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INTEGRATED WEED MANAGEMENT THROUGH HERBICIDES AND DIFFERENT SEED RATES IN WHEAT-II

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ABSTRACT

To investigate the effect of herbicides and planting densities on weed management in wheat, field experiment was conducted at NWFP Agricultural University Peshawar during crop season 2003-04. The experiment was laid out in a randomized complete block design with split-plot arrangement. Four seeding rates viz. 100,120,140 and 160 kg ha^{-1} were assigned to main plots, while kept into the sub-plots were six herbicides Topik 15WP (clodinafop-propargyl), 2,4-D sodium salt, Isoproturon 75WP (isoproturon), Puma super 75EW (fenoxaprop-p-ethyl), Agritop 500 GL^{-1}(MCPA) and Affinity 50WDG (isoproturon + carfentrazone-ethyl ester) alongwith hand weeding and weedy check. Data were recorded on fresh weed biomass (kg ha^{-1}), spike length (cm), spikelets spike^{-1}, No. of grains spike^{-1} and grain yield kg ha^{-1}. Analysis of the data revealed that all the herbicides had highly significant effect ($p \leq 0.01$) on the mean performance for all the traits. Seed rates significantly affected the spike length and grain yield, while for interaction of herbicides with seed rates, manifested significant effect on fresh weed biomass and grains spike^{-1}. Maximum spike length (9.40 cm), spikelets spike^{-1} (19.48), grains spike^{-1} (58.97) and grain yield (3656 kg ha^{-1}) were recorded in Topik 15WP treated plots by having effective weed control. Affinity 50WDG and Topik 15WP possessed the minimum and statistically at par fresh weed biomass of 1875 and 1938 kg ha^{-1} as compared to weedy check (5313 kg ha^{-1}), respectively. Affinity 50 WDG closely followed the Topik 15WP in performance.

Key Words: Chemical weed control, seeding density, hand weeding, weedy check.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is foremost among cereals and indeed among all crops, as direct source of food for human beings. On world basis, wheat ranks second after rice by providing protein and caloric requirements to one third of the world population. Wheat is the main staple food of 135 million Pakistani's. It is the cheapest source and supplying 72 percent of the calories and protein in the average diet (Heyne 1987). In Pakistan, during 2003-04, the area under wheat crop was 8.034 million ha^{-1} with grain production of 19.2 million tons, while in NWFP the wheat crop area was on 0.732 million ha^{-1} with grain production of 1.064 million tons (Anonymous, 2003). Due to development of the different wheat cultivars, the per unit yield of wheat is increased in the country during the last five years, but still our yield is low as compared to other advanced wheat growing countries.

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Many factors affecting the wheat yield but one of the most serious but less noticeable cause of low yield is weed infestation. Weeds are one of the major problems in crop production. They compete with crop plants for moisture, nutrients, light and space. Weeds may encourage the development of diseases; provide shelter and acts as an alternate host for pests. Arnon (1972) reported that weeds also increase harvesting costs, deteriorate the quality of product, clog waterways and increase fire hazards. Weeds reduced the wheat yield from 9.50 to 16.03% depending on the intensity of weeds (Young *et al.* 1978). It is therefore, essential to control the weeds in order to obtain maximum yield of wheat having good quality. In NWFP wheat crop is severely infested by *Avena fatua*, *Phalaris minor*, *Convolvulus arvensus*, *Carthamus oxyacantha*, *Cirsium arvense*, *Galium aparine* and *Fumaria indica* (Hassan et al. 2003). Management of weeds has been practiced from time immemorial by manual labor or animal drawn implements. The manual weed control is time consuming, laborious and expensive due to high cost of labour, which increases the interest in chemical control (Iqbal, 1994). But the exclusive reliance on herbicides and their non-judicious use results in pollution of the environment, inter- and intra-specific shifts of weed flora rather than benefit to the crop productivity. The choice of best herbicide, proper time of application and proper dosage are important considerations for lucrative returns from chemical control of weeds.

