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Effect of Weed Management Practices on Different Traits of Wheat

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Abstract: The experiment was laid-out to study the effect of weed management practices on different traits of wheat. The factors were: three varieties; three types of herbicides, broad-spectrum, broad leaf, grassy weeds herbicide and a control plots and row spacings 18, 25 and 32 cm were used. Varieties were assigned to main plots, herbicides kept in subplots and row spacings arranged in sub-sub plots. Broad spectrum herbicide controlled more effectively both grassy and broad leaf weeds and reduced dry weed biomass and increased grain yield ha^{-1}. Effect of varieties on grassy and broad leaf weeds density m^{-2} was nonsignificant and dry weed biomass was lower in variety Inqilab-91, while grain yield was higher in Bakhtawar-92. In 18 cm row spacing number of grassy and broad leaf weeds m^{-2} were less as compared to row spacing 25 and 32 cm. Absolute growth rate at 15 days interval was more in variety Inqilab-91 up to 4th cutting, but later on maximum ratio was recorded in Bakhtawar-92 having more tillers m^{-2}. Highest dry matter accumulation was recorded in broad-spectrum herbicide treated plots followed by broad leaf and grassy weed herbicide and control. The absolute growth rate was more in 18 cm row spacing, followed by 25 and 32 cm. It can be concluded that variety Bakhtawar-92 integrated with broad-spectrum herbicide and 18 cm row spacing would minimize weeds density and maximize wheat production.

Key words: Weed control in wheat, dry weed biomass, growth rate

Introduction

Wheat (*Triticum aestivum* L.) production per unit area is low in Pakistan 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% (Burns, 1944).

Proper row spacing is one of the most important factors affecting the growth specially the weeds growth in the early stages of the crop development. 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.

Control of weeds is a basic requirement and major component of management in most crop production systems (Young *et al.*, 1994; Norris, 1982). 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 and good quality seed.

Materials and Methods

An experiment was laid out at NWFP Agricultural University, Peshawar (Pakistan), for two consecutive seasons 1998-1999 and 1999-2000 to study effect of varieties, row spacing and herbicides on different traits of wheat. Split plot design was used replicated three times. The factors include were: three varieties (Bakhtawar-92, Ghaznavi-98, Inqilab-91), three 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 herbicide (Isoproturon 75% WP) and a control and three row spacings 18, 25 and 32 cm. Varieties were allotted to main plots, herbicides to sub-plots and row spacings were kept in sub-sub-plots. Data on being observations were collected using the following procedure: for weeds density m^{-2} was recorded by randomly throwing 33 x 33 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°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). 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°C (for 72 h) till it dried to a constant weight and thereafter its dry matter yield was computed g m^{-2} day $^{-1}$. Grain yield was recorded on per plot basis and then converted into tons ha^{-1}.

The data were statistically analyzed according to split plot design. The analysis of variance was applied to detect whether the effect of treatments for different characters were significant or not. The significant means were subsequently separated by the least significance difference test (LSD) by using the MSTAT-C computer software package.

Results and Discussion

Weeds density (m^{-2}): Effect of herbicides, row spacing, herbicides x row spacing and varieties x herbicides were found significant ($P < 0.01$). The lowest grassy and broad leaf weeds m^{-2} (Table 1) were recorded in broad spectrum herbicide (10.09, 41.33) treated plots and 18 cm row spacing (36.7 and 107.67), while maximum number of grassy and broad leaf weeds were recorded in control plot (72.65 and 203.52) and row spacing 32 cm (44.26 and 123.03). In the interaction of herbicides with row spacing, minimum grassy and broad leaf weeds m^{-2} were recorded in the broad-spectrum with 18 cm row spacing (8.67 and 37.06), while maximum number of grassy and broad leaf weeds were found in control with 32 cm row spacing (78.89 and 214.67) (Table 1). In the interaction of varieties with herbicides, minimum number of broad leaf weeds m^{-2} were found in variety Inqilab-91 and broad spectrum herbicide (36.83) interaction, while maximum (206.33) was recorded in Bakhtawar-92 with control treatment (Table 1).

