Pak J. Weed Sci. Res. 8(1-2):81-93, 2002

INTEGRATED WEED MANAGEMENT IN WHEAT I. WEED DENSITY, DRY WEED BIOMASS, ABSOLUTE GROWTH RATE AND GRAIN YIELD

Muhammad Iqbal Marwat[1], Haji Khalil Ahmad[2], Khan Bahadar Marwat[3], Gul Hassan

ABSTRACT

An experiment was conducted at two locations, i.e., Malakandher Farm, NWFP Agricultural University, Peshawar and Research Farm, Faculty of Agriculture, Gomal University, D.I.Khan, NWFP, Pakistan, for two seasons 1998-1999 and 1999-2000 to study the effect of varieties assigned to main plots, herbicides kept in subplots, and row spacings arranged in sub-sub plots on weeds of wheat. The experiment was laid out in split – split plot in RCBD with three replications. The varieties were Bakhtawar-92, Ghaznavi-98, and Inqilab-91, herbicides used were broad-spectrum (2,4-D + Isoproturon), broad leaf (2,4-D), grassy weeds herbicide (Isoproturon), and check (herbicide not used) and row spacings included 18, 25 and 32 cm. The grassy weed control by broad spectrum, broad leaf and grassy weed herbicides was 84.44, 11.42 and 83.11, respectively. Whereas the broad leaf control by the above herbicides was to the extent of 80.22, 78.81 and 12.92%, respectively. The grassy and broad leaf weeds density m^{-2} in the tallest variety Inqilab-91 was minimum as compared to Bakhtawar-92 and Ghaznavi-98. Row space 18 and 25 cm control grassy and broad leaf weeds m^{-2} by 18.91% & 14.75% and 8.35% & 7.28% over row space 32 cm, respectively. Dry weed biomass g m^{-2} was reduced with treatment of broad spectrum herbicide (33.58%), broad leaf herbicide (32.28%), and grassy weed herbicide (13.79%) over control treatments. Absolute growth rate (g m^{-2} day^{-1}) at 15 days interval way more in variety Inqilab-91 up to 4th cutting (which is fast growing and tall variety), but later on maximum ratio was recorded in Bakhtawar-92 having more tillers m^{-2}. In herbicides, less dry matter accumulation was found in broad spectrum herbicide treated plots followed by broad leaf and grassy weed herbicide and control. The absolute growth rate (g m^{-2} day^{-1}) was more in 18 cm followed by 25 cm row space. Grain yield was more in broad spectrum herbicide, broad leaf herbicide, grassy weed herbicide; to the extent 21, 18, 11%, respectively over control. The grain yield was more in 18 cm row space by 10.40% followed by 25 cm (4.96%) over 32 cm row space. The interaction of broad spectrum with 18 cm row space was also significant in controlling both grassy and broad leaf weeds. The reduction in grassy and broad leaf weeds over the weedy check was 85 and 81%, respectively. It is concluded that broad spectrum herbicide may be integrated with 18 cm row spacing for bumprer harvest of wheat.

Key words: Weed control in wheat, growth rate.

[1] Institute of Development Studies, NWFP Agricultural University, Peshawar.

[2] Faculty of Agriculture, Gomal University, D.I.Khan

[3] Weed Science Department, NWFP Agricultural University, Peshawar.

INTRODUCTION

Wheat (*Triticum aestivum L.*) in Pakistan ranks first among the cereal crops and occupies about 66% of the annual food crop area (Anonymous, 1996). The wheat yield in Pakistan is low as compared to other advanced countries of the world. To increase production ha^{-1}, cultural management plays a significant role in wheat production. Among which weed control, planting and quality seed can improve yield by about 50 - 70 percent (Burns, 1944).

Weeds are one of the most serious pests reducing the growth and yield of wheat in addition to several other factors. Control of weeds is a basic requirement and major component of management in most crop production systems (Young *et al.*, 1994; Norris, 1982; Triplett, 1976). In another study, an intensity of 9 to 17 weeds feet^{-2} decreased wheat yield by 10% (Chatta, 1973). It is therefore essential to control weeds in order to obtain maximum yield of wheat having good quality grains.

