RESPONSE OF WHEAT (*Triticum aestivum* L.) TO VARIOUS HERBICIDES AT DIFFERENT GROWTH STAGES

Muhammad Shafi[1], Roohul Amin[1], Jehan Bakht[1], Shazma Anwar[1], Wajid Ali Shah[1] and Muhammad Aman Khan[2]

ABSTRACT

To study the response of wheat to various herbicides at different growth stages, an experiment was conducted at Malakandhar Research Farm, NWFP Agricultural University Peshawar during 1999-2000 in split plot design having four replications. Application of four herbicides (2, 4-D, Arelon, Bactril-M and Isoproturon) at four different stages (seedling, tillering stage, booting stage and soft dough stage) was studied during the experiment. Statistical analysis of the data revealed that application of various herbicides at different growth stages of wheat significantly ($P \leq 0.05$) affected number of tillers m^{-2}, spikelets $spike^{-1}$, plant height, thousand grain weight, biomass and grain yield. Maximum reduction in weeds (79 %), highest number (331.25) of tillers m^{-2}, spikelets $spike^{-1}$ (20.25), grains $spike^{-1}$ (60.32), plant height (109.64 cm), thousand grain weight (52.45 g), biomass yield (12291.50 kg ha^{-1}) and grain yield (4174 kg ha^{-1}) were recorded in the plots treated with Isoproturon at tillering stage.

Key words: Herbicides, growth stages, grain yield, yield components, wheat.

INTRODUCTION

Wheat is a chief source of food for a great deal of population of the world. Due to its high demand and adaptability, wheat is grown on a large area of the world all round the year. Wheat is regarded as the most important cereal both in respect of area and dietary need of people. A healthy wheat crop is not a symbol of prosperity but also an important source of strength for the nation. It ranks 1st among the cereal crops and is the staple food in Pakistan. Wheat provides a nutritious diet for human beings. Despite the use of all scientific measures and techniques wheat production is still very low regarding its need. Among the many deficits lower yield is also due to the serious weeds infestations in the field. The weeds compete for moisture, nutrients, space and light with the crop and deteriorate the quantity and quality of crops. The major weeds of the wheat crop are *Phalaris minor, Avena fauta, A. ludoviciana, A. sterilis, Chenopodium album, Melilotus indica* and *Rumex crispus*.

It has been estimated that annual losses caused by weeds in Pakistan amount to Rs.1150 million which are little more than those caused by diseases (Haq, 1970), whereas weed losses in wheat alone have exceeded 25 billion during 1998 (Marwat, 1998). Weeds have affected agriculture adversely, because they rob moisture, nutrients, harbor insects pests and diseases for arable crop plants. Weeds are source of clogging

1 Department of Agronomy NWFP Agricultural University, Peshawar – Pakistan.
2 Department of Biological Sciences, Quaid-e-Azam University, Islamabad-Pakistan.
E-mail address wajidshah76@hotmail.com

of water channels and main canals thus increase cost of production. Per unit production can be increased by judicious application of fertilizer, timely irrigation, high quality seed, adequate and timely application of insecticides and pesticides but keeping in view the importance of weed management practices in increasing unit $^{-1}$ production of wheat. Emergence of plants was not significantly affected by different weed management technique (Challah *et al.*, 1983) reported that plant height could be significantly affected by weed control methods and stages of weed growth and their interaction. Biomass production can be significantly increased by different weed control methods (Prasad, 1985). Sharma *et al.*, 1989) observed that grain yield could be significantly affected by various stages of wheat. Weeds were well controlled by hoeing with or without chain harrowing, but chain harrowing on its own had only limited success (Rafi, 1993). Grain yield increased by 78 % relative to the current farmer's practices of selective and partial hand weeding (Tanner *et al.*, 1993). Thakur and Singh (1989) investigated the interaction between weed control method and nitrogen levels and showed that grain yield increased significantly up to 80 kg N ha^{-1} in herbicides treated and manually weeded plots. Malik *et al.* (1993) reported that all weed control treatments except for Tribenuron and fertilizer treatments increased wheat grain yield. Popay *et al.* (1992) reported that in plots treated with herbicides combination, no tine weeding resulted in greater yield than tine weeding and barley. Jarwar *et al* (1999) observed that chemical weed control method is also effective along with cultural methods of weed control. However a combination of chemical, cultural and hand weed control methods was more effective in controlling weeds than their isolated applications (Rao, 1983). While, Sabir (1990) found that hand weeding treatment gave maximum increase in the yield of wheat, where as skip row sowing gave the lowest yield.