The increased yield can be achieved by adopting advanced cultural practices like certified seed use of improved varieties, proper and timely application of irrigation, fertilizers, herbicides and better crop management. To keep pace with the high growth rate of population in the country (*ca.* 2.2%) and in addition, a burden of 2.5 million afghan refugees, serious attention should be paid to achieve higher wheat yield. Increased wheat production will help to get rid of future wheat import and it could be a possible source to earn foreign exchange through its export to our neighboring countries. Therefore, there is a dire need to collect and formulate information on different weed control measures to properly address the weed problem in wheat crop and to develop a package of weed control technology for the wheat growers. In order to investigate the different weed control measures in wheat, an experiment was designed to study the impact of different herbicides and crop densities in controlling weeds in wheat crop.

MATERIALS AND METHODS

The experiment was laid out in randomized complete block design with split plot arrangement at NWFP Agricultural University, Peshawar. Wheat cultivar Ghaznavi-98 was sown on 19th November, 2003. The experiment having four replications and each replication was comprised of four main plots having four different seed rates 100, 120, 140 and 160 kg ha^{-1} and each main plot consisted of eight sub-plots having six herbicides, hand weeding and weedy check (Table-1). Row to row distance was kept 25 cm apart, while sub–plot size was kept at 4x1.5 m^2. All the herbicides were applied as post emergence with the help of a knapsack sprayer 35 days after sowing. All the precautionary measures were adopted to have an effective and even spray of herbicides. Data were recorded on fresh weed biomass (kg ha^{-1}), spike length (cm) spikelets spike^{-1}, grains spike^{-1} and grain yield ha^{-1}. All the data were subjected to analysis of variance (ANOVA) and LSD through MSTATC computer programme as outlined by Steel and Torrie (1980).

Table-1. Detail of the different treatments used in wheat crop during 2003-04.

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
Afinity 50WDG	isoprturon + carfentrazone–ethyl ester	0.35
Hand weeding	-	-
Weedy check	-	-

RESULTS AND DISCUSSION

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

Analysis of the data revealed that herbicides showed highly significant ($p \leq 0.01$), while their interaction with seed rates showed significant ($p \leq 0.05$) differences for fresh weed biomass. However, the seed rates were having non-significant effect on the mean performance. It is evident from the data in Table-2 that the zero fresh weed biomass was recorded in manual hand weeding. Over average, the minimum and statistically at par fresh weed biomass (1875 and 1938 kg ha^{-1}) was noted in the Affinity 50 WDG and Topik 15WP, respectively due to their effective weed control. These were followed by Puma super 75EW by having 2938 kg ha^{-1} fresh weed biomass. Maximum fresh weed biomass (5313 kg ha^{-1}) was recorded in the weedy check plot. The seed rates were having non-significant effect; however, the lowest numerical fresh weed biomass was recorded in seed rate of 100 kg ha^{-1}, while the highest value (3093.75 kg ha^{-1}) was recorded in seed rate of 160 kg ha^{-1}. In interaction of herbicides with seed rates, the zero fresh weed biomass was recorded in hand weeding with all seed rates due to manual weed control. Among the herbicides over seed rates, the lowest fresh weed biomass was recorded in Topik 15WP when seeded with 120 kg ha^{-1}. It was statistically at par with Affinity 50 WDG with 100 (1625 kg), 140 (1625 kg) and 160 kg ha^{-1} (1875 kg) seed rates and TopiK 15WP (1875 kg^{-1}) with 100 kg seed rate ha^{-1}. The maximum fresh weed biomass (6125.0 kg ha^{-1}) was recorded in 120 kg ha^{-1} seed rate in weedy check plot. It was also found statistically at par with fresh weed biomass of 5375 kg ha^{-1} given by weedy check with seed rate of 160 kg ha^{-1}. Analogous results were reported by Borghain *et al.* (1985), Punia et al. (1996), Shahid (1994), Khan *et al.* (2002) and Tunio *et al.* (2004) and reported that herbicides application decreased the fresh weed biomass as compared to weedy check and significantly reduced the weed density.

