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INTEGRATED WEED MANAGEMENT THROUGH HERBICIDES AND SEEDING DENSITIES IN WHEAT-I

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ABSTRACT

Field experiment was conducted to study the weed management in wheat through four different seedling rates viz. 100,120,140 and 160 kg ha^{-1} and six herbicides viz. Topik 15WP (clodinafop-propargyl), 2,4-D sodium salt, Isoproturon 75WP (isoproturon), Puma super 75EW (fenoxaprop-p-ethyl), Agritop 500 G L^{-1}(MCPA) and Affinity 50WDG (isoproturon + carfentrazone-ethyl ester) alongwith hand weeding and a weedy check, at NWFP Agricultural University Peshawar during 2003-04. The experiment was laid out in a Randomized Complete Block design with split-plot arrangement. Seeding rates were assigned to the main-plots, while herbicides were kept in sub-plots. The crop was predominately infested with the grassy weeds. The findings revealed that all the parameters were significantly affected by different herbicides, while seed rates and their interaction with the herbcides was non-significant statistically for all the traits examined. Topik 15WP treated plots exhibited the best performance for 1000 grain weight (39.49 g), biological yield (9188kg ha^{-1}), harvest index (41.06%) and cost-benefit ratio (1:24.09). Affinity closely followed Topik 15WP for all the parameters deciphered. Owing to the highest cost-benefit ratio, Topik 75 EW is recommended for weed management in wheat under the agro-ecological conditions of Peshawar, Pakistan under predominantly grassy infestations of the crop.

Key Words: Weed control, herbicides, seed rates, hand weeding

INTRODUCTION

Human beings practically attain all their sustenance directly or indirectly from crop plants. Cereal crops belonging to family Poaceae produce large edible grains, which provide about one-half of man's food calories and a major portion of his nutrient requirements. 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, providing protein and caloric requirements to one third of the world population. Wheat is the main staple food of 135 million Pakistanis. 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

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wheat growing countries. Many factors affecting the yield but one of the most serious but less noticeable cause of low yield is weed infestation. 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, insecticides and better 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. 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.

Management of weeds has been practiced from time immemorial by manual labor or animal drawn implements. These methods, besides being laborious and tiresome are also expensive due to the increase in labor wages; animal and implements cost (Iqbal, 1994) and as such have stimulated interest in the use of chemical weed control. But, the exclusive reliance on herbicides results in pollution of the environment and inter- and intra-specific shifts of weed flora. 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 sustainable weed control technology for the wheat growers. In order to investigate the different weed control approaches in wheat, an experiment was designed to investigate the impact of different crop population and herbicides in controlling weed flora in wheat crop under Peshawar conditions.

MATERIALS AND METHODS

The experiment was conducted at NWFP Agricultural University, Peshawar during the crop season 2003-04. Wheat Cultivar Ghaznavi-98 was sown on 19th November, 2003. The experiment was laid out in randomized complete block design with split plot arrangement having four replications. In each replication, there were four main plots having seed rates of 100, 120, 140 and 160 kg ha^{-1} and each main plot consisted of eight sub-plots having six herbicides and hand weeded and weedy check (Table-1). Sub–plot size was kept at 4 x 1.5 m^2. Row to row distance was kept 25 cm apart. All the herbicides were applied as post emergence with the help of knapsack sprayer 35 days after sowing. All the precautionary measures were adopted to have an effective spray and to avoid the uneven distribution of herbicides. The data were recorded on 1000-grain weight (g), biological yield (kg ha^{-1}), harvest index (%) and cost- benefit ratio. 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 15WP	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

1000-grain weight (g)