The use of herbicides has become indispensable for the control of weeds, resulting in the diverting of nutrients and moisture etc. to the major crop plants. Keeping in view the importance of weed control in the growth and development of wheat the present project was designed to study the response of wheat to various herbicides at different growth stages.

Materials and Methods

The experiment entitled "Response of wheat to various herbicides at different growth stages" was conducted at Malakandher Research Farm, NWFP Agricultural University, Peshawar, during 1999-2000. The experiment was conducted in a randomized complete block design with split plot arrangement. The herbicidal treatments were assigned to main-plots, while growth stages were kept into the sub-plots. Wheat variety Inqilab –91 was sown at normal seed rate of 100 kg ha-1in a sub-plot size of 5 x 1.8 m2 having six rows with row spacing of 30 cm. A basal dose of N: P fertilizer was applied at the rate of 120:60 kg ha^{-1} as urea and D.A.P. Half of the nitrogen and full dose of phosphate was applied at the time of seedbed preparation, while the remaining half of the nitrogen was applied at the time of 1st irrigation. The treatment combination was as under:

1. Detail of herbicidal treatments (Main-plots)

Common Name	Trade Name	Rate (a. i. kg ha^{-1})
2, 4–D	2, 4-D salt 27 WP	0.8
Isoproturon	Arelon 50 S	1.00
bromoxynil + MCPA	Buctril M 40. E C	0.52
isoproturon.	Isoproturon 50 WP	0.63

2. Stages of wheat for the application of herbicides (Sub-plots)

i. Seedling
ii. Tillering
iii. Booting
iv. Soft dough grain

The major weeds recorded from different plots were *Phalaris minor, Convolvulus arvensis, Avena fatua, Cronopus didymus, Ranuculus* sp., *Rumex dentatus, Fumaria indica, Cynodon dactylon* and *Vicia sativa*.

The observations were recorded on weed count m^{-2} , number of tillers m^{-2}, number of spikelets spike^{-1}, number of grains spike^{-1}, plant height (cm), thousand grain weight (g), biomass and grain yield (kg ha^{-1}). The data for each trait was subjected to ANOVA and means were subsequently separated (Gomez and Gomez, 1983).

RESULTS AND DISCUSSION

Weed count m^{-2}

Table-1 presents data concerning weed counts m^{-2}. Mean values of the data showed that before application of herbicides weeds at the seedling stage were in the range of 52-68 m^{-2}. After the application of herbicides, maximum reduction of 71 % in weeds was obtained with the application of Arelon. On the average across the tillering, booting and soft dough grain stage, maximum reduction of 69 and 57% in weeds population was obtained with the application of 2, 4–D and Buctril-M, while in control plots 3% increase in weed population was noticed. Similar results are also reported by Hashim *et al.*, (2002). They reported that maximum weeds density was recorded in weedy check plots.