Table-2. Effect of herbicides and seed rates on fresh weed biomass (kg ha^{-1}) of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	120	140	160	
2,4-D Sodium salt 9%	2875 g-k	4875 bc	4375 cd	3875 def	4000 b*
Puma super 75EW	2375 g-m	2625 h-l	3500 d-h	3250 f-j	2938 c
Topik 15WP	1875 lmn	1375 n	2000 k-n	2500 i-m	1938 d
Isoproturon 75WP	3375 e-i	3000 f-j	3875 def	4250 cde	3625 b
Agritop 500G/L	3625 d-j	3750 d-g	3375 e-i	3625 d-g	3594 b
Affinity 50WDG	1625 mn	2375 j-m	1625 mn	1875 lmn	1875 d
Hand weeding	0.00 o	0.00 o	0.00 o	0.00 o	0.0 e
Weedy check	4875 bc	6125 a	4875 bc	5375 ab	5313 a
Seed rate means	2578.125	3015.625	2953.125	3093.750	

$LSD_{0.05}$ for herbicides = 481.1 $LSD_{0.05}$ for interaction = 962.30

* Means followed by a common letter in the respective category do not differ significantly by $LSD_{0.05}$

Spike length (cm)

The data revealed that the herbicides were having highly significant ($p \leq 0.01$) differences, while seed rates significantly ($p \leq 0.05$) affected the mean values for spike length. The interaction of herbicides with seed rates showed non-significant variation. Results further manifested that the highest and statistically at par spike length was recorded in Topik 15WP and Affinity 50WDG measuring 9.31 and 9.40 cm, respectively (Table-3). These were closely followed by hand weeding with spike length of 8.87 cm. The minimum spike length (6.94 cm) was recorded in weedy check plots. The other three herbicides like Puma super, Isoproturon 50WDG and Agritop 500G/L were having at par values ranging from 7.94 to 8.20 cm. Among the seed rates, the higher and statistically at par spike length of 8.58 and 8.53 cm was obtained in 140 and 160 kg ha^{-1}, respectively. While the lower and statistically at par spike length was found in seed rates of 100 and 140 kg ha^{-1} having 7.98 to 8.04 cm spike length, respectively (Table-3). For the interaction of seed rates with the herbicides, the differences although were non-significant, however, the maximum spike length (9.625 cm) was recorded in 140 kg ha^{-1} seed rate treated with Affinity 50WDG herbicide. It was followed by the spike length of crop treated with Topik 15 WP measuring 9.55 to 9.52 cm with seed rates of 140 and 160 kg ha^{-1}, respectively. The minimum spike length (6.450 cm) was recorded in 100 kg ha^{-1} seed rate in weedy check. These results are in accordance with the findings of Ahmed et al. (1999) who reported that spike length is significantly affected by herbicides.

Table-3. Effect of herbicides and seed rates on spike length (cm) of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	120	140	160	
2,4-D Sodium salt 92%	6.850	7.375	7.675	7.950	7.46 d *
Puma super 75EW	7.975	8.250	8.325	8.275	8.20 c
Topik 15WP	9.275	9.250	9.550	9.525	9.40 a
Isoproturon 75WP	7.775	7.825	8.400	8.425	8.10 c
Agritop 500G/L	7.40	7.575	8.350	8.450	7.94 c
Affinity 50WDG	9.350	9.000	9.625	9.300	9.31 a
Hand weeding	8.800	8.400	9.200	9.100	8.87 b
Weedy check	6.450	6.650	7.500	7.175	6.94 e
Seed rate means (cm)	7.984 b	8.041b	8.578 a	8.525 a	