Analysis of the data revealed that 1000-grain weight was significantly ($p \leq 0.01$) affected by different herbicidal treatments, while the mean differences for seed rates and their interaction with herbicides were non–significant. Results revealed that maximum 1000 grain weight (39.49 g) was recorded in Topik 15WP (Table-2). However, it was closely followed by Affinity 50WDG and hand weeding possessing the grain weight of 36.50 to 37.97 g. The minimum (28.29 g) 1000 grain weight was recorded in weedy check plots. Although seed rates means were non-significant statistically, the highest numerical value of 1000-grain weight (35.36 g) was recorded in 140 kg ha^{-1} seed rate. which was closely followed by 100 kg ha^{-1} (35.10 g). Lowest value (34.74 g) of 1000 grain weight was recorded in seed rate of 160 kg ha^{-1} (Table-2). The interaction of herbicides with seed rates was also non-significant statistically, but the maximum 1000 grain weight (39.79 g) was recorded in the plots seeded with 140 kg ha^{-1} and treated with Topik 15WP. While the minimum 1000 grain weight (27.65 g) was recorded in 160 kg ha^{-1} seed rate under weedy check (Table-2). The increased 1000-grain weight given by Topik 15WP and Affinity 50 WDG was due to the increased availability of nutrients to the wheat crop due to effective weed control. As 1000-grain weight is a very important yield component in every crop and the increase in 1000-grain weight will have a strong impact on grain yield. Sohail *et al.* (1993), Tanveer et al (1993), Khalil *et al.* (1993), Saini and Angiras (1998) and Hassan *et al.* (2003) also concluded that herbicides application increased 1000-grain weight in wheat significantly when compared with the weedy check.

Table-2. Effect of seed rates and herbicides on 1000-grain weight (g) of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	12 0	140	160	
2,4-D Sodium salt 92%	33.09	33.13	34.45	32.60	33.32 f *
Puma super 75EW	34.97	35.28	36.00	35.71	35.49 d
Topik 15WP	39.61	39.23	39.76	39.33	39.49 a
Isoproturon 75WP	36.27	32.23	34.01	33.95	34.13 e
Agritop 500G/L	34.50	34.09	35.28	34.22	34.53 e
Affinity 50WDG	38.34	37.90	37.92	37.73	37.97 b
Hand weeding	36.23	36.09	36.89	36.77	36.50 c
Weedy check	27.83	29.09	28.75	27.65	28.29 g
Seed rate means (g)	35.10	34.63	35.36	34.74	

$LSD_{0.05}$ for herbicides = 0.6758

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

Biological yield (kg ha^{-1})

For the biological yield, the data revealed that the herbicides showed highly significant differences ($p \leq 0.01$) among their mean values, while the differences among the seed rates and their interaction with herbicides were non-significant statistically. It is evident from Table-3 that the biological yield of wheat was significantly affected by different herbicidal treatments. Maximum and statistically at par biological yield was recorded in Topik 15WP and Affinity 50WDG having 8719 and 9188 kg ha^{-1}, respectively (Table-3). These were closely followed by hand weeding with biological yield of 8250 kg ha^{-1}. Minimum biological yield (5375 kg ha^{-1}) was observed in weedy check due to heavy weed infestation (data reported elsewhere). Isoproturon 75WP, Agritop 500GL^{-1} and 2, 4-D were statistically comparable by having 6375, 6563 and 6719 kg ha^{-1} biological yield, respectively. Among the seed rates, the highest biological yield (7500 kg ha^{-1}) was recorded in seed rate of 140 kg ha^{-1} that was closely followed by 160 kg ha^{-1} seed rate having biological yield of 7468.75 kg ha^{-1} (Table-3). The interaction of herbicides with seed rates though non-significant exhibited the maximum biological yield (9125 kg ha^{-1}) in plots having seed rate of 120 kg ha^{-1} treated with Topik 15WP, while minimum and at par biological yield (5125 kg ha^{-1}) was recorded in 160 and 100 kg ha^{-1} seed rates under weedy check (Table-3). The highest biological yield was due to better weed management. Brar *et al.* (1999) and Hassan *et al.* (2003) reported analogous results in wheat.