Row spacing is another important factor affecting the growth specially the weeds growth in the early stages of the crop growth season. Narrow row spacing may be one of the possible way of controlling weeds as the soil surface is quickly covered and providing little chance for weeds nourishment. Narrow row spacing also has the higher leaf photosynthesis and suppresses weeds growth compared with wider row spacing (Dwyer *et al.*, 1991). It will also helps in maximizing light interception, penetration and distribution in crop canopy.

MATERIALS AND METHODS

In order to study the effect of herbicides and row spacing, an experiment was carried out at Malakandher Farm, NWFP Agricultural University, Peshawar (Pakistan) and the Research Farm, Faculty of Agriculture, Gomal University, D.I.Khan (Pakistan), for two seasons 1998-1999 and 1999-2000. The experiment was conducted in Randomized Complete Block Design (RCBD) with Split-Split plot arrangement of treatments. The factors included in the experiment were: Varieties (Bakhtawar-92, Ghaznavi-98, Inqilab-91, Herbicides [Broad-spectrum herbicide (2,4-D Butyl Ester: 72% EC + Isoproturon 75% WP), Broad leaf herbicide (2,4-D Butyl Ester: 72% EC), Grassy weeds herbicide (Isoproturon 75% WP), and Check (no herbicide)], and Row spacings (18, 25 and 32 cm). Varieties were allotted to main plots, while herbicides were allotted to sub-plots and row spacings were kept in sub-sub-plots. Experiment was replicated three times with a sub-sub plot size of 9.60 m^2. Data on individual observations was collected using the following procedure. The data on weed density were recorded by randomly throwing 33x33 cm^2 quadrate at 3 places in each treatment and subsequently taking the mean and converting the data to m^2. Dry Weeds biomass was recorded by harvesting weeds above ground level from an area of one quadrate (33x33 cm^2) from each sub-sub-plot, bagged separately and then oven drying at 60 ^{0}C till it dried to a constant weight. The dry weeds were weighed with an electronic balance, and thereafter its dry matter yield was calculated on m^2 basis. Dry matter accumulation Absolute growth rate (AGR) is the unit change in weight per unit change in time (DW/DT = $W_2 - W_1 / T_2 - T_1$). In Peshawar location data collection for dry matter accumulation was started from December 10 (40 days after sowing) to March 25 for both years, while in D.I.Khan data collection for dry matter accumulation was started from December 28 (40 days after sowing) to March 27 for both years. Dry matter accumulation was determined at fifteen days interval. An area of one quadrate (33x33 cm^2) was harvested from each treatment, sun dried for two days and

then placed in an oven at 60 ^{0}C (for 72 hours) till it dried to a constant weight and thereafter its dry matter yield was computed g m^{-2}.day^{-1}.

The data were statistically analyzed according to RCB Design with split-split plot arrangement. The significant means were subsequently separated by the least significance difference test (LSD) by using the MSTATC computer software package.

Results and Discussion

Weeds Density (m^{-2})

The lowest grassy and broad leaf weeds m^{-2} were recorded in variety Inqilab-91 (27.81 and 103.65), broad spectrum herbicide (8.31 and 38.26) treated plots, and 18 cm row spacing (26.33 and 101.57), while highest grassy and broad leaf weeds m^{-2} were found in Bakhtawar-92 (31.39) and Ghaznavi-98 (115.47), control (53.42 and 208.43) and 32 cm row space (32.47 and 119.15), respectively (Table 1,2,3 & 4). In varieties x herbicides interaction, minimum grassy and broad leaf weeds m^{-2} were present in the variety Inqilab-91 with broad-spectrum (7.77 and 36.44), while maximum number of grassy and broad leaf weeds were found in the variety Bakhtawar-92 with control (57.11 and 197.61) and Ghaznavi-98 with control (52.77 and 199.72) treatments, respectively (Table 1 & 2). For herbicides x row spacing interaction, minimum number of grassy and broad leaf weeds m^{-2} were found in row spacing 18 cm x broad-spectrum herbicide (7.18 and 33.28) treated plots, while maximum density was observed in control with 32 cm row space (58.37 and 208.83), respectively (Tables 3 & 4).

