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WEED MANAGEMENT THROUGH PLANTING DATE, SEEDING RATE AND WEED CONTROL METHOD IN WHEAT

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ABSTRACT

A field trial was conducted during 1990-91 to 1992-93 to assess the effect of planting date, seeding rate and weed control method on the weed density, dry weed biomass and grain yield of wheat at Cereal Crops Research Institute, (CCRI) Pirsabak, Nowshera, Pakistan. The treatments were three planting dates viz; October 15, November 15 and December 15, three seeding rates viz; 50, 100 and 150 kg ha^{-1} and three weed control methods viz; no weeding, manual and chemical weeding with Dicuran MA-60 WP (Chlorotoluran + MCPA) @ 2.25 kg ha^{-1}. The data indicated that weeds density and dry weed biomass were lesser in December 15 planting compared to early and mid plantings of October 15 and November 15. An increase in the seeding rate viz. 150 kg per hectare decreased the weeds density and dry weed biomass. Chemical weed control with Dicuran MA-60 was the most effective in decreasing weeds density and dry weed biomass as compared to manual or no weeding. The crop planted on November 15, produced the highest grain yield as compared to late and early planting. The 100 kg ha^{-1} seeding rate produced the highest grain yield followed by 150 kg seeding rate. The interaction between planting date x seeding rate x weeding method was significant for weeds density and non significant for weed biomass. The three-way interactions indicated that increasing the seeding rate with later seeding date and chemical weeding suppressed the weeds density and reduced the weed biomass. The combined interaction of planting date x seeding rate x weeding method averaged across the years demonstrated that mid November planting with 100 kg seeding rate per hectare and chemical weeding was the best in increasing the grain yield

Key Words: Weed management, planting date, seed rate, wheat

INTRODUCTION

Wheat (*Triticum aestivum* L. em Thell) is one of the most important cereal crops of Pakistan. It plays an important role in the dietary requirements of the country. A tremendous increase in the human population demands a sure supply of food for keeping the human race prosperous and healthy. For obtaining an increase in productivity, wheat breeders and agronomists are developing wheat varieties, which are high yielding, disease resistant, responsive to fertilizer, cultural managements, resistant to drought and other stresses. Despite all the efforts towards increasing the production, the national average yield of wheat per hectare is still far below the potential yield. There are many factors contributing to low yield but weeds infestation is the major one. Weed control is a basic and major component of management in crop production system (Young et al., 1994; Norris, 1982). Weeds particularly in the early season compete strongly with wheat crop and as a result cause considerable losses to wheat crop. Ghafoor and Sadiq (1991) and Byerlee et al. (1984) indicated that weeds compete with crop for nutrients, water, light and space causing considerable losses, ranging from 16 to 30% in wheat. They further indicated that weeds reduced wheat vigor, tillering, head size and kernel weight. Tanji et al. (1987) reported that weed competition resulted in grain yield losses upto 35% and straw yield losses upto 23% in wheat.

Planting date also is very important factor in wheat production. Choudhry et al. (1992) and Thill et al. (1978) found that early and mid planting of wheat realized the potential yield better than late planting. Bhan (1987) concluded that delaying the sowing of wheat past November reduced weed population

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but also reduced wheat yield. He further indicated that increasing the seeding rate from 100 to 150 kg ha^{-1} significantly reduced the dry matter of weeds and increased grain yield of wheat. Wilson et al. (1990) showed that an increased seeding rate of barley reduced the initial growth of wild oats seedlings. Blue et al. (1990) and Nazir et al. (1987) reported that 100 kg ha^{-1} was the most effective in producing taller plants and higher wheat yield as compared to low seeding rate.

Chemical and hand weeding have often been used as weed control method in wheat. Ahmad et al. (1993) and Singh and Singh (1996) observed that herbicide application and hand weeding decreased dry weight of weeds significantly compared to dry weight in non treated plots. Chemical weed control in wheat was better in producing maximum grain yield than hand weeding (Akhtar et al. 1991) Khan (1999) and Kotru et al. (1999) found that application of grassy and broad leaved herbicides increased grain yield and yield components. The objective of this study was to determine the effects of planting date, seeding rate and weed control method on weed control and wheat yield.