Number of tillers m^{-2}

Data regarding number of tillers m^{-2} are presented in Table-2. Analysis of the data revealed that application of herbicides at different growth stages had significantly ($P \leq 0.05$) affected the number of tillers m^{-2}. When herbicides were applied at tillering stage it gave maximum (301.60) number of tillers m^{-2}, while herbicides applied at soft dough grain stage recorded minimum (267.55) number of tillers m^{-2}. In case of herbicides Isoproturon gave better results and produced maximum (293.00) number of tillers m^{-2}, while control plots gave minimum (262.87) number of tillers m^{-2}. It can be inferred form the data that maximum number of tillers (331.25 m^{-2}) were produced by those plots, which were treated with Isoproturon at the tillering stage, while minimum number of tillers (254.25 m^{-2}) were produced by control plots. The reason could be due to the timely application of control measures of weeds and thus the crop utilized the available resources efficiently. Similar results were also reported by Tangi and Regehr (1988), they reported that grain and straw yield increased by an average of 100 and 28 % with the herbicide application.

The logic behind significant interaction could be the various control techniques that affected weed population and their growth was checked thereby diverting nutrients, solar radiation and moisture channel towards the development of wheat (clum), fully utilizing space and converting assimilates into various food components for vigorous growth of wheat. These observations are supported by Singh *et al.* (1888). Similar results are also reported by Akhtar *et al.* (1991), who reported that application of Isoproturon increased fertile tiller density from 312.25 to 320.50 tillers m^{-2}).

Number of spikelets spike^{-1}

Data concerning number of spikelets spike^{-1} are shown in Table-3. Statistical analysis of the data revealed that number of spikelets spike^{-1} had significantly ($P \leq 0.05$) affected by various herbicides applied at different growth stages of wheat. Mean value of the data indicated that maximum (18.30) spikelets spike^{-1} was recorded from the plots on which herbicides were applied at tillering stage, while minimum (16.05) spikelets spike^{-1} were produced from the plots treated at booting stage. In case of herbicides applications, Isoproturon gave maximum (17.62) spikelets spike^{-1}, while minimum spikelets spike^{-1} was recorded from control plots. It can be seen from the mean values of data that maximum number of spikelets spike^{-1} (20.25) were produced by those plots which were treated with Isoproturon at the tillering stage, while minimum number of spikelets spike^{-1} (14.25) were recorded in control plots. The possible reason may be that weeds were controlled and the nutrients were spared for the growth and development of wheat crop, which resulted in increased number of spikelets spike^{-1}.

Number of grains spike^{-1}

Data regarding number of grains spike^{-1} is shown in Table-4. Analysis of the data showed that application of various herbicides at different growth stages had significantly ($P \leq 0.05$) affected grains spike^{-1}. Mean value of the data indicated that maximum grains spike^{-1} was produced from the plots treated with Arelon, Bactril – M, Isoproturon and 2,4-D, while minimum grains spike^{-1} were produced from control plots. It can be also seen from the mean value that greater grains spike^{-1} were produced from the plots when herbicides was applied at tillering stage, followed by seedling, while least grains spike^{-1} were recorded from the plots when herbicides were applied at soft dough grain stage. In case of interaction between herbicides and growth stages, maximum grains spike^{-1} (60.32) were produced by those plots which were treated with Isoproturon at the tillering stage, while minimum number of grains spike^{-1} (44.71) were produced by those plots which did not receive any treatment (control). Similar results were also reported by Khalil *et al.* (1991), who concluded that application of Isoproturon increased grain yield, and also total net income. These results however contrary with Khan *et al.* (2002), who reported that weed control did not affect the number of grains spike^{-1}.

Plant height (cm)

Data concerning plant height is shown in Table-5. Statistical analysis of the data showed that plant height was significantly ($P \leq 0.05$) affected by various herbicides applied at different growth stages of wheat. Mean value of the data indicated that taller plants were produced from those plots on which herbicides were applied at booting stage (102.83 cm), while shorter plants were noted in the plots when herbicides were applied at soft dough stage of wheat. Analysis of the data also showed that Arelon gave better results followed by Buctril-M, 2,4-D and Isoproturon, produced taller plants as compared to control plots, which recorded shorter plants. It is obvious from the data shown in Table-5 that maximum plant height (109.64 cm) was attained by those plots which were treated with Isoproturon applied at the tillering stage, while minimum plant height (85.45 cm) was recorded from those plots which did not receive any treatment (control) at booting stage. The possible reason could be the availability of more space, light and nutrients due to the early inhibition of weeds by Isoproturon to wheat plants. These results are in contrary to Challalah *et al.*, (1983), who revealed that plant height could be significantly affected by weed control methods and stage of wheat growth and their interaction.