Variety inqilab-91 is the tallest and thus having larger canopy as compared to other two varieties, it might have suppressed weeds germination and establishment by better shading. The broad-spectrum herbicide best controlled both grassy and broad leaved weeds. The above findings are in agreement with work of Boparai *et al.*, (1991), Panwar *et al.*, (1995), Prasad and Singh, (1995), Brar *et al.*, (1997), Sodhi *et al.*, (1998), Kotru *et al.*, (1999), who had found that greater height and broad spectrum herbicide (isoproturon + 2,4-d) controlled weeds population more effectively as compared to grassy weeds killer or broad leaf herbicide used alone. The second best interaction having minimum (8.32) grassy weeds was inqilab-91 x use of grassy weeds herbicide. These findings are also in agreement with Sodhi *et al.*, (1998), Brar *et al.*, (1997), Sharma *et al.*, (1991), Roperia *et al.*, (1991), and Thakur and Singh (1991), who reported that greater height of wheat variety and application of isoproturon controlled grassy weeds density in wheat crop.

The lowest grassy and broad leaf weeds m^{-2} recorded in 18 cm row space might be due to more competition from wheat crop for development resources. These findings are in agreement with the work of sharma *et al.*, (1989), Rath *et al.*, (1990), Vinod *et al.*, (1996), Jena and Behera (1998) and Sarir (1998), who reported that minimum weeds m^{-2} were found in narrow rows. While comparing the interaction of herbicides x row spaces, the least weeds density was found in broad-spectrum herbicide x 18 cm row space interaction: as availability of lesser space for weeds development and use of broad-spectrum (2,4-d + isoproturon) herbicide effectively controlled weeds. These findings are in analogy with the work of Bhagawati *et al.*, (1989), Sharma *et al.*, (1989), Rath *et al.*, (1990), Boparai *et al.*, (1991), Panwar *et al.*, (1995), Prasad & Singh, (1995), Vinod *et al.*, (1996), Sarir (1998), and Jena and Behera (1998), Kotru *et al.*, (1999), who verified that with the closer row spacing (15

Table 1. Effect of Varieties, Herbicides, and Varieties x Herbicides Interaction on Grassy Weeds Density m^{-2} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Varieties	Herbicide				Varieties Mean
	Broad Spectrum	Broad Leaf	Grassy Leaf	Control	
Bakhtawar-92	8.63 d	50.19 b	9.63 d	57.11 a	31.39 a
Ghaznavi-98	8.53 d	47.02 c	9.10 d	52.77 b	29.36 b
Inqilab-91	7.77 d	44.76 c	8.32 d	50.39 b	27.81 b
Herbicide Mean	8.31 c	47.32 b	9.02 c	53.42 a	
LSD at alpha 0.01 for variety = 1.81					
LSD at alpha 0.01 for herbicide = 1.59					
LSD at alpha 0.01 for variety x herbicide = 2.75					

Table 2. Effect of Varieties, Herbicides and Varieties x Herbicides Interaction on Broad Leaf Weeds Density m^{-2} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Variety	Herbicide				Variety Mean
	Broad Spectrum	Broad Leaf	Grassy Leaf	Control	
Bakhtawar-92	37.53 f	39.81 ef	173.33 c	197.61 a	112.07 a
Ghaznavi-98	40.81 ef	45.83 e	175.50 bc	199.72 a	115.47 a
Inqilab-91	36.44 f	37.33 f	157.83 d	183.00 b	103.65 b
Herbicide Mean	38.26 e	40.99 e	168.89 b	193.44 a	
LSD at alpha 0.01 for variety = 5.16					
LSD at alpha 0.01 for herbicide = 4.67					
LSD at alpha 0.01 for variety x herbicide = 8.09					

Table 3. Effect of Herbicides x Row spaces Interaction on Grassy Weeds Density m^{-2} in Peshawar and D.I.Khan During 1998-99 and 1999-2000

Row Space (cm)	Herbicide				Row Space Mean
	Broad Spectrum	Broad Leaf	Grassy Leaf	Control	
Row space-18	7.18 j	42.70	7.86 ij	47.60 d	26.33 c
Row space-25	8.25 hi	47.50 d	8.98 gh	54.30 b	29.76 b
Row space-32	9.51 fg	51.77 c	10.22 f	58.37 a	32.47 a
LSD at alpha 0.01 for herbicide x row Space = 0.94					