MATERIALS AND METHODS

A Three-year study (1990-91 to 1992-93) was conducted at Cereal Crops Research Institute, Pirsabak, Nowshera, Pakistan under irrigated conditions. Wheat variety Pirsabak-85 was used as a test cultivar. The trials were laid out in split- split plot design with four replications. Each sub-sub plot measured 5 x 1.8 m^2. The planting dates, seeding rates and weed control methods were randomized in the main sub and sub-sub plots, respectively. The experimental treatments comprised planting dates viz: October 15, November 15 and December 15, seeding rates of 50, 100 and 150 kg ha^{-1} and weed control methods of no weeding, manual and Dicuran MA 60 WP Dicuran MA-60 WP (Chlorotoluran + MCPA), @ 2.25 kg ha^{-1}. The crop was sown with a single row hand drill on a well prepared seed-bed in 30 cm apart rows. A basal dose of Nitrogen @ 120 kg ha^{-1} and Phosphorus @ 75 kg ha^{-1} was applied in the form of Urea and DAP, respectively. Half of Nitrogen and the whole of Phosphorus was applied at the time of sowing and the remaining half of Nitrogen was added with the 2nd irrigation. Except for weed control, all other agronomic practices were kept normal and uniform among all the treatments.

The herbicide Dicuran MA 60 WP was sprayed as post emergence after 1st irrigation, when the crop was at 2-3 leaf stage and soil was at field capacity. A knapsack hand sprayer with four "T" jet nozzles was used. Before spraying proper calibration was done for an appropriate application. Hand weeding was done 30 days after sowing in the concerned treatment with the help of a 'khurpa' (a hand hoeing tool).

The data were recorded on weed density and biomass m^{-2} and grain yield (kg ha^{-1}). Weeds were counted at two stages, first at 30 days after sowing before applying weed control methods and second 60 days after sowing, when the treatments had shown their effects. For counting weeds a quadrate of 1m^2 was used and it was thrown twice at random in each treatment. The data on dry weed biomass were recorded at the time of harvest. For determination of dry weeds weight a quadrate of 1m^2 was used at random in each treatment and weeds were pulled out. These weeds were then dried in oven and subsequently weight was recorded. Grain yield data were recorded by harvesting 4 central rows measuring 6m^2 area. The bundles from each treatment were dried and threshed separately. Grains were dried to a uniform moisture level of 13% and net wheat yield per treatment was determined and converted to kg ha^{-1}.

The data of three years, so collected were analyzed statistically using ANOVA technique and the significant means were separated at by the least significant difference test (Steel and Torrie, 1980)

RESULTS AND DISCUSSION

Weeds density m^{-2}

In total, eleven weed species were recorded infesting wheat crop at the experimental site. The weeds infestation data (Table-1) in percentage averaged across years indicated that the infestation of broad leaf weeds was more prevalent than grassy weeds in this area. *Phalaris minor* had the highest intensity of 13% among the grassy weeds, while *Convolvulus arvensis, Spergula arvensis, Silene conoidea* and

Melilotus parviflora were more numerous (13 to 17%) among the broad leaf weeds. Previous research of Khushk and Memon (1991) also reported all these weed species infesting wheat crop. Among the weeds, recorded, Sweet clover (*Melilotus parviflora)* had the highest intensity of 25%, followed by canary grass (*Phalaris minor*) with 22% infestation. Byerlee et al. (1984) indicated 28% of wheat fields in Punjab as having substantial to serious *Phalaris* problem and 13% wild oat problem. They estimated an average yield of 1.93 t/ha from clean fields compared to 1.39 t/ha in fields infested with *Phalaris*. Geological and ecological differences deeply influence the weed species in each region and therefore as environmental conditions were different at this site than others, the weed species at this site were also different than at other sites. Similar observations were also quoted by Peng (1984). The data (Table 2) further indicated that the three agronomic practices significantly affected weeds density m^{-2}. The maximum weeds emerged in October 15 planting followed by November 15 planting. This could be due to suitable temperature for weeds growth. There were fewer weeds in December 15 planting. Reduction in weed density in December planting most probably resulted due to the delayed planting, when thermo-sensitive weeds had emerged which were uprooted in the land preparation. Bhan (1987) also reported that delay in the planting of wheat past November reduced weeds population and growth. Wheat at high seeding rate of 150 kg ha^{-1} reduced the weeds density m^{-2} compared to seeding rate of 50 or 100 kg ha^{-1}. The results suggested that high density of wheat plants successfully competed the weeds for light, space and nutrients and reduced the weeds density significantly. Wilson et al. (1990) also reported that an increased seeding rate of barley reduced the initial growth of wild oats seedlings. The weeding methods were more effective in reducing weeds density than planting date and seeding rate. However, chemical weeding was more effective than hand weeding. Other studies also indicated the same trend (Ahmad et al., 1993). They revealed that weeds density after weeds control was highest in no weeding plots, while minimum number of weeds m^{-2} were found in Dicuran MA-60 applied plots. The mean values across the years for all the interactions were significant. The combined interaction between planting date x seeding rate x weeding method for weeds density showed that maximum weeds were in October planting with 50 kg ha -1seeding rate per hectare and no weeding. 150 kg seeding rate accompanied by chemical weeding depressed the weeds in all sowing dates. Minimum weeds were in the plots where planting was on December 15 with seeding rate of 150 kg ha and chemically weeded.