Thousand grain weight (g)

Data recorded on thousand-grain weight is shown in Table 6. Analysis of the data revealed that thousand-grain weight was significantly ($P \leq 0.05$) affected by various herbicides applied at different growth stages of wheat. It can be inferred from the data that heavier seed were produced from the plots on which herbicides were applied at tillering stage, while lighter seed were produced from plots when herbicides was treated at soft dough stage. Analysis of the data also indicated that maximum (56.69 g) thousand grain weights was recorded from the plots where Buctril–M was applied, while minimum thousand grain weight (40.05) was recorded when no herbicide was applied (control). In case of interaction between herbicide and growth stages maximum grain weight (52.45 g) was obtained from those plots, which were treated with Isoproturon at the tillering stage, while minimum thousand grain weight (36.92 g) was recorded by control plots. These observations helped greatly in the development of healthy wheat crop, which in turn produced bigger, well-filled and heavy grains, when compared to the other control treatments. These results are in agreement with those reported by Qureshi *et al.* (2002).

Biomass (kg ha^{-1})

Data concerning biomass yield is given in Table-7. Statistical analysis of the data showed that application of herbicides at different growth stages had significantly ($P \leq 0.05$) affected biomass. It can be inferred from the mean data that maximum (10704.25 kg ha^{-1}) biomass was recorded from the plots when herbicides were applied at tillering stage. The possible reason could be the removal of weeds at early growth stages, which in turn diverted nutrients, moisture and provided more space and light interaction to wheat. The natural resources that were to be utilized by weeds were diverted towards increased biomass of wheat. Similar observations were reported by Khan et al. (2003).

Grain yield (kg ha^{-1})

Data regarding grain yield are given in Table 8 and Fig I. Statistical analysis of the data showed that application of herbicides at different growth stages had significantly ($P \leq 0.05$) affected by the application of herbicides at different growth stages. Analysis of the data indicated that maximum (3529.75 kg ha^{-1}) grain yield was produced from the plots on which herbicides were applied at tillering stage, followed by plots treated as a seedling stage produced (3454.20 kg ha^{-1}). Similarly in case of herbicide application, Isoproturon gave better result (3256.77 kg ha^{-1}), while minimum (2383.97 kg ha^{-1}) was recorded from control plots. In case of interaction between herbicides and growth stages maximum those plots, which were treated by Isoproturon at the tillering stage, produced grain plots treated as control recorded yield of 4174.00 kg ha^{-1} while minimum grain yield of 2258.00 kg ha^{-1}. The possible explanation for this increase in grain yield at tillering stage could be that weeds controlled at early stages diverted the nutrients to the crop which in turn resulted in increased grain yield. Similar observations have also been reported by Prasad (1985), who reported that application of 1 kg Isoproturon, 1.6 kg methabenzthiazuron, 1.5 kg metoxuron and 0.5 kg 2, 4-D ha^{-1} increased grain yield. Our results are in agreement with those of Mohibullah and Ali (1974) and Khan *et al.* (2003). They observed that herbicidal application increased the grain yield of wheat significantly.

CONCLUSION

From the experiment it is concluded that:

1) Herbicides applied at seedling and Tillering stage gave better result (3554.20 and 3529. 75 kg ha^{-1}) as compared to booting stage and Soft dough stages.
2) In case of herbicides, Isoproturon and Buctril- M produced higher production.