Table 4. Effect of Row Spaces and Herbicides x Row spaces Interaction on Broad Leaf Weeds Density m^{-2} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Row space	Herbicide				Row space Mean
	Broad Spectrum	Broad Leaf	Grassy Leaf	Control	
18 cm	33.28 j	35.39 ij	160.53 e	177.08 c	101.57 c
25 cm	38.06 hi	41.31 gh	168.11 d	194.42 b	110.47 b
32 cm	43.44 fg	46.28 f	178.03 c	208.83 a	119.15 a
LSD at alpha 0.01for row space = 1.94					
LSD at alpha 0.01 for herbicide x row space = 3.88					

Table 5. Effect of Varieties on Dry Weed Biomass g m^{-2} day^{-1} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Variety	Variety Mean
Bakhtawar-92	207.33 a
Ghaznavi-98	200.36 b
Inqilab-91	188.00 c
LSD at alpha 0.01 for variety = 0.99	

Table 6. Effect of Herbicides on Dry Weed Biomass g m^{-2} day^{-1} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Herbicide	Herbicide Mean
Broad Spectrum	213.51 a
Broad Leaf	204.34 b
Grassy Leaf	195.66 c
Control	180.75 d
LSD at alpha 0.01 for herbicide = 0.81	

Table 7. Effect of Row spaces on Dry Weed Biomass g m^{-2} day^{-1} in Peshawar and D.I.Khan during 1998-99 and 1999-2000

Row Space (cm)	Row Space Mean
Row space-18	207.01 a
Row space-25	198.49 b
Row space-32	190.19 c
LSD at alpha 0.01 for row space = 0.70	

Table 8. Effect of Varieties and Varieties x Herbicides on Grain Yield (t ha^{-1}) during 1998-99 and 1999-2000 at Peshawar and D.I.Khan

Variety	Herbicide				Variety Mean
	Broad Spectrum	Broad Leaf	Grassy Leaf	Control	
Bakhtawar-92	5.07 a	4.93 ab	4.58 de	4.09 gh	4.67 a
Ghaznavi-98	4.84 bc	4.67 cd	4.34 f	3.91 hi	4.44 b
Inqilab-91	4.44 ef	4.39 ef	4.23 fg	3.87 I	4.23 c
Herbicide Mean	4.79 a	4.66 b	4.38 c	3.95 d	
LSD at alpha 0.01 for variety = 0.16					
LSD at alpha 0.01 for herbicide = 0.12					
LSD at alpha 0.01 for variety x herbicide = 0.21					

Table 9. Effect of Row Spaces and Locations x Varieties on Grain Yield (t ha^{-1}) during 1998-99 and 1999-2000 at Peshawar and D.I.Khan

Row space (cm)	Variety			Row Space Mean
	Bakhtawar-92	Ghaznavi-98	Inqilab-91	
Row space-18	4.88 a	4.72 b	4.42 e	4.67 a
Row space-25	4.72 b	4.39 e	4.22 d	4.44 b
Row space-32	4.40 e	4.21 d	4.08 d	4.23 c
LSD at alpha 0.01 for row space = 0.08				
LSD at alpha 0.01 for variety x row space = 0.14				

Fig 1. Effect of Wheat Varieties on Dry Matter Accumulation of Wheat Crop during 1998-99 and 1999-2000 at Peshawar