The broad-spectrum herbicide best controlled both grassy and broad-leaved weeds. 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 above findings were in agreement with work of Prasad and Singh, (1995); Brar *et al.* (1997); Sodhi and Dhaliwal (1998) and Kotru *et al.* (1999), who 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 lowest grassy and broad leaf weeds m^{-2} recorded in 18 cm

Table 1: Effect of herbicides, varieties, row spacings and interactions on different trait of wheat

Parameters	Grassy weeds m^{-2}	Broad leaf weeds m^{-2}	Dry weed biomass m^{-2}	Grain yield (t ha^{-1})
Herbicides				
Broad spectrum	10.09c	41.33c	30.71c	4.76a
Broad leaf	69.19b	44.82c	33.57b	4.64a
Grassy leaf	10.82c	176.19b	35.38b	4.34b
Control	72.65a	203.52a	38.85a	3.90c
Varieties				
Bakhtawar-92	-	-	35.43a	4.67a
Ghaznavi-98	-	-	35.04a	4.46a
Inqilab-91	-	-	33.41a	4.09b
Row spacings (cm)				
Row space-18	36.71c	107.67c	27.18c	4.62a
Row space-25	40.33b	118.69b	34.42b	4.40b
Row space-32	44.26a	123.03a	42.29a	4.20c
Interaction of herbicides with varieties				
Broad spectrum x Bakhtawar-92	-	44.44de	-	5.14a
Broad leaf x Bakhtawar-92	-	47.39d	-	4.96ab
Grassy leaf x Bakhtawar-92	-	183.89b	-	4.53cd
Control x Bakhtawar-92	-	206.33a	-	4.03f-h
Broad spectrum x Ghaznavi-98	-	42.72de	-	4.88ab
Broad leaf x Ghaznavi-98	-	45.94d	-	4.72bc
Grassy leaf x Ghaznavi-98	-	179.50b	-	4.36de
Control x Ghaznavi-98	-	202.94a	-	3.89gh
Broad spectrum x Inqilab-91	-	36.83e	-	4.26d-f
Broad leaf x Inqilab-91	-	39.11e	-	4.20ef
Grassy leaf x Inqilab-91	-	165.17c	-	4.11e-g
Control x Inqilab-91	-	200.28a	-	3.77h
Interaction of herbicides with row spacings				
Broad spectrum x 18 cm	8.67g	37.06f	-	-
Broad leaf x 18 cm	62.50d	38.94ef	-	-
Grassy leaf x 18 cm	9.44fg	169.67c	-	-
Control x 18 cm	66.22c	185.00b	-	-
Broad spectrum x 25 cm	10.06e-g	41.22ef	-	-
Broad leaf x 25 cm	67.72c	44.56d-f	-	-
Grassy leaf x 25 cm	10.72e-g	174.33c	-	-
Control x 25 cm	72.83b	210.89a	-	-
Broad spectrum x 32 cm	11.56ef	45.72de	-	-
Broad leaf x 32 cm	74.33b	50.94d	-	-
Grassy leaf x 32 cm	12.28e	184.56b	-	-
Control x 32 cm	78.89a	214.67a	-	-
LSD at alpha 0.01				
Herbicide	1.52	4.96	1.29	0.17
Variety	-	-	1.64	0.35
Row space	1.32	4.29	1.12	0.15
Herbicides x varieties	-	8.58	-	0.30
Herbicides x row spacing	2.63	8.58	-	-

Table 2: Effect of wheat varieties on dry matter accumulation (g m^{-2} day^{-1}) during 1998-99 and 1999-2000 at Peshawar