Table-1. Effect of herbicides at different growth stages on weeds count m^{-2}

Herbicides	Growth stages											
	Seedling			Tillering			Booting			Soft dough		
	Bef.	Aft.	% (+/-)	Bef.	Aft.	% (+/-)	Bef.	Aft.	% (+/-)	Bef.	Aft.	% (+/-)
2,4-D	55.75	21.00	62-	82.75	40.25	51-	119.0	45.70	61-	136.5	41.70	69-
Arelon	68.75	19.50	71-	93.50	34.50	63-	129.3	52.00	59-	149.2	78.00	47-
Buctril – M	62.50	27.75	58-	88.00	38.75	55-	121.5	38.20	68-	167.5	71.70	57-
Isoproturon	52.25	18.00	65-	97.25	19.50	79-	130.0	60.50	53-	144.0	75.20	47-
Control	65.75	89.50	36+	91.50	121.25	32+	127.7	158.5	24+	152.5	157.7	3+

Table-2. Effect of herbicides at different growth stages on tillers m^{-2}

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2,4 -D	294.00	301.25	177.78	266.75	284.90 b
Arelon	303.50	289.25	285.75	272.25	287.56 ab
Buctril – M	310.00	324.75	262.25	264.50	290.37 ab
Isoproturon	318.50	331.25	259.75	262.50	293.00 a
Control	254.25	261.50	257.25	271.75	262.87 c
Mean	297.30 a	301.60 a	268.55 b	267.55 b	

LSD value at $P \leq 0.05$ for herbicides = 5.85
LSD value at $P \leq 0.05$ for growth stages = 6.78

Table-3. Effect of herbicides at different growth stages on number of spikelets $spike^{-1}$

Herbicides	Growth stages				
	Seedling 1	Tillering	Booting	Soft dough	Mean
2, 4 – D	17.75	18.50	17.00	15.25	17.13 a
Arelon	18.75	17.50	17.25	16.75	17.56 a
Buctril - M	19.00	19.75	16.00	16.25	17.56 a
Isoproturon	19.25	20.25	15.25	15.75	17.62 a
Control	14.25	15.50	14.75	16.75	15.31 b
Mean	17.80 a	18.30 a	16.05 b	16.15 b	

LSD value at $P \leq 0.05$ for herbicides = 1.37
LSD value at $P \leq 0.05$ for growth stages = 1.05

Table-4. Effect of herbicides at different growth stages on grains $spike^{-1}$

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2, 4 – D	44.86	55.87	52.01	46.22	52.24 a
Arelon	56.13	54.08	52.72	51.12	53.51 a
Buctril – M	58.41	56.94	48.56	49.62	53.38 a
Isoproturon	57.83	60.32	46.31	47.87	53.08 a
Control	44.71	46.56	45.24	50.33	46.70 b
Mean	54.38 a	54.74 a	48.96 b	49.03 b	

LSD value at $P < 0.05$ for herbicides = 1.86
LSD value at $P \leq 0.05$ for growth stages = 1.94

Table-5. Effect of herbicides at different growth stages on plant height (cm)

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2, 4 – D	102.38	103.53	98.59	85.97	97.61 a
Arelon	104.93	102.43	99.45	97.72	101.13 a
Buctril – M	106.12	108.35	94.39	72.73	95.39 a
Isoproturon	107.41	109.64	88.85	92.78	99.67 a
Control	84.61	90.70	85.45	97.26	89.50 b
Mean	101.09 a	102.83 a	93.34 a	89.29 b	

LSD value at P < 0.05 for herbicides = 7.73
LSD value at P ≤ 0.05 for growth stages = 6.32

Table-6. Effect of herbicides at different growth stages on 1000- grain weight (g)

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2, 4 · D	47.32	47.82	45.18	39.84	45.04 b
Arelon	48.29	46.97	45.96	44.93	46.51 b
Buctril – M	49.83	50.58	42.73	43.62	56.69 a
Isoproturon	49.15	52.45	40.51	41.85	45.99 b
Control	36.92	41.09	38.93	43.29	40.05 c
Mean	46.30 b	47.78 a	42.64 c	42.70 c	