Table-3. Effect of seed rates and herbicides on biological yield (kg ha^{-1}) of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	120	140	160	
2,4-D Sodium salt 92%	6625	6625	6875	6750	6719 d *
Puma super 75EW	7625	7250	7875	8000	7688 c
Topik 15WP	8875	9125	8875	8750	9188 a
Isoproturon 75WP	6000	6125	6750	7000	6375 d
Agritop 500G/L	6250	6500	6500	7000	6563 d
Affinity 50WDG	8750	8500	8875	8750	8719 a
Hand weeding	8250	7875	8375	8350	8250 b
Weedy check	5125	5750	5875	5125	5375 e
Seed rate means	7187.50	7218.75	7500.00	7468.75	

$LSD_{0.05}$ for herbicides = 366.9

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

Harvest index (%)

Analysis of variance showed that the mean differences for harvest index (%) due to herbicides were highly significantly ($p \leq 0.01$). However, among the seed rates and their interaction with herbicides the variability was non-significant statistically. The data

However hand weeding (38.37%) was having statistically at par harvest index (%) with above two herbicides. Minimum harvest index of 25.22% was obtained in the weedy check. Although seed rates were non-significant, but the highest and comparable numerical values of harvest index 36.65 and 36.60% were obtained in seed rates of 140 and 160 kg ha^{-1} (Table-4). The interaction of herbicides with seed rates was also non-significant, exhibited the maximum harvest index (45.74%) in the plots seeded with 160 kg ha^{-1} and treated with Affinity 50WDG. The minimum harvest index (21.75%) was recorded in seed rate of 120 kg ha^{-1} under weedy check.

Table-4. Effect of seed rates and herbicides on harvest index of wheat.

Treatments	Seed rates (kg ha^{-1})				Herbicide means
	100	120	140	160	
2,4-D Sodium salt 92%	27.71	30.21	32.73	35.29	31.49 d*
Puma super 75EW	33.78	34.46	38.10	34.31	35.16 bc
Topik 15WP	40.75	39.78	42.28	41.41	41.06 a
Isoproturon 75WP	31.28	28.95	33.45	34.06	31.94 cd
Agritop 500G/L	33.73	33.40	39.99	32.62	34.94 c
Affinity 50WDG	34.02	38.29	42.23	45.74	40.07 a
Hand weeding	37.74	36.45	38.97	40.32	38.37 ab
Weedy check	24.54	21.75	25.50	29.09	25.22 e
Seed rate means	32.94	32.91	36.65	36.60	

$LSD_{0.05}$ for herbicides = 3.36

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

Cost-benefit ratio for herbicides (CBR)

The benefit is the ultimate objective of all economic pursuits. The effect of different herbicides on cost-benefit ratio was significant. Table-5 indicated that the maximum cost-benefit ratios were recorded for Topik 15WP (1:24.09), Affinity 50WDG (1:16.95) and Puma super 75EW (1:13.32). The lowest cost-benefit ratio was recorded for Isoproturon 75WP (1:9.33). These values indicated that all the herbicidal treatments gave optimum cost-benefit ratio as compared to the yield in the weedy check. The possible reason for the highest return of herbicides might be their lower cost and timely weed control as compared to hand weeded and unweeded checks. Due to expensive labor the hand weeding with a cost benefit ratio of 1:0.76 emerged as uneconomical despite its environmental benefits, which of course are not accounted for in our computation.

Table 5. Cost-benefit ratio for herbicides in wheat

Treatments	Cost benefit ratio
2,4-D Sodium salt 92%	1: 13.51
Puma super 75EW	1: 13.32
Topik 15WP	1: 24.09
Isoproturon 75EW	1:9.33
Agritop 500G/L	1: 13.28
Affinity 50WDG	1: 16.95
Hand weeding	1: 0.76
Weedy check	--

CONCLUSIONS AND RECOMMENDATIONS

Herbicides play an important role in controlling weeds and significantly affected the mean differences. Seed rates manifested no effect in managing weed infestation through crop population. In herbicides, Topik 15WP and Affinity 50WDG exhibited the best performance through effective weed control. Topik having the outstanding cost-benefit ratio is recommended for weed management in wheat under agro-ecological conditions of Peshawar Pakistan.

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