$LSD_{0.05}$ for herbicides = 0.2786, $LSD_{0.05}$ for seed rates = 0.3987

* Means followed by a common letter in the respective category do not differ significantly by $LSD_{0.05}$

Spikelets spike^{-1}

Analysis of the data revealed that the herbicides showed highly significant mean differences ($p \leq 0.01$). However, the means governed by seed rates and their interaction with herbicides were non-significant. It is evident from the data in Table-4 that over average, the plots treated with Topik 15WP and Affinity 50WDG produced 19.48 and 18.99 spikelets spike^{-1}, which were the highest and statistically at par. These were followed by hand weeding with 18.43 spikelets per spike. The minimum spikelets spike^{-1} (15.37) were recorded in weedy check due to higher weed competition. In case of seed rates, although non-significant, however, the highest numerical value of spikelets spike^{-1} (17.794) was recorded in 160 kg ha^{-1} seed rate that was closely followed by seed rates of 140 and 100 kg ha^{-1} (Table-4). The interaction of herbicides with seed rates though non-significant revealed that the maximum spikelets spike^{-1} (19.825) was obtained in the plots seeded @ 160 kg ha^{-1} and treated with Topik 15WP. The least spikelets spike^{-1} (15.00) were recorded in 140 kg ha^{-1} seed rate under weedy check. Khan *et al.* (1999) and Khan et al. (2001) also reported that several yield components including spikelets spike^{-1} were significantly affected with the use of herbicides.

Table-4. Effect of herbicides and seed rates on spikelets spike^{-1} of wheat during 2003-04.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	120	140	160	
2,4-D Sodium salt 92%	16.95	17.00	17.18	16.88	17.0d*
Puma super 75EW	17.88	17.38	17.90	18.10	17.81c
Topik 15WP	19.25	19.35	19.48	19.83	19.48a
Isoproturon 75WP	16.10	15.68	16.75	16.65	16.29e
Agritop 500G/L	16.93	16.43	16.98	16.98	16.83d
Affinity 50WDG	19.13	18.48	19.18	19.20	18.99a
Hand weeding	18.18	18.20	18.68	18.68	18.43b
Weedy check	15.45	14.98	15.00	16.05	15.37f
Seed rate means	17.48	17.18	17.64	17.79	

$LSD_{0.05}$ for herbicides = 0.482

* Means followed by a common letter in the respective column do not differ significantly by $LSD_{0.05}$

Noumber of Grains spike^{-1}

In case of grains spike^{-1}, highly significant differences ($p \leq 0.01$) were evidenced in herbicides and their interaction with seed rates, while the differences among the seed rates means were non-significant statistically. Grains spike^{-1} showed that herbicides over average had significant effect on No. of grains spike^{-1} (Table-5). Maximum grains spike^{-1} (58.97) were recorded in Topik 15WP. It was followed by Affinity 50WDG with 55.59 grains spike^{-1}. The herbicides 2, 4-D, Isoproturon 75WP and Agritop 500G/L produced comparable grains spike^{-1} i.e. 42.66, 41.33 and 40.13, respectively. Minimum grains spikes^{-1} (34.35) were recorded in weedy check plots. Among the seed rates, the highest grains spike^{-1} (47.57) were recorded in 140 kg ha^{-1}, which was closely followed by seed rate of 160 kg ha^{-1} (47.10). For the interaction of seed rates with the herbicides, the maximum grains spike^{-1} (85.32) were recorded in 140 kg ha^{-1} seed rate treated with Topik 15WP. It was followed by Isoproturon 75 WP with 140 kg ha^{-1} seed rates and Topik seeded with 160 kg ha^{-1} with 74.05 and 60.12 grains spike^{-1}, respectively. The minimum grains and statistically at par grains spike^{-1} (30.60 and 31.00) were recorded in 120 and 100 kg ha^{-1} seed rate under weedy check (Table-5). The reason of increased number of grains spikes^{-1} is attributed to the effective weed control in those treatments and the wheat crop efficiently utilized all the available resources. Khan *et al.* (1999), Khan et al. (2002) and Khan et al. (2003) also reported that herbicidal applications significantly increased the grains spike^{-1}.