LSD value at P < 0.05 for herbicides = 2.09
LSD value at P ≤ 0.05 for growth stages = 1.39

Table-7. Effect of herbicides at different growth stages on biomass (kg ha^{-1})

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2, 4 – D	10455.75	10998.00	9728.50	7285.00	9616.80 a
Arelon	11256.00	10218.75	9863.75	9146.00	10121.13 a
Buctril – M	11699.25	12187.25	8214.00	8606.25	10176.68 a
Isoproturon	11874.00	12291.50	7619.00	7993.25	9944.43 a
Control	6894.50	7825.75	7114.50	8972.75	7701.87 b
Mean	10435.90 a	10704.25 a	8507.95 d	8400.65 d	

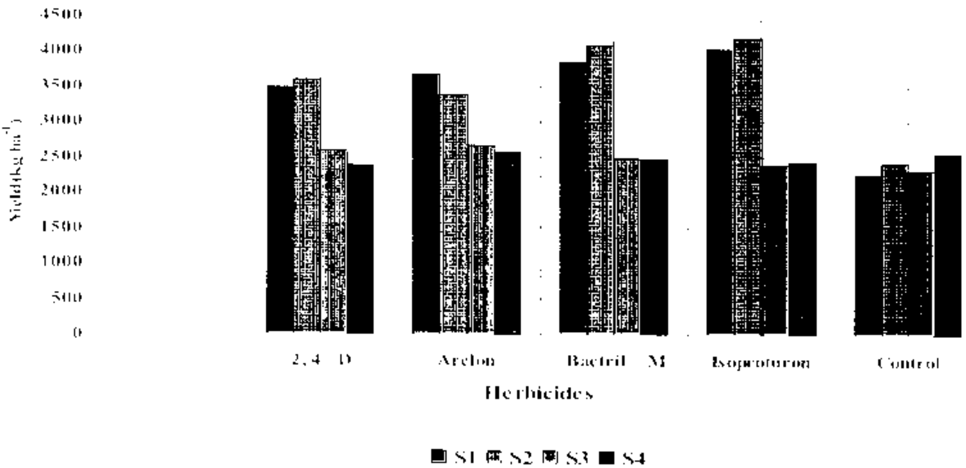
LSD value at P ≤ 0.05 for herbicides = 591.20
LSD value at P ≤ 0.05 for growth stages = 1.39

Table-8. Effect of herbicides at different growth stages on grain yield (kg ha-1)

Herbicides	Growth stages				
	Seedling	Tillering	Booting	Soft dough	Mean
2, 4 – D	3484.00	3600.75	2592.75	2376.50	3013.50 c
Arelon	3667.25	3378.00	2675.00	2567.25	3071.78 bc
Buctril M	3829.75	4077.75	2470.25	2481.75	3214.83 ab
Isoproturon	4032.00	4174.00	2387.25	2434.25	3256.77 a
Control	2258.00	2418.25	2310.75	2548.50	2383.97 d
Mean	3454.20 a	3529.75 a	2487.25 b	2481.65 b	

LSD value at P $\leq$ 0.05 for herbicides = 169.40
LSD value at P $\leq$ 0.05 for growth stages = 113.30

Fig. 1 Effect of herbicides at different growth stages on grain yield (kg ha^{-1})



REFERENCES CITED

Akhtar, M., Q. Hamyun, M. B. Gill amd M. S. Nazir. 1991. Comparative study of various crop management practices on weed growth and wheat yield. Sarhad J. Agric. 7 (2): 91-94

Chahan, R. L., G. A. Ramsol, O. C. Wicks and V. A. Johnson. 1983. Evaluation of weeds competitive ability of winter wheat cultivars. Am. J. Agron. 35: 85-91.

