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Suppressing Impact of *Avena fatua* and *Phlaris minor* on the Growth and Yield in Wheat

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Abstract: Weed-crop competition is a complex field of study. The extent of competition is governed by a number of factors including crop species, crop cultivar, crop density, weed species, weed density, the relative time of emergence of the crop and weed, the duration of the weed presence, the efficiency of weed control and soil and environmental factors. The greatest single cause of economic loss is, however, a reduction in yield due to weeds competing with the crop for available light, nutrients and moisture. The effect of *Phalaris minor* and *Avena fatua* on wheat was investigated at agronomic research area, College of Agriculture, Dera Ghazi Khan during 2007-2008. The experiment was laid out according to Randomized Complete Block Design (RCBD) having four replications and a net plot size of 5×2.5m. Plant density of 2, 4, 6 and 8 m^{-2} for *Phalaris minor* and *Avena fatua* was maintained. The data collected were analyzed using appropriate statistical techniques. Maximum plant density of wheat (96.500) was observed in T_1 (control). All other parameters like total number of tillers (403.25), number of fertile tillers (400.25) and maximum plant height (86.750) was also observed in T_1 (control). Growth and yield parameters like number of spike lets/spike, number of grains/spike, 1000 grain weight, grain yield and biological yield showed significant response in the presence of *Phalaris minor* and *Avena fatua* under study. Maximum grain yield (7.0500 t/ha) was obtained in T_1 (control) and T_2 (6.8500 t/ha) and T_6 (6.8750 t/ha), respectively. Maximum biological yield (14.875 t/ha) was obtained in T_1 (control) and T_2 (15.750 t/ha) and T_6 (15.975 t/ha), respectively. It can be conclude from the current study that presence of weeds (*Phalaris minor* and *Avena fatua*) in wheat has remarkable adverse effect on the yield and its contributing factors. As the density increases, the crop performance is gradually declined.

Key words: *Phalaris minor*, *Avena fatua*, weed density, growth, yield

INTRODUCTION

Wheat *(Triticum aestivum* L.) belongs to family Poaceae and ranks first in the world among cereal crops. It is the staple food of people of Pakistan and about 75% world's population. It not only meets the major dietary requirements of human being but also used as feed for animals as well as raw material for paper and clipboard industry in Pakistan (Kisana *et al.*, 2003).

Pakistan is predominantly an agricultural country. In spite of favorable conditions of soils, irrigation water and climate, the agriculture in the country suffers from under-production in term of yield/ha. Wheat is the most important cereal crop in Pakistan and thus occupies a central place in forming agriculture policies and dominates all crops in acreage and production. It contributes 14.4% to the value added in agriculture and 3.0% to gross domestic product (Pervaiz and Quazi, 1992). In Pakistan, during 2012-13 wheat was grown on an area of 8693 thousand hectares with total production of 24231 thousand tones (Government of Pakistan, 2013) with an average yield 2787 kg/ha, which is extremely low as compared to other important wheat growing countries like United Kingdom (8300 kg/ha), France (7700 kg/ha), Germany (7128 kg/ha) and Egypt (6300 kg/ha).

Use of poor quality seed, improper time of sowing, low and imbalance use of fertilizers, presence of weeds are the major production constraints. Among them weed infestation is one of the serious problems. In wheat fields, presence of certain weeds especially *Phalaris minor* (Dumbi sitti) and *Avena fatua* (Jangli jai) are one of the main reasons for decreasing its yield. Weeds compete with cultivated crops for light, nutrients, space and other growth factors, adversely affecting the quantity and quality of the produce (Qureshi *et al.*, 2002; Khan *et al.*, 2002). Wild oat (*Avena fatua* L.) competition increased the losses in yield of wheat with increased densities of seedlings. At a certain place, wild oat

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densities of 70 and 160 seedlings/sq reduced the wheat yield 22.1 and 39.1%, respectively, compared to the wild oat-free check (Khan *et al*., 2013).

Keeping these losses in view, present study was designed to investigate the impact of *Phalaris minor and Avena fatua* on growth and yield of wheat.