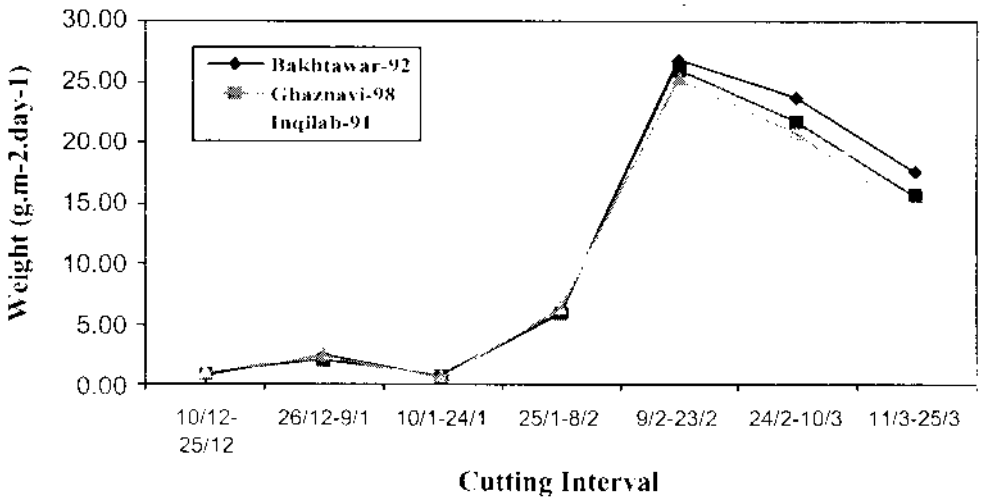


Fig 2. Effect of Herbicides on Dry Matter Accumulation of Wheat Crop during 1998-99 and 1999-2000 at Peshawar

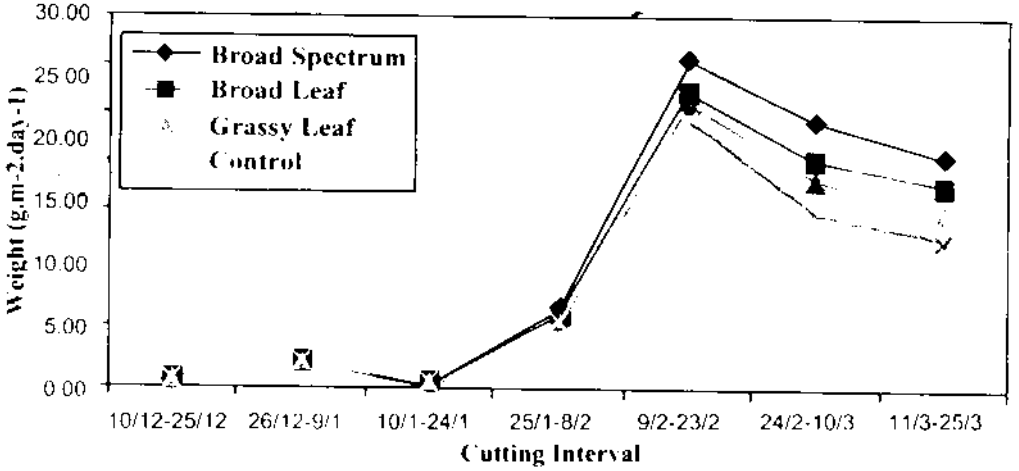


Fig 3. Effect of Row spaces on Dry Matter Accumulation of Wheat Crop during 1998-99 and 1999-2000 at Peshawar