Table-5. Effect of herbicides and seed rates on grains spike^{-1} of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means (kg ha^{-1})
	100	120	140	160	
2,4-D Sodium salt 92%	42.32 l-o	42.72 l-o	43.67 k-n	41.90 l-p	42.66 de*
Puma super 75EW	45.05 klm	45.60 jkl	43.95 k-n	46.02 i-l	45.16 d
Topik 15WP	58.87 cd	58.55 cde	85.32 a	60.12 c	58.97 a
Isoproturon 75WP	38.35 opq	36.60 q	74.05 b	38.50 opq	40.13 e
Agritop 500G/L	38.40 opq	39.52 n-q	46.78 i-l	40.12 m-q	41.33 e
Affinity 50WDG	54.40 d-g	55.80 c-f	53.50 e-h	58.67 cd	55.59 b
Hand weeding	50.30 d-j	51.10 f-i	48.45 h-k	54.45 d-g	51.08 c
Weedy check	31.00 r	30.60 r	38.80 n-q	37.00 pq	34.35 f
Seed rate means (kg ha^{-1})	44.83	45.11	47.57	47.10	

$LSD_{0.05}$ for herbicides = 2.576 $LSD_{0.05}$ for interaction = 5.151

* Means followed by a common letter in the respective category do not differ significantly by $LSD_{0.05}$

Grain yield (kg ha^{-1})

Grain yield means showed highly significant ($p \leq 0.01$) differences due to herbicides and significant differences ($p \leq 0.05$) due to seed rates. However, their interaction was non-significant (Table-6). The maximum and statistically at par grain yield of 3656 and 3469 kg ha^{-1} was recorded in plots treated with Topik 15WP and Affinity 50WDG, respectively and were closely followed by hand weeding (3188 kg ha^{-1}). Isoproturon 50WDG, 2, 4-D sodium salt and Agritop 500G/L were having comparable grain yield. Minimum grain yield (1375 kg ha^{-1}) was observed in weedy check. Among the seed rates, over average, the maximum grain yield (2796.87 kg ha^{-1}) was recorded in seed rate of 140 kg ha^{-1}, which was closely followed by seed rate of 160 kg ha^{-1} (2765.62 kg ha^{-1}). Lowest grain yield (2421.87) was recorded in seed rate of 120 kg ha^{-1} (Table-6). The interaction of herbicides with seed rates was non-significant. However, the highest grain yield (3875.0 kg ha^{-1}) was recorded in the plots seeded with 160 kg ha^{-1} and treated with Affinity 50WDG. The lowest grain yield of 1225.0 kg ha^{-1} was revealed by seed rate of 120 kg ha^{-1} under weedy check. Increase in grain yield in the herbicide treated plots was probably due to the effective weed control and thus the crop efficiently utilized all the available resources. These results are in conformity with the findings of Awan et al. (1990), Tanveer et al. (1993), Hassan et al. (2003) and Tunio et al. (2004) who reported that herbicidal treatments significantly increased grain yield in wheat.

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

Treatments	Seed rates (kg ha^{-1})				Herbicide 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 (kg ha^{-1})	2437.50bc	2421.87c	2796.87a	2765.62ab	

$LSD_{0.05}$ for herbicides = 216.9 $LSD_{0.05}$ for seed rates =334.2

* Means followed by a common letter in the respective category do not differ significantly by $LSD_{0.05}$

CONCLUSIONS AND RECOMMENDATIONS

Herbicides significantly affected the mean differences for all the parameters, while the main effects of seed rates had no effect in managing weed infestation through crop densities. In herbicides, Topik 15WP and Affinity 50WDG exhibited the best performance through effective weed control. Therefore, Topik 15WP and Affinity 15WDG are recommended for managing weed flora in wheat crop and better economic returns.

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