Department of Extension Education & Communication, NWFP Agricultural University Peshawar 25130 Pakistan.

and supplies of the calories and protein in the average diet (Heyne, 1987). In Pakistan during 2006-2007, area under wheat was 8.578 million ha with grain production of 23.947 million tons. In the same year, the total area in NWFP under wheat crop was 0.754 million ha with grain production of 1.160 million tons (Anonymous, 2006). A better progress has been made in the development of wheat varieties, but still Pakistan has lower yield as compared to other advanced wheat growing countries of the world.

Yield reducing factors among others; include disease, insect and weeds. The presence of weeds in a crop can adversely affect production in a number of ways. Weeds compete with crop plants for light, moisture, nutrients and space. Weeds also increase harvesting costs, reduce quality of product, and increase fire hazards (Arnon, 1972). Wheat yield losses due to weeds amount to be more that 28 billion at national level and 2 billions in NWFP (Hassan and Marwat, 2001). In order to increase wheat yields it is important to manage weeds, which resulted higher yield in wheat crop (Khan *et al*., 2003). Bhan *et al.* (1987) concluded that increasing seedling rate from 100 to 150 kg ha^{-1} significantly reduced the dry matter of weeds and increased grain yield of wheat. Nazir *et al*. (1987) showed that 100 kg ha^{-1} was the most effective in producing taller plants and higher yield as compared to low seedling rate. Mennan and Zandstra (2005) reported that decreasing the seeding rate from 250-200 kg ha^{-1} decreased wheat yield in the presence of weed.

Chemical and hand weeding have often been used as a weed control in wheat. Ahmad *et al*. (1993) observed that herbicides application and hand weeding decreased dry weight of weeds significantly compared to dry weight in non treated plots. Chemical weed control in wheat was best in producing higher grain yield than hand weeding. Akhtar *et al*. (1991) found that application of grassy and broad leaf herbicides increased grain yield and yield components.

In view of the importance of the problem of weeds in wheat crop, the experiment was designed to study the effect of different herbicides and seed rates for effective control of weeds in wheat.

MATERIALS AND METHODS

The experiment was conducted at Malakandher Research Farm, N.W.F.P. Agricultural University, Peshawar during Rabi Season 2003-2004 RCB design with split plot arrangement. In each replication, there were four main plots. Each main plot was consist of

eight sub-plots. The size of sub–plot was 4 x 1.5m^2. Row to row distance was kept at 25 cm apart. The seed rates were kept in main plots while herbicides, hand weeding and weedy check were assigned to sub-plots. All the herbicides were applied as post emergence. The seed of 'Ghaznavi-98' variety was sown on 19th November 2003 at the rate of 100, 120, 140 and 160 kg ha^{-1} with the help of hand hoe. Herbicides were applied with the help of Knapsacks sprayer thirty-five days after sowing. To spray the herbicides successfully all the precautionary measures were adopted so as to avoid any danger by misuse of the herbicides. The data were recorded on the following parameters. Weed densitym^{-2} 25 days after herbicides application, weed density m^{-2} 45 days after herbicides, weed fresh bio-mass before harvesting, number of tiller m^{-2}, plant height at maturity (cm) and grain yield kg ha^{-1}.

The detail of the treatments is as under:

Herbicides (Trade name)	**Common name**	**Rate (kg a.i.ha^{-1})**
Topik 15 WP	clodinafop-propargyl	0.04
2,4-D Sodium salt 92%	2,4-D	0.90
Puma super 75EW	fenoxaprop-p-ethyl	0.75
Isoproturon 75WP	isoproturon	0.63
Agritop 500G/L	MCPA	0.43
Affinity 50WDG	carfentrazon–ethyl ester	0.35
Hand weeding	-----	----
Weedy check	-----	----

RESULTS AND DISCUSSION

Weeds density m^{-2} 25 days after herbicidal application

Statistical analysis of the data regarding weeds density m^{-2}, 25 days after application of herbicides revealed that there was significant effect of different herbicides on weed density m^{-2} whereas the seed rates and their interaction with herbicides was non-significant (Table-1). Minimum weeds density (157.8 m^{-2}) was recorded in Topik treated plots. While maximum (352.0) weeds density was recorded in weedy check followed by Agritop and 2, 4-D. Among the seed rates, the highest weed density m^{-2} (198.65) was recorded in 120 kg ha^{-1}, which was closely followed by 160 (197.06 kg ha^{-1}) seed rate. The interaction of herbicides with seed rates was non-significant. For controlling weeds, Topik and Affinity showed prominent results by decreasing weeds density m^{-2} when applied at post-emergence stage of wheat crop. The least density of weeds in Topik and Affinity treated plots exhibits the preponderances of grasses in the

experiment. It is further evident from the data that relatively higher density of weeds m^{-2} was noticed in 2,4-D and Agritop. These findings have a sufficient support from the previous work of Punia *et al*. (1996), who concluded in their studies that different herbicides lowered weed density.