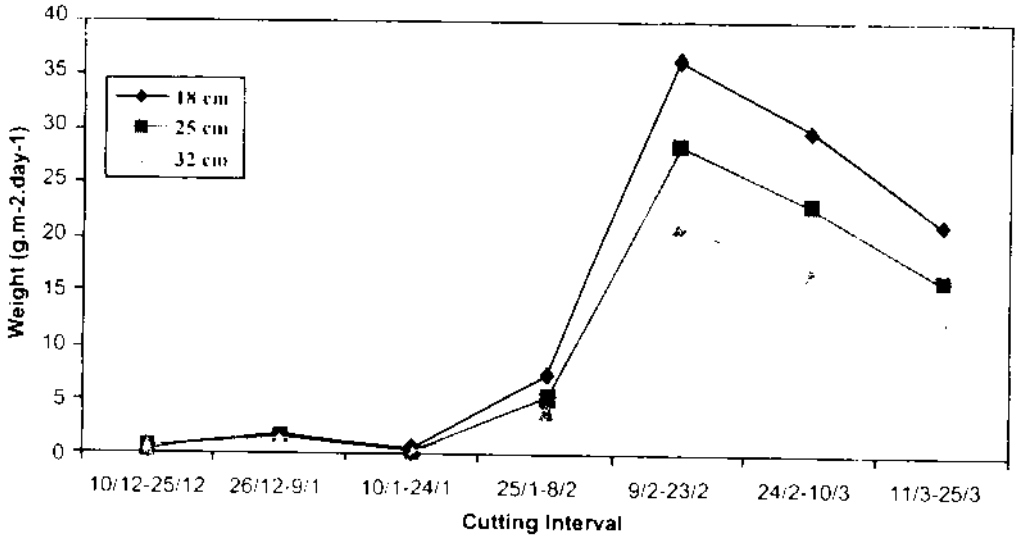


Fig 4. Effect of Wheat Varieties on Dry Matter Accumulation during 1998-99 & 1999-2000 at D.I.Khan

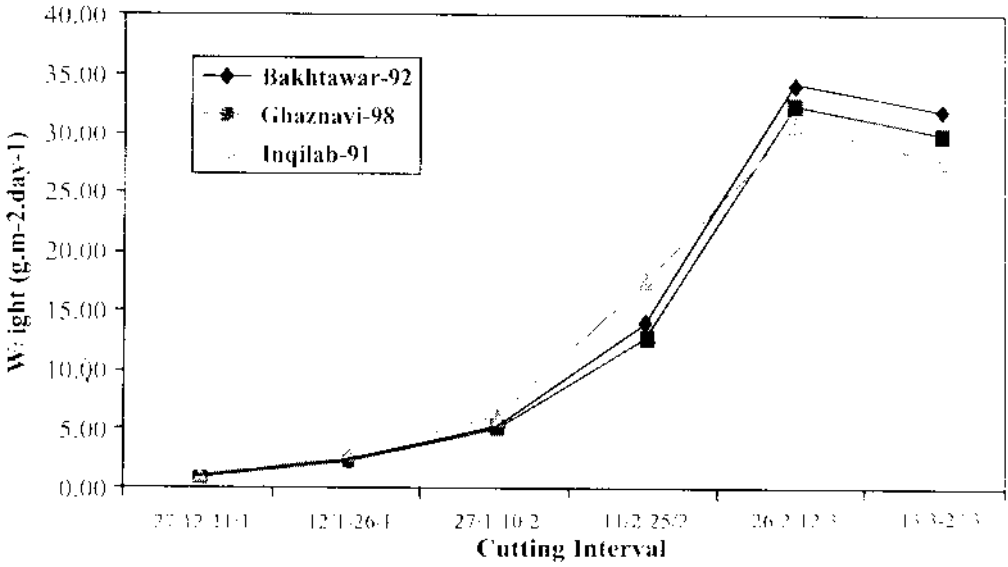


Fig 5. Effect of Herbicides on Dry Matter Accumulation of Wheat Crop during 1998-99 and 1999-2000 at D.I.Khan