Dry weed biomass (g m^{-2})

Mean values across years for different planting dates (Table-3) indicated that minimum dry weed biomass was recorded in plots where the seeding was done on December 15. Maximum dry weed biomass was Recorded in plots planted on October 15. Seeding rates also affected biomass. Minimum dry weed biomass was recorded in plots, where the seeding rate was 150 kg per hectare. The maximum dry biomass was obtained in plots where the seeding rate was 50 kg per hectare. Similar results were reported by Bhan (1987), who indicated that increasing the seeding rate from 100 to 150 kg ha^{-1} significantly reduced the dry matter yield of weeds. Biomass was markedly affected by different weed control methods. Weedy plots produced the highest biomass compared to other treatments. The lowest biomass was recorded in those plots, where the weeds were controlled by the herbicide. These findings are in line with previous research of Panwar et al. (1995).

Table-1 **Weeds and their infestation percentage in wheat field during various years.**

				% age infestation			
Weeds	English name	Local name	Family	1990-91	1991-92	1992-93	Mean
Grasses							
Phalaris minor	Canary grass	Chundwage	Gramineae	18	12	9	13
Avena fatua L.	Wild oat	Jumdur	Gramineae	9	7	2	6
Broad leafs							
Convolvulus arvensis L.	Field Bind weed	Pravatay	Convolvulaceae	15	17	13	15
Spergula arvensis L.	Sand weed	Khachay	Carophylaceae	13	24	14	17
Silene conodiea L.	Conoid catchfly	Mangota (spingulay)	Carophyllaceae	9	17	13	13
Chenopodium murale L.	Nettle leaf goose foot	Sarmay	Chenopodiaceae	7	10	7	8
Medicago denticulata L.	Wild medich	Peshtaray	Papilionaceae	5	3	4	4
Melilotus parviflora L.	Yellow clover	Levanay	Papilionaceae	16	9	20	15
Anagallis arvensis L.	Scarlet pimpernel	Mangota (adigulay)	Primuliaceae	4	3	8	5
Coronopus didymus L.	Swine cress	Alum	Brassicaceae	4	1	1	2
Fumaria parviflora	Fumitory	Papra	Fumariaceae	3	1	2	2

Table-2 Weeds density m^{-2} as affected by planting dates, seeding rates and weed control methods in various years.

Treatments	30 days after sowing before weed control				60 days after sowing after weed control			
	1990-91	1991-92	1992-93	Mean	1990-91	1991-92	1992-93	Mean
Planting date								
October 15	142 a	198 a	380 a	240 a	62 a	107 a	176 a	115 a
November 15	136 a	107 b	368 b	203 b	54 b	59 b	178 a	97 b
December 15	111 b	61 c	156 c	109 c	44 c	38 c	70 b	51 c
Seeding rate								
50 kg/ha	133 ns	134 a	354 a	207 a	61 a	90 a	181 a	111 a
100 kg/ha	128 ns	125 a	316 b	189 b	53 b	68 b	151 b	91 b
150 kg/ha	128 ns	107 b	234 c	156 c	46 c	48 c	97 c	62 c
Weeding methods								
No weeding	116 c	152 a	291 b	187 a	116 a	152 a	291 a	187 a
Hand weeding	141 a	111 b	318 a	190 a	32 b	38 b	97 b	55 b
Chemical weeding	132 b	102 b	295 b	176 b	13 c	13 c	36 c	21 c
Years Mean	130 b	122 c	301 a	184	53 c	68 b	141 a	

Mean followed by different letter, are significantly different by the LSD at P=0.05.

Prasad and Singh (1995) Prasad and Rafey (1996) and Singh and Singh (1996), who reported that herbicide application was the best treatment in reducing dry weed biomass and produced the greatest straw and grain yields as compared to un-weeded plots.The interaction between planting date x weeding methods and seeding rate x weeding methods was significant when data were combined across years. The interactions between planting date x seeding rate and planting date x seeding rate x weeding method were non-significant. The combined interaction between planting date x seeding rate x weeding method showed that 15 December planting with 150 kg ha^{-1} seeding rate and chemically weeded plots produced the lowest weed biomass.

Table-3. Dry weed biomass (g m^{-2}) affected by planting datesxratesxcontrol methods.ars.