MATERIALS AND METHODS

The proposed research work was carried out at the Research Area, College of Agriculture, Dera Ghazi Khan during winter (Rabi) season 2007-2008. The experiment was laid out in Randomized Complete Block Design (RCBD) with four replications. The net plot size was 5×2.5 m. The following treatments (T_1: control, T_2, T_3, T_4, T_5: 2, 4, 6, 8 *Phalaris minor* plants/m^2 and T_5, T_6, T_7, T_8: 2, 4, 6, 8 *Avena fatua* plants/m^2, respectively) were tested in present studies. A wheat cultivar AS-2002 was sown on a well prepared field with single row hand drill on November 15, 2007, using seed rate of 105 kg/ha in 25 cm apart single row. Seeds of *Phalaris minor* (Dumbi sitti) and *Avena fatua* (Jangli jai) were mixed in wheat seed and broadcast in the field. After germination the extra weed plants were removed manually. The required weed population of weeds was maintained up to maturity of wheat. All other agronomic practices were kept normal and uniform for all the treatments. Plant protection measures were adopted to keep the crop free from pests and disease. Whole P(34 kg), K(25 kg) and 1/3rd N(14 kg) was applied at the time of sowing and remaining two doses of N(14,14 kg) were top dressed at the time of 2nd and 3rd irrigation, respectively. Urea, Diammonium phosphate (DAP) and Murate of potash (MOP) were used as a source of N, P and K, respectively. First irrigation was given twenty days after sowing at tillering stage, second irrigation was given after 80 days of sowing at booting stage and 3rd irrigation was given 128 days after sowing at milking stage. The crop was harvested on April 20, 2008 at full maturity.

RESULTS AND DISCUSSION

Total number of plants is an important yield component contributed to the total grain yield. The minimum number of plants was observed in T_9 which has 8 *Avena fatua* plants/m^2, which is statistically similar to T_8 (6 *Avena fatua* plants/m^2). As the number of weeds increases the total number of wheat plants decreases. It means that more weeds caused more reduction of yield and *viceversa*. *Phalaris minor* causes severe reduction in grain yield as compared to *Avena fatua* in same infestation level. The maximum number of plants (96.5) m^{-2} were observed in T_1 (weedy check). It was followed by T_2, T_3, T_4 and T_5. T_3 was statistically similar with T_6, T_7, T_8 and T_9 which gave 85.75, 87.0, 85.25, 78.50 and 78.25 number of plants/m^2, respectively. Germination percentage of weeds is more than that of wheat. When number of weeds increases, more resources like water, nutrients, light and carbon dioxide are utilized by weeds which cause depletion of these resources for wheat plants because the weeds have more capacity to utilize these resources efficiently than wheat plants. These results are supported by Khan *et al.* (2013), Din *et al.* (2011) and Ali *et al.* (2004) that numbers of weeds are negatively correlated with number of plants/unit area and vice versa.

A fertile tiller/unit area is an important yield component which influences the final yield of wheat. Minimum number of tillers (381.50) were observed in T_8 followed by T_8, T_4 and T_6 having 382.25, 386.50 and 386.0 numbers of tillers/m^2, respectively. It means that more number of weeds decreased the number of fertile tillers. Maximum number of tillers (403.25) was observed in T_1 (control) in which weeds were controlled manually which was statistically similar with T_2 and T_6 in which 397.50 and 397.25 numbers of tillers are obtained, respectively. More numbers of tillers was due to the absence of weeds in control treatment. T_3 (4 *Phlaris minor* plants/m^2) shows non-significant results when compare it with T_5 (8 phlaris minor plants/m^2). Both weeds *Phlaris minor* and *Avena fatua* have same impact on tillers production at same infestation level. These results are supported by Ali *et al.* (2004) and Din *et al.* (2011) that numbers of weeds are negatively correlated with number of tillers/unit area and vice versa. The importance of fertile tillers is evident from the fact that it influences directly the final grain yield. The data presented in the Table 2 indicated that the minimum number of fertile tillers (377.5 m^{-2}) was observed in T_5 followed by T_4, T_7 and T_8 having 383.7, 383.25 and 377.7 number of fertile tillers/m^2, respectively. While the maximum number of fertile tillers (400.25 m^{-2}) were observed in T_1 (control), in which weeds were controlled manually followed by T_2 or T_6, T_3 T_4 and T_7 having 389.25, 385.50, 383.75 and 383.25 tillers/m^2, respectively. As the number of weeds increases the total number of fertile tillers decreases due to competitive stress on the neighboring wheat plants. When the comparison between *Phalaris minor* and *Avena fatua* was evaluated, the impact of *Avena fatua* was more to decrease number of fertile tillers. The results are statistically highly significant. These results are in accordance with the findings of Khan *et al.* (2013) and Mehra and Gill (1988) that numbers of weeds are negatively correlated with number of fertile tillers/unit area and vice versa.