No. of cutting	Date of cutting (15 days interval)	Variety: Bakhtawar-92	Ghaznavi-98	Inqilab-91
1st	10/12-25/12	0.62	0.41	0.88
2nd	26/12-9/1	2.06	1.87	2.15
3rd	10/1-24/1	0.50	0.45	0.52
4th	25/1-8/2	5.74	5.68	6.16
5th	9/2-23/2	26.93	26.11	25.45
6th	24/2-10/3	23.69	21.77	20.78
7th	11/3-25/3	17.48	15.63	14.05

row spacing might be due to more competition of wheat crop for development resources. These findings were in agreement with the work of Sharma *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 and row spacing, the least weeds density 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 were in analogy with the work of Rath *et al.* (1990); Boparai *et al.* (1991); Panwar *et al.* (1995); Prasad and Singh (1995); Sharma *et al.* (1996); Sarir (1998); Jena and Behera (1998) and Kotru *et al.* (1999); who verified that with the closer row spacing (15 cm), the weeds growth rate was lower, while light interception, crop growth rate and grain yield were higher than with the distant row spacing (20 cm).

Table 3: Effect of herbicides on dry matter accumulation (g m^{-2} day^{-1}) of wheat crop during 1998-99 and 1999-2000 at Peshawar

No. of cutting	Date of cutting (15 days interval)	Herbicides: Broad spectrum	Broad leaf	Grassy leaf	Control
1st	10/12-25/12	0.69	0.56	0.53	0.53
2nd	26/12-9/1	2.08	2.06	2.04	1.97
3rd	10/1-24/1	0.55	0.45	0.47	0.42
4th	25/1-8/2	6.49	6.06	5.59	5.65
5th	9/2-23/2	26.53	23.93	23.08	21.79
6th	24/2-10/3	21.60	18.47	16.79	14.30
7th	11/3-25/3	18.66	16.24	14.16	12.15

Table 4: Effect of row spacing on dry matter accumulation (g m^{-2} day^{-}) of wheat crop during 1998-99 and 1999-2000 at Peshawar

No. of cutting	Date of cutting (15 days interval)	Row space (cm): 18	25	32
1st	10/12-25/12	0.66	0.61	0.44
2nd	26/12-9/1	1.68	1.84	1.46
3rd	10/1-24/1	0.60	0.40	0.37
4th	25/1-8/2	7.30	5.33	4.21
5th	9/2-23/2	36.40	28.57	21.03
6th	24/2-10/3	29.80	22.91	17.03
7th	11/3-25/3	21.26	16.13	12.89

Dry weed biomass (g m^{-2}): Varieties, herbicides and row spacing significantly affected the dry weed biomass ($P<0.01$). The lowest dry weed biomass (33.41 g m^{-2}) was recorded in variety Inqilab-91 (taller variety), followed by var. Ghaznavi-98 (35.04 g m^{-2}) and Bakhtawar-92 (35.43 g m^{-2}). Among herbicides, minimum dry weed biomass (30.71 g m^{-2}) was recorded in broad-spectrum herbicide, followed by broad leaf (33.57 g m^{-2}), grassy leaf (35.38 g m^{-2}) and control (38.85 g m^{-2}) treatments (Table 1). Row space measuring 18 cm had minimum dry weed biomass (27.18 g m^{-2}) followed by 25 and 32 cm (Table 1).

These findings were in harmony with the work of Sodhi and Dhaliwal (1998), who reported that taller cultivar (PBW343) had a competitive advantage with weeds over dwarfer cultivar (HD2329). As a result cultivar PBW 343 exerted more canopy pressure over wild oats and reduced its dry matter production by 14%. The broad-spectrum herbicide effectively controlled weeds population and thus dry weed biomass was also lesser in this treatment. These findings were in agreement with Prasad and Singh (1995), Kumar *et al.* (1996) and Azad *et al.* (1997), who reported that combination of 2,4-D + isoproturon herbicide reduced dry weed biomass. The minimum dry weed biomass found in 18 cm row spacing might be due to less space available for development of weeds as compared to wider row spacings. These results were in agreement with the work of Angiras *et al.* (1996); Jena and Behera (1998) and Sarir (1998), who found that dry weed biomass increases with the increase in row spacing.