Treatments	1990-91	1991-92	1992-93	Mean
Planting date				
October 15	144 a	94 a	83 ns	107 a
November 15	110 a	86 a	62 ns	86 b
December 15	51 b	76 b	72 ns	66 c
Seeding rate				
50 kg/ha	120 a	93 a	73 ns	95 a
100 kg/ha	107 a	86 b	76 ns	90 a
150 kg/ha	78 b	77 c	68 ns	74 b
Weeding method				
No weeding	173 a	166 a	153 a	164 a
Hand weeding	115 b	75 b	58 b	83 b
Chemical weeding	18 c	14 c	6 c	13 c
Years Mean	102 a..	85 b	72 c	86

Means followed by different letters are significantly different by the LSD test at P=0.05

Grain yield (kg ha^{-1})

Statistical analysis of the data revealed that planting date, seeding rate and method of weed control significantly affected grain yield per hectare (Table-4). The mid planting of November 15 produced maximum grain yield, followed by early planting of October 15. These results agreed with those of Choudhry et al (1992) and Thill et al (1978), who concluded that early and mid planted wheat had superior grain yield potential because its rooting system was capable of extracting sufficient soil water during spring to sustain a good plant water status, thus maintaining a greater leaf area during the grain filing period. Late planting frequently leads to yield reduction due to onset of high temperature and drought before maturity. As regards crop density, mean values across years, for different seeding rate indicated that there was a corresponding increase in grain yield from low to high seeding rate. This increase was only significant between 50 kg and 100 kg ha $^{-1}$ 100 kg ha^{-1} was better in producing maximum grain yield than low and high seeding rate. This yield increase could be partially attributed to an increase in productive tillers, which helped in controlling weeds. These results are in agreement with those of other researchers (Nazir et al,1987 and Blue et al.1990). There was also significant difference in weed control methods. Maximum grain yield was recorded in those plots where weeds were controlled by herbicide, whereas minimum grain yield was recorded in the plots where weeds were not controlled by any method. The overall results revealed that weed control by any method increased wheat yield. However, chemical weed control was the most acceptable. Similar findings were reported by Ahamd et al (1993) and Singh and Singh (1996), who concluded that herbicide application and hand weeding increased grain yield compared to unweeded check. However chemical weeding was more effective than hand weeding. In other studies Khan (1999) and Kotru et al (1999) also reported the similar results. They reported that application of grassy and broad leaf herbicides increased grain yield and yield components. Mean values across years for planting date x weeding method interaction was significant, while non-significant for all other interactions. The interaction between the two variables viz planting date x weed control method indicated that mid November planting accompanied with herbicide application for weed control was beneficial in increasing the grain

yield. The grain yield varied over the years, because of the difference in seasonal patterns. During December 1990-91, rainfall was optimum for best wheat growth. This is the time which has been generally considered the critical stage for root development resulting at later stages in better nutritional and water absorption. The lowest grain yield during 1992-93 could be attributed probably to high rainfall during March and April 1993. High rainfall promoted lodging, and diseases and therefore lower average grain yield was obtained. Similar observations were reported by Salmon (1941), who indicated that high rainfall favored development of wheat diseases, promoted lodging and leached fertility elements particularly nitrates, from wheat rooting zone of the soil.

Conclusion and Recommendation

It is concluded from the results of the three years studies that wheat crop should be planted in the Ist fort-night of November with 100 kg seeding rate ha^{-1}. Chemical weeding is recommended for best weed control. In situations where chemical weed control is not done either due to cost of the product or any other reason, the alternative could be weeding with mechanical method. In case weeding by mechanical or chemical method can not be carried out then 150 kg ha^{-1} seeding rate could suppress weeds and increase grain yield. Additional studies are suggested on the following lines:

i. Influence of crop density, spacing and varieties on weed competition and grain yield in wheat.
ii. Economics of weed control practices in wheat.

Table-4. Grain yield (kg ha^{-1}) of wheat as affected by planting dates, seeding rates and weed control methods in various years.

Treatments	1990-91	1991-92	1992-93	Mean
Planting date				
October 15	3737 b	3103 b	2353 b	3064 b
November 15	4624 a	3712 a	3146 a	3794 a
December 15	1663 c	1956 c	1256 c	1622 c
Seeding rate				
50 kg/ha	3108 b	2575 b	2087 b	2590 b
100 kg/ha	3500 a	3125 a	2316 a	2980 a
150 kg/ha	3307 a	3071 a	2351 a	2910 a
Weeding method				
No weeding	2954 b	2460 c	1800 c	2413 c
Hand weeding	3427 a	2991 b	2350 b	2923 b
Chemical weeding	3535 a	3293 a	2605 a	3144 a
Years Mean	3305 a	2974 b	2251 c	2827

Means followed by different letters are significantly different by the LSD test at P=0.05

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