Plant height is a function of both the genetic condition of a plant and the environmental conditions under which it is grown. Data on plant height of wheat as influenced by the presence of weeds like *Phalaris minor* and *Avena fatua* plants are presented in Table 2. It is evident from the table that average plant height of wheat was affected significantly by the presence of *Phalaris minor* and *Avena fatua*. Maximum plant height (86.75 cm) was

Table 1: Mean squares for studied traits

Source of variance	d.f	No. plants/m^2	Total No. tillers/m^2	No. fertile tillers/m^2	Plant height (cm)	Spike Length (cm)	No. Spikelets/Spike	No. grains/spike	1000-grain) weight (g	Grain yield (t/ha)	Biological yield (t/ha)
Replications	3	10 NS	44.917NS	28.963NS	13.1321NS	0.45556NS	1.4352NS	1.8889NS	0.87630NS	0.35435NS	0.07000NS
Treatments	8	136.861**	254.111**	219.257**	61.1136**	6.03257**	11.0625**	82.8819**	4.81590*	1.77236**	2.38715**
Error	24	15.917	28	28.775	4.6696	0.63701	1.5810	7.0764	0.81275	0.18727	0.07688

Table 2: Mean comparison for individual traits

Treatments	No. plants/m^2	Total No. tillers/m^2	No. fertile tillers/m^2	Plant height (cm)	Spike Length (cm)
Weed control by hoeing	96.50^a	403.25^a	400.25^a	86.75^a	11.50^a
2 *Phalaris minor* plants/m^2	87.00^b	397.50^a	389.25^b	84.00^{ab}	10.10^b
4 Phalaris minor plants/m^2	85.75^b	378.25^a	385.50^{bc}	80.75^c	9.75^{bc}
6 Phalaris minor plants/m^2	83.5^{bc}	386.00^b	383.75^{bcd}	80.45^c	8.75^{cd}
8 *Phalaris minor* plants/m^2	78.25^c	382.25^b	377.50^d	76.50^d	7.90^d
2 Avena fatua plants/m^{-2}	87.00^b	397.25^a	389.25^b	84.50^{ab}	10.225^b
4 *Avena fatua* plants/m^2	85.25^b	386.50^b	383.25^{bcd}	81.375^{bc}	9.50^{bc}
6 *Avena fatua* plants/m^2	78.50^c	381.50^b	377.75^{cd}	75.75^d	8.175^d
8 *Avena fatua* plants/m^2	78.25^c	382.25^b	377.50^d	76.50^d	7.90^d

Treatments	No. Spikelets/Spike	No. grains/spike	1000 grain weight (g)	Grain yield (t/ha)	Biologica yield (t/ha)
Weed control by hoeing	18.75^a	46.75^a	42.675^a	7.0500^a	14.875^c
2 *Phalaris minor* plants/m^2	18.00^{ab}	45.50^{ab}	42.650^a	6.8500^{ab}	15.750^b
4 Phalaris minor plants/m^2	17.50^{abc}	42.50^b	42.150^a	6.1000^{cd}	15.760^b
6 *Phalaris minor* plants/m^2	16.00^{cd}	42.50^b	41.450^b	6.3000^{bc}	16.225^a
8 *Phalaris minor* plants/m^2	14.50^d	35.50^c	40.150^c	5.3000^e	14.375^d
2 Avena fatua plants/m^2	17.75^{abc}	46.75^a	42.350^a	6.8750^{ab}	15.975^{ab}
4 *Avena fatua* plants/m^2	16.25^{bcd}	43.00^{ab}	42.000^a	6.1000^{cd}	16.100^{ab}
6 *Avena fatua* plants/m^2	14.50^d	36.50^c	40.150^c	5.6500^{de}	14.400^d
8 *Avena fatua* plants/m^2	14.50^d	36.00^c	40.125^c	5.3000^e	14.525^{cd}