Gomez, K.A. and A.A. Gomez. 1983. Statistical Procedures for Agric. Res., 2nd edition. John Wiley and Sons New York, USA.

Hashim, S., K. B. Marwat and G. Hassan. 2002. Response of wheat varieties to substituted urea herbicides. Pak. J. Weed Sci. Res. 8 (1-2): 49-55.

Haq, A. 1970. Losses caused by crop pests in Pakistan. J. Agric. Res. Punjab. 8 (3):297-303.

Jarwar, A. D., S. D. Tunio, H. I. Majeedano and M. A. Kaisrani. 1999. Efficiency of different weedicides in controlling weeds of wheat. Pak. J. Agric. Agric. Engg. and Vet. Sci. 15 (2): 17-20.

Khan, M. A., G. Hassan, W. A. Shah and M. Z. Afridi. 2002. Duration effect of weed competition on the yield and yield components of wheat. Sarhad J. Agric. 18 (3): 335-337.

Khalil, A., Z. Shah, I.U.Awan, Himayatullah and Hayatullah. 1993. Effect of some post-mergence herbicides on wheat and associated weeds. Sarhad J. Agric.9(4):323-326.

Khan, I., G. Hassan, M.A.Khan and M.I.Khan. 2003. Efficacy of some new herbicidal molecules on weed density and yield and yield components of Wheat. Pak. J. Weed Sci. Res. 9(3-4):141-146.

Malik, R. S., S. K. Yadav, R. K. Malik, D. P. Singh and S. S. Kaisrani. 1993. Effect of Tribenuron and fertility levels for weed control in wheat. Proc. Indian Soc. of Weed Sci. Int. Symp. Hisar. 3: pp 83-85.

Marwat, K. B. 1998. Weed losses in Pakistan Fact sheet. NWFP Agric. Uni. Peshawar.

Mohibullah and A. Ali. 1974. Efficacy of different herbicides in controlling weeds and their effect on wheat yield. Front. J. Agric. Res. 1(1): 41-45.

Popay, I., W. Stiefel and E. Sorenson. 1992. Tine weeding effect on cereal crops with few weed. Proc. 45th New Zealand Plant Prot. Conf. Wellington, New Zealand, 1-2 Aug., 1992.

Prasad, K. 1985. Effect of post emergence weedicides applied at different stages in control of annual weeds of irrigated wheat under mid Himalayan conditions. Agric. Absts.19: 20-22.

Qureshi, M. A., A. D. Jarwar, S. D. Tunio and H. I. Majeedano. 2002. Efficiency of various weed management practices in wheat. Pak. J. Weed Sci. Res. 8 (1-2) 63-69.

Rafi, S. 1993. Interaction between various methods of weed control and increased fertilizer with different wheat cultivars in the Islamic Republic of Iran. Iranian J. Agric. 28 (3): 250-261.

Rao, V. S. 1983. Principles of Weed Science. Oxford and IBH publishing Co. New Delhi, pp-483.

Sharma, M. L., S. K. Bharadaj and G. S. Shaadwi 1989. Comparative efficiency of cultural and chemical methods of weed control in wheat. Indian J. Agron. 34: 209-212.

Singh, S. J., S. K. Bharadaj and G. S. Shaadwj. 1988. Effect of nitrogen and weed control productivity in rice wheat rotation. Indian J. Agron. 33: 265-269.

Sabir, G. A. 1990. Integrated weed management. M.Sc.Thesis, Department of Agronomy, Sindh Agric. Uni. Tandojam, Pakistan.

Tangi, A. and D. I. Regehr. 1998. Small grain cereal and dicotyledon weed response to herbicides applied at two growth stages in Chaolua (Semi arid region of Morocco). Arab J. Plant Prot. 6: 119-124.

Thakur, D. R. and K. K. Singh. 1989. Effect of weed control methods and nitrogen on wheat cultivars under late sown rainfed conditions. Indian J. Weed Sci. 21-56.