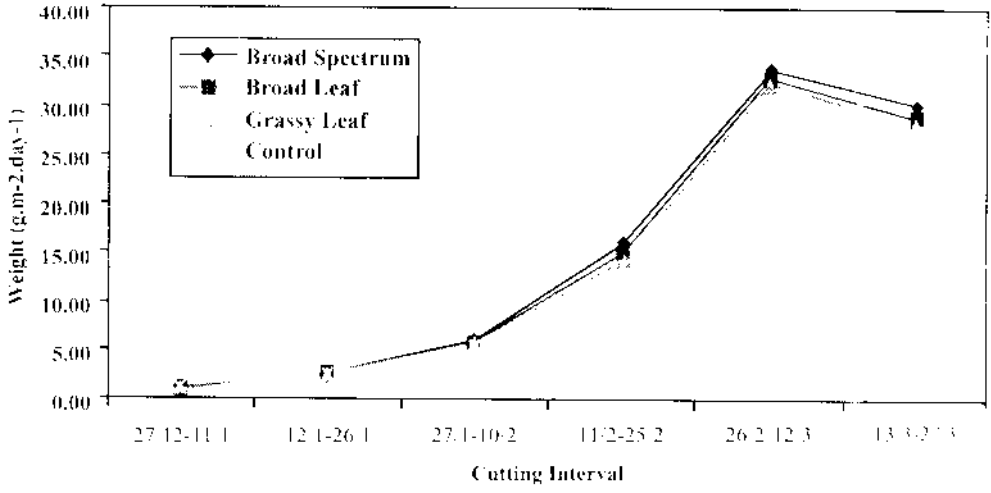
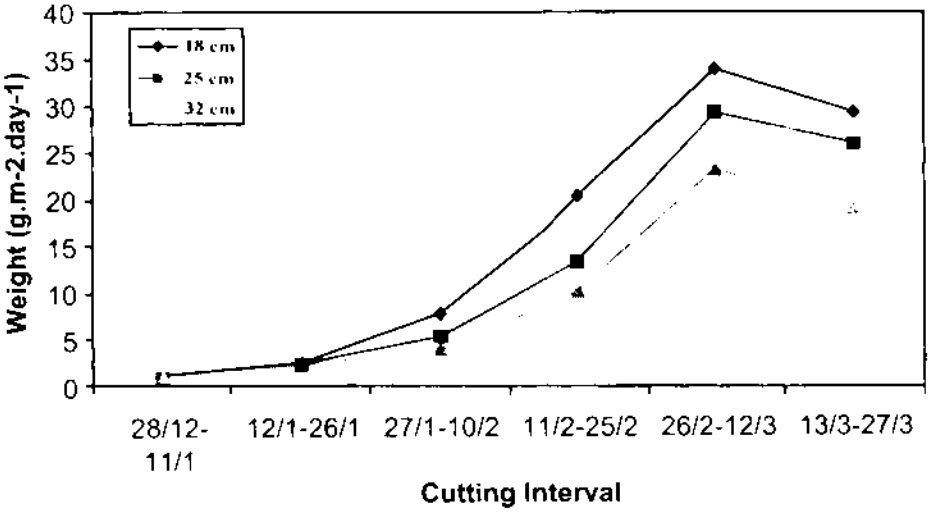


Fig 6. Effect of Row spaces on Dry Matter Accumulation of Wheat Crop during 1998-99 and 1999-2000 at D.I.Khan



LITERATURE CITED

Angiras, N.N., Vinod Sharma, and V.Sharma .1996. Influence of row orientation, row spacing and weed control methods on physiological performance of irrigated wheat (*Triticum aestivum*). Indian J. Agron. 41(1): 41-47.

Anonymous. 1996. Agricultural Statistics of Pakistan, Government of Pakistan, Ministry of Food and Agriculture and Cooperative, Food and Agriculture Division (Planning Unit), Islamabad.

Azad, B.S., H. Singh, and H.Singh. 1997. Effect of weed control measures and nitrogen on productivity of wheat (*Triticum aestivum*). Indian J.Agron. 42(1):98-103.

Behera, AK. 1995. Effect of seed rate, row spacing and fertilizer on wheat (*Triticum aestivum*). Indian J. Agron. 40 (3): 510-511.

Bhagawati, PC., A.S.Faroda, and R.K.Malik. 1989. Competition between wheat and associated weeds at different nitrogen rates. Beitrage zur Tropischen Landwirtschaft-und-Veterinarmedizin. 27(4): 427-433.

Boparai, BS., H.S.Dhaliwal, and D.Singh.1991. Chemical control of small canary grass (*Phalaris minor*) and broad-leaf weeds in wheat (*Triticum aestivum*). Indian J.Agron. 36: Supplement, 198-201.

Brar, L.S., S.Bhagwant, and B.Singh.1997. Efficacy of diclofop-methyl against isoproturon-resistant *Phalaris minor* in relation to wheat cultivars and spacing. Crop protection conference on weeds. Proceedings of an international conference, Brighton, U.K. 17-20, November, 1997. Volume 1.331-336.

Chatta, M.A. 1973. Investigating chemical weed control in wheat. M.Sc. Thesis. W.P. Agricultural University. Lyallpur.

Dwyer, L.M., M. Tollenaar, and D.W.Stewart. 1991. Changes in plant density dependence of leaf photosynthesis of maize (*Zea mays L.*) hybrids. 1959 to 1988. Can.J.Plant Sci.71:1-11.

Ercoli,L. and A.Masoni 1995.Effects of row spacing and orientation on yield and yield components of winter wheat. Agricoltura Mediterranea. 125(3):215-221.