Table-1. Weed density m^{-2} 25 days after herbicidal application.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	227	232	242	252	238.4 b*
Puma super 75EW	187	194	187	185	188.3 d
Topik 15WP	153	166	158	154	157.8 e
Isoproturon 75WP	215	230	205	208	214.7 c
Agritop 500G/L	216	230	228	236	227.5 b
Affinity 50WDG	171	182	192	182	181.8 d
Hand weeding	0.0	0.0	0.0	0.0	0.0 f
Weedy check	348	355	347	358	352.0 a
Seed rate means	189.65	198.65	194.87	197.06	

$LSD_{0.05}$ for herbicides = 12.58

* Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

Weeds density m^{-2} 45 days after herbicidal application

Effect of herbicides was significant, whereas the effect of seed rate and seed rate by herbicide interaction was not significant (Table- 2).

Minimum weeds density m^{-2} (74.75) was recorded in Topik treated plots followed by Puma super (91.25) and Affinity (91.50) whereas maximum (387.3) weeds density m^{-2} was recorded in weedy check plots. The data exhibits that these herbicides were persistent enough to suppress weeds up to 45 days after treatment and perhaps beyond that. Thus, the lack of competition with weeds enabled wheat to close its canopy and dominate weeds throughout the growing season. The results of lsoproturon, Agritop and 2, 4-D were statistically comparable to one another. These results are in line with those of Salarzai *et al*. (1999) and Nati (1994) who concluded that herbicides significantly affected the weed population per unit area.

Table-2. Weed density m^{-2} 45 days after herbicidal application.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	167	174	172	172	171.2b*
Puma super 75EW	100	196	85	84	91.25e
Topik 15WP	75	96	74	83	74.75f
Isoproturon 75WP	137	138	141	137	138.3d
Agritop 500G/L	155	156	146	143	150.0c
Affinity 50WDG	186	90	95	95	91.50e
Hand weeding	0.0	0.0	0.0	0.0	0.0
Weedy check	379	390	390	390	387.3a
Seed rate means	137	138	137	138	

$LSD_{0.05}$ for herbicides = 10.39*

*Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

Fresh weed biomass (kg ha^{-1}) before harvesting

The effect of seed rates, herbicides and their interaction was significant on fresh weed biomass (Table-3). Maximum fresh weed biomass (5313 kg ha^{-1}) was recorded in the weedy check, while minimum fresh weed biomass (1875 and 1938 kg ha^{-1}) was recorded in the Affinity and Topik, respectively. Among the seed rates the highest weed fresh biomass (3093.75 kg ha^{-1}) was recorded in 160 kg ha^{-1}, which were closely followed by 120, and 140 kg ha^{-1}, (3015.62, 2953.12), respectively. The maximum fresh weed biomass (6125.0 kg ha^{-1}) was recorded in 120 kg ha^{-1} seed rate in weedy check interaction. While the minimum fresh weed biomass (1375 kg ha^{-1}) was recorded in 120 kg ha^{-1} seed rate treated with Topik. Analogous results were reported by Shahid (1994) and Tunio *et al.* (2004). They reported that herbicides application decreased the fresh weed biomass as compared to weedy check.

Table- 3. Weed fresh biomass (kg ha^{-1}) before harvesting.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	2875	4875	4375	3875	4000 b*
Puma super 75EW	2375	2625	3500	3250	2938 c
Topik 15WP	1875	1375	2000	2500	1938 d
Isoproturon 75WP	3375	3000	3875	4250	3625 b
Agritop 500G/L	3625	3750	3375	3625	3594 b
Affinity 50WDG	1625	2375	1625	1875	1875 d
Hand weeding	0.0	0.0	0.0	0.0	0.0 e
Weedy check	4875	6125	4875	5375	5313 a
Seed rate means	2578.12	3015.62	2953.12	3093.75	

$LSD_{0.05}$ for herbicides = 481.1, $LSD_{0.05}$ for interaction = 1407

*Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

Number of tillers m^{-2}

Statistical analysis of the data showed that the numbers of tillers m^{-2} were significantly affected by different herbicidal treatments while the seed rates and interaction of herbicides with the seed rates were non-significant (Table-4). Maximum (215.6) tillers m^{-2} were recorded in Topik treated plots followed by Affinity, having (213.0) tillers m^{-2}. The minimum (152.0) tillers m^{-2} was recorded in weedy check plots. Other herbicides like Agritop, Isoproturon and 2,4-D having the values (175.2, 173.1 and 170.9) were intermediate in tillers production. The grasses escaped from their phytotoxicity and were competitive with wheat resulting in lesser tillers. Among the seed rates the highest number of tillers (194.95) m^{-2} were recorded in 160 kg ha^{-1}, but it failed to surpass the other seed rates. Baldha *et al*. (1998) and Sohail *et al.* (1993) also reported similar results. They communicated that application of herbicides significantly influenced the number of tillers m^{-2}.