achieved in the case of T_1 (control). It was followed by T_2 which gave plant height of 84.0 cm and in turn was statistically at par with T_6. The minimum plant height (75.75 cm) was achieved in T_5 and T_8 which was statistically similar with T_9. These results are in accordance with the findings of Khan *et al.* (2013) and Majeed and Sandhu (1984) that plant height increases with the increase in number of weeds and vice versa. The data presented in Table 2 showed that presence of weeds significantly affected the number of spikelets/spike. The maximum number of spikelets/spike (18.75) was recorded in T_1 (control) which is statistically at par with T_2, T_3 and T_6 which gave 18, 17.50 and 17.75 spikelets/spike, respectively. The minimum number of spikelets/spike (14.50) was observed in case of T_5 which was statistically similar with T_4, T_7, T_8 and T_9 which gave 16.0, 16.25, 14.50 and 14.50 number of spike lets/spike, respectively. It means that as the number of weed increases, the spikelets/spike decreases. These results are supported by Qureshi *et al.* (2002), Mehra and Gill (1988) that number of spikelets increases with the increase in number of weeds and vice versa. Spike length is an important yield component that contributed to the grain yield. The data presented in the Table 2 showed that presence of weeds significantly affected the spike length/spike. The data presented in Table 2 showed that, the minimum spike length (7.9 cm) was observed in T_5 and T_9 which was statistically similar with T_4 and T_8 (6 *Avena fatua* plants/m^2) which gave 8.750 and 8.175 cm spike length, respectively. The maximum spike length (11.50 cm) was observed in case of T_1 (control). It was followed by T_2, T_3, T_4, T_5, T_6, T_7 and T_8 having spike length 10.10, 9.750, 8.750, 7.90, 10.225, 9.50 and 8.175 cm, respectively. The results were statistically highly significant. These results are supported by Khan *et al.* (2002), Qureshi *et al.* (2002) and Khan *et al.* (2013) that spike length increases with the increase in number of weeds and vice versa.

Number of grain per spike is an important yield component which contributes materially towards final grain yield of wheat. Data regarding the number of grains/spike are given in the Table 2. It is evident from the data that presence of weeds has significant effect on number of grains/spike. T_1 (c zontrol) gave best result with a value of 46.75 which is maximum number of grains/spike which was statistically at par with T_2, T_3, T_4, T_6 and T_7. The significantly minimum number of grains/spike (35.50) was recorded in T_5 which had resulted from weed crop competition. These results are supported by Din *et al.* (2011), Ali *et al.* (2004) and Pervaiz and Quazi (1992) that number of grains/spike increase with the decrease in number of weeds/unit area and vice versa. 1000 grain weight reflected the photosynthetic efficiency of a plant and its potential to transport its assimilates to economically variable plant organs. The data pertaining to 1000 grain weight presented in Table 2 revealed that weedy and non-weedy plants had significant effects on 1000 grain weight. The significantly maximum 1000 grain weight (42.675 g) was obtained from T_1 (control) followed by T_2, T_3 and T_7 having 1000 grain weight (g) 42.650, 42.150 and 42.000, respectively. Minimum 1000 grain weight (40.125 g) was observed in T_9 followed by T_2, T_3, T_4, T_6 and T_8 having 1000 grain weight (g) 42.650, 42.150, 41.450, 42.350 and 40.150, respectively. These results are in accordance with the findings of Majeed and Sandhu (1984) and Mehra and Gill (1988) that 1000 grain weight increase with the decrease in number of weeds/unit area and vice versa. The final grain yield/ha is influenced by the combined effect of the individual yield components such as number of fertile tillers, number of grains/spike and 1000 grain weight. Yield/ha is the function of various yield determining parameters. Grain yield is an important parameter used for evaluation of effectiveness of any treatment because grain production is the ultimate objective of cereals used for feeding of human beings in the world. Maximum grain yield (7.05 t/ha) was recorded in case of T_1 (control). This was followed by T_2 which produced grain yield of (6.85 t/ha) and in turn did not differ statistically from T_6. Absence of weeds and increase in yield components of wheat due to better weed control might be the reason of high yield in T_1 (control) as compared to other treated plots. The results are in line with the findings of Khan *et al.* (2002), Din *et al.* (2011) and Kisana *et al.* (2003) that final grain yield in wheat grains in terms of Kg/ha increases normally with the decrease in number of weeds/unit area and vice versa. The weight of the total biomass/ha determines the overall growth and behavior of crop during the given period of time. Data pertaining to biological yield as affected by different treatment are given in Table 2. Data given in table reveals that the parameter under discussion was significantly influenced by different treatments. It is evident from the treatment means that maximum biological yield (16.225 t/ha) was reported in case of T_4 followed by T_3, T_6 and T_7 having biological yield (t/ha) were 15.760, 15.975 and 16.100, respectively. The minimum biological yield (14.40 t/ha) was recorded in T_8 followed by T_2, T_3, T_9 and T_1 (control), having biological yield (t/ha) were 15.750, 15.760, 14.525 and 14.875, respectively. This is made up of yield components such as number of tillers/unit area, number of grains/spike and grain weight. The data presented in this table indicated that biological yield was also affected by infestation level of *Phalaris minor* and *Avena fatua*. The results are statistically significant. It means that as the number of weeds increases, the biological yield decreases. These results are supported by Khan *et al.* (2013), Khan *et al.* (2002) and Qureshi *et al.* (2002) that final biological yield in wheat grains in terms of Kg/ha increases normally with the decrease in number of weeds/unit area and vice versa.

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