Jena, S.N., and A.K.Behera. 1998.Effect of row spacing, seed rate and fertilizer levels on weeds and yield of wheat (*Triticum aestivum*). Indian Agriculturist. 42(2):139-142.

Koturu, R., B.S.Azad. and H.Singh. 1999. Chemical control of weeds in wheat (*Triticum aestivum L.*). in India.Environment and Ecology. 17(3): 646-649.

Malik. MA., M.Haroon-ur-Rasheed, and A. Razzaq. 1996.Row spacing study on two wheat varieties under rainfed Conditions. Sarhad J.Agric. 12(1): 31-36.

Marko, F.1994. Effects of row spacing and seed rates on grain yield and properties of winter wheat seed. Rostlinna-Vyroba. 40(5):431-438.

Norris, R.F. 1982. Interactions between weeds and other pest in the Agro-Ecosystem. p.343-406. In J.L.Hatfield and I.J.Thomson(ed) Proc. Conf. On Biometeorology in Integrated Pest Management, Univ. of California, Davis, CA. 15-17 July, 1980. Academic Press. New York.

Panwar, RS., S.S.Rathi. and R.K.Malik. 1995. Effect of Isoproturon and 2, 4-D Combination on weed control in wheat. Haryana Agri. Univ. J.Res. 25 (3): 101-105.

Patel, HC. and P.N.Upadhyay. 1990. Integrated weed management in irrigated wheat. Indian J.Weed-Science. 22(1-2): 89-91.

Prasad, K., and R.S.Singh. 1995. Influence of weed and nitrogen management on weed growth, nutrient uptake and yield of wheat (*Triticum aestivum*). Indian J.Agric. Sciences. 65(2): 117-122.

Rajender K., J.S.Hooda, and R.Kumar.1996.Effect of methods of weed control on yield of wheat and associated weeds. Annals of Biology, Ludhiana. 12(1): 49-51.

Rath, R., R.B.L.Bhardwaj, and K.N.Ahuja. 1990. Effect of sowing methods and herbicide application on population, dry matter production and nutrient uptake by weeds and yield of wheat. Annals of Agri. Rese. 11(2): 115-160.

Roperia, S., R.S.Hooda, and R.K.Malik. 1991. Influence of herbicides on *Phalaris minor* in wheat. Haryana J.Agron. 7(2): 149-150.

Sarir, A.J. 1998.Effect of different levels of pre and post-emergence herbicides application on wheat planted at various row spaces. M.Sc. Thesis, Department of Agronomy, Faculty of Crop Production Sciences, NWFP Agricultural University, Peshawar, Pakistan.

Sharma, ML., S.K.Bhardwaji, and G.S.Bhardwaji. 1989. Comparative study of chemical and mechanical weed control in wheat. College of Agriculture, Gwalior, India. Haryana-Journal-of-Agronomy. 1989, 5: 2,177-178.

Sharma, ML., S.K.Bharadwaj, and G.S.Bharadwaj. 1991. Comparative efficiency of chemical and mechanical weed control methods in wheat. Indian J.Agron. 36(2): 260-261.

Sharma,V. N.N. Angiras, and V.Sharma1996. Effect of row orientations, row spacing and weed-control methods on light interception, canopy temperature and productivity of wheat (*Triticum aestivum*). Indian J.Agron. 41(3): 390-396.

Sodhi, PS., and BK. Dhaliwal.1998.Effect of crop density and cultivars on competitive interaction between wheat and wild oats (*Avena ludoviciana Dur.*). Indian J. of Ecol. 25 (2): 138-145.

Thakur, DR., and K.K.Singh. 1991. A note on weed control efficiency of Isoproturon and Methabenzthiazuron in wheat under mid Hills of Himachal Pradesh. Himachal J.Agric.Res. 17(1-2): 110-113.

Triplett, G. B., Jr. 1976. Management of weeds in reduced tillage system. Bull. Entomol.Soc. Am.22:298-299.

Young, F.JL., A. G. Ogg, Jr., R. I. Papendick, D.C.Thill, and J. R. Alldredge. 1994. Tillage and weed management affects winter wheat yield in an integrated pest management system. Agron. J. 86: 147-154.