Table-4. Effect of seed rates and herbicides on tillers m^{-2}.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	180.00	159.75	168.50	175.25	170.9 d*
Puma super 75EW	188.25	177.25	190.75	197.75	188.5 c
Topik 15WP	216.75	211.25	213.50	221.00	215.6 a
Isoproturon 75WP	183.75	158.25	162.00	196.75	175.2 d
Agritop 500G/L	173.75	170.75	173.50	174.25	173.1 d
Affinity 50WDG	216.50	209.25	209.50	216.75	213.0 ab
Hand weeding	208.75	196.25	205.75	211.25	205.5 b
Weedy check	157.75	142.25	145.00	166.75	152.9 e
Seed rate means	190.68	178.12	183.56	194.95	

$LSD_{0.05}$ for herbicides = 8.311

*Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

Plant height (cm)

Analysis of data showed that differences among the seed rates and herbicides were statistically significant while the interaction of herbicides with seed rates was non-significant (Table-5).

Maximum plant height (64.47 cm) was recorded in the weedy check, while minimum plant height (52.76 cm) was recorded in hand weeding. The tallest plants in the weedy check and the shortest in hand weeding signify the competition of weeds. In weedy check the wheat crop invested photosynthate in attaining the

vegetative superiority by shading weeds. The tallest plants (59.75 cm) were recorded in 120 kg ha^{-1} seed rate which were however closely followed by 100, and 160 kg ha^{-1} (59.45, 59.27). These findings are in conformity with the work reported by Ahmad *et al*. (1993) and Khalil *et al.* (2000), who concluded that plant height is strongly under genetic control and not affected by herbicides application.

Table-5. Effect of seed rates and herbicides on plant height of wheat.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	61.750	60.275	60.050	61.100	60.79 c*
Puma super 75EW	57.550	58.325	57.725	59.250	58.21 d
Topik 15WP	59.175	57.950	54.250	54.750	56.53 e
Isoproturon 75WP	62.625	63.300	61.900	63.225	62.76 b
Agritop 500G/L	61.350	61.900	61.325	61.775	61.59 bc
Affinity 50WDG	57.625	57.250	55.600	57.200	56.27 de
Hand weeding	51.150	54.075	52.125	51.725	52.27 f
Weedy check	64.225	64.925	63.600	65.150	64.47 a
Seed rate means	59.43a	59.75a	58.32b	59.27 ab	

$LSD_{0.05}$ for herbicides = 1.353
$LSD_{0.05}$ for seed rates = 1.016
*Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

Grain yield (kg ha^{-1})

The analysis of the data showed that grain yield was significantly affected by different herbicides and seed rates, while the interaction of seed rates with herbicides were non-significant statistically (Table-6).

Different herbicidal treatments had significant effect on grain yield of wheat. Maximum (3656 kg ha^{-1}) grain yield was recorded in Topik and Affinity (3469 kg ha^{-1}) treated plots closed followed by Hand weeding (3188). Minimum (1375 kg ha^{-1}) grain yield was recorded in weedy check. The yield of Isoproturon, 2,4-D and Agritop, were statistically comparable to one another. Among the seed rates the maximum grain yield (2796.87) was recorded in 140 kg ha^{-1} seed rate, which was closely followed by (2765.62) in 160 kg ha^{-1} seed rates, while lowest grain yield (2421.87) was recorded in 120 kg ha^{-1}. Increased in yield in herbicides treated plots were due to the efficient weed control and thus the crop utilized all the available resources. These results are in conformity with the work of Tanveer *et al*. (1993), Hassan *et al.* (2003) and Tunio *et al.* (2004). They

reported that herbicidal treatments significantly increased grain yield in wheat.

Table 6. Effect of seed rates and herbicides on grain yield (kg ha^{-1}) of wheat.

Treatments	Seed rates (kg ha^{-1})				Means
	100	120	140	160	
2,4-D Sodium salt 92%	1875	2000	2250	2375	2125 d *
Puma super 75EW	2625	2500	3000	2750	2719 c
Topik 15WP	3625	3625	3750	3625	3656 a
Isoproturon 75EW	1875	1750	2250	2375	2063 d
Agritop 500G/L	2125	2125	2500	2250	2250 d
Affinity 50WDG	3000	3250	3750	3875	3469 a
Hand weeding	3125	2875	3375	3375	3188 b
Weedy check	1250	1225	1500	1500	1375 e
Seed rate means	2437.50bc	2421.87c	2796.87a	2765.62ab	

$LSD_{0.05}$ for herbicides = 216.9
$LSD_{0.05}$ for seed rates = 334.2
*Means sharing a letter in common in the respective category do not differ significantly using LSD Test at alpha 0.05.

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