Absolute growth rate: The response of variety for dry matter accumulation during 1998-99 and 1999-2000 revealed that up to 4th cutting, maximum dry matter was attained by the variety Inqilab-91 followed by the variety Bakhtawar-92. The broad-spectrum herbicide treated plots accumulated maximum dry matter, followed by broad leaf and grassy weeds herbicides treated plots. The highest dry matter accumulation was recorded in 18 cm row spacing, followed by 25 and 32 cm row space. Among all cuttings, maximum dry matter accumulation was found in 5th cutting and then declined in 6th cutting (Tables 2, 3, 4).

Maximum dry matter accumulation in variety Inqilab-91 in the earlier cuttings correlates with less dry weed biomass recorded in the same variety. Evidently Inqilab-91 captured the space earlier; hence it was more competitive with the weeds and affected their growth adversely. These findings were in agreement with Sodhi and Dhaliwal (1998) who reported that taller variety had more dry matter accumulation as compared to dwarfer variety. From 5th cutting onward maximum accumulation of dry matter found in Bakhtawar-92, followed by Ghaznavi-98, which might be due to higher number of tillers m^{-2} in Bakhtawar-92 and Ghaznavi-98 as compared to Inqilab-91. The maximum dry matter accumulation observed in the 5th cutting might be due to optimum temperature for growth of wheat crop (maximum 28.8°C and minimum 12.13°C).

The maximum dry matter accumulation in 18 cm row space might be due to fact that in the same row space, maximum number of tillers m^{-2} were observed, which probably gave maximum dry matter accumulation in 18 cm row space. These findings were in agreement with Ercoli and Masoni (1995), who reported that above ground biomass progressively decreased with increasing row spacing.

Grain yield (t ha^{-1}): Effect of varieties, herbicides, row spacing and interaction of varieties with herbicides was significant. Maximum grain yield was recorded in the variety Bakhtawar-92 (4.67 t ha^{-1}), broad-spectrum herbicide (4.76 t ha^{-1}) treated plots and 18 cm row space (4.62 t ha^{-1}) (Table 1). In the interaction of varieties with herbicides higher grain yield was recorded in variety Bakhtawar-92 x broad-spectrum herbicide (5.14 t ha^{-1}), while lowest yield was observed in variety Inqilab-91 with 32 cm row spacing (3.77 t ha^{-1}).

The maximum grain yield in variety Bakhtawar-92 was probably due to higher genetic potential of variety Bakhtawar-92 for yield as compared to other two varieties. Maximum grain yield in broad-spectrum herbicide treated plots might be that it controlled both types of weeds in the treatments and out yielded rest of the herbicides. These results were in agreement with the findings of Boparai *et al.* (1991), Azad *et al.* (1997). Kotru *et al.* (1999) reported that post-emergence application of 2, 4-D + isoproturon was found to be the best treatment combination in reducing dry matter of weeds and producing the greatest straw and grain yields (5.93 and 3.96 t ha^{-1}, respectively, compared to 2.74 and 1.66 t ha^{-1} in the un-weeded control).

The maximum grain yield observed in 18 cm row spacing might be due to the fact that the productive tillers were more in 18 cm row spacing as compared to other two row spacings. These results were in agreement with the work of Marko (1994), Behera *et al.* (1995), Ercoli and Masoni (1995) and Malik *et al.* (1996), who found that grain yield was highest at 6 and 15 cm row spacing and decreased at wider row spacing.

The most effective herbicide was the broad spectrum (2, 4-D + isoproturon), which reduced number of weeds, dry weed biomass and gave maximum grain yield ha^{-1} as compared to broad leaf (2, 4-D) and grassy (Isoproturon) herbicide used alone. Among varieties, Bakhtawar-92 gave the highest grain yield followed by Ghaznavi-91 and Inqilab-91, while dry weed biomass was less in treatment of variety Inqilab-91 followed by Ghaznavi-98 and Bakhtawar-92. The 18 cm row spacing gave the best results by reducing weeds in the field, dry weed biomass and increased grain yield as compared to 25 and 32 cm row spacing.

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