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Influence of Crop Density and Weeding Frequency on Crop Growth and Grain Yield in Wheat

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ABSTRAK

Influence of seed rates at 100, 125, 150, and 175 kg/ha and four weeding frequencies W_0 *(no weeding),* W_1 *(weeding after 20 days of sowing),* W_2 *(weeding after 20 and 40 days of sowing) and* W_3 *(weeding after 20, 40 and 60 days of sowing) on growth and yield of wheat were studied. The major weeds species were Chenopodium album L., Cynodon dactylon (L) Pers, Dactyloctenium aegyptium L. and Vicia sativa L. The highest grain yield per hectare, panicle length, and filled grains/panicle were obtained with the seeding rate of 125 kg/ha. The lowest grain yield (3.11 t/ha) with minimum effective tillers/plant, panicle length and filled grains/panicle were produced by the highest seed rate (175 kg/ha). The plant population per meter square was significantly influenced by seed rates. Weeding at 20 and 40 days after sowing* (W_2) *gave the highest grain and straw yields along with highest effective tillers/plant, panicle length, and filled grains/panicle. On the other hand no weeding treatment gave the lowest grain and straw yields, effective tillers/plant, panicle length and filled grains/panicle. The critical period of weed competition was between 20 and 40 days after sowing. High seed rate with three times weeding* (W_3) *decreased weed dry weight/m*^{2} *significantly.*

ABSTRACT

Influence of seed rates at 100, 125, 150 and 175 kg/ha and four weeding frequencies W_0 *(no weeding),* W_1 *(weeding after 20 days of sowing),* W_2 *(weeding after 20 and 40 days of sowing) and* W_3 *(weeding after 20, 40 and 60 days of sowing) on growth and yield of wheat were studied. The major weeds species were Chenopodium album L., Cynodon dactylon (L) Pers, Dactyloctenium aegyptium L. and Vicia sativa L. The highest grain yield per hectare, panicle length, and filled grains/panicle were obtained with the seeding rate of 125 kg/ha. The lowest grain yield (3.11 t/ha) with minimum effective tillers/plant, panicle length and filled grains/panicle were produced by the highest seed rate (175 kg/ha). The plant population per meter square was significantly influenced by seed rates. Weeding at 20 and 40 days after sowing* (W_2) *gave the highest grain and straw yields along with highest effective tillers/plant, panicle length, and filled grains/panicle. On the other hand no weeding treatment gave the lowest grain and straw yields, effective tillers/plant, panicle length and filled grains/panicle. The critical period of weed competition was between 20 and 40 days after sowing. High seed rate with three times weeding* (W_3) *decreased weed dry weight/m*^{2} *significantly.*

INTRODUCTION

Wheat (*Triticum aestivum*) stands first in regard to hectareage and production among the cereal crops of the world. In Bangladesh, wheat is second in importance as cereal crops next to rice. In 1989-90 an area cultivated was 592,000 hectares which produced 890,000 tons of wheat, with an average yield of 1.50 t/ha (Anonymous, 1991). During the last decade considerable efforts were made to increase the production of wheat in order to minimize food shortage in Bangladesh. Introduction of high yielding varieties and cultural practices like optimum fertilization, proper water management and weed control measures were the major efforts.

Weeds became a serious problem with the introduction of high yielding dwarf varieties of wheat and factors like plant population per unit area, fertilization and irrigation are considered essential for achieving high yields. Besides caus-

ing considerable reduction in yield, weeds deplete soil fertility, particularly nitrogen within 4 to 6 weeks of crop sowing (Gautem and Singh, 1981). Higher than recommended seed rate, within limits, may provide some degree of weed control in cereal crops (Dewling, 1984). Increasing plant populations per unit area increase competitiveness of plants with consequent reduction in weed growth. This practice may easily be adopted by farmers with a view to reducing weed infestation. Critical period of weed competition is the range within which a crop must be weeded to save the crop from ravages of weeds. It was observed that a weed free period of 30 days from sowing was sufficient to prevent crop loss due to weed competition in a wheat crop (Rahman *et al.* 1990). However, information on systematic approach to determine the time and frequency of weeding required for obtaining maximum yield of wheat is limited.

The objective of the study was to determine the optimum seed rate and time of weeding on the nature and degree of weed infestation, critical period of weed competition and performance of wheat.

MATERIALS AND METHODS

The experiment was conducted at the Bangladesh Agricultural University Farm, Mymensingh, Bangladesh. The trial site was the old Brahmaputra Floodplain region (UNDP/FAO, 1988) consisting of non-calcareous dark grey floodplain soil of silt loam texture. The soil contains about 1.9 % organic matter. The soil pH ranged from 5.6 to 7.4 (BARC, 1989).

The study consisted of two sets of treatments, which were the seeding rates and weeding frequencies. The seeding rates were 100 kg/ha (S_1), 125 kg/ha (S_2), 150 kg/ha (S_3) and 175 kg/ha (S_4). The weeding frequencies were no weeding (W_0), weeding at 20 days after sowing (DAS) (W_1), weeding at 20 and 40 DAS (W_2) and weeding at 20, 40 and 60 DAS (W_3).

The experiment was laid out in a split-plot design with three replications. Seed rates were main plot treatments and weeding frequencies were sub-plots. The unit plot size was 4m 3 2.5m (10 m^2). The land was prepared by harrowing followed by laddering. The land was uniformly fertilized with 80 kg N, 62 kg P_2O_5 and 45 kg K_2O/ha using urea, triple super phosphate and muriate of potash, respectively. The entire quantity of triple super phosphate and muriate of potash and one-third of urea were applied at the time of final land preparation. The remaining two thirds of the urea was top dressed in two equal splits at crown root formation stage (24 days after sowing) and lag vegetative phase (54 days after sowing). Seeds of wheat cultivar Kanchon were sown by hand at 25 cm spacing in 6 cm deep furrows. The crop was irrigated twice, 25 and 55 days after sowing following urea top dressings. There was no major infestation of insect pests and diseases and no plant protection measure was needed.

Effective tillers per plant, plant height, panicle length and filled grains per panicle were recorded from 10 randomly selected sample plants from each sub-plot. On the following day after sampling, the mature crop was harvested plot-wise. The harvested crop was cleaned, threshed and sun-dried. The weed species within quadrates were identified, cleaned and dried for 72 hours at 70°C. Grain and straw yields were recorded and expressed in ton per hectare (at 14% moisture). The plant population in each treatment was recorded using 1 m^2 quadrat.

The data were analyzed statistically and mean differences adjudged by Duncan New Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The predominant weed species was *Chenopo-dium album* which constituted about 44.6 per cent of the total weed vegetation with a population density of 166.77 plants per square meter and an intensity of 3.21. *Cynodon dactylon, Dactyloctenium aegyptium* and *Vicia sativa* constituted about 14.2, 11.94 and 8.91% of total weed vegetation with intensities of 1.02, 0.86 and 0.64, respectively. Degree of infestation by the weed species *Amaranthus viridis, Cyperus rotundus, Digitaria sanguinalis,* and *Polygonum hydropiper* were 7.42, 6.29, 3.09, 2.19 and 1.34% of weed vegetation with intensities of 0.54, 0.45, 0.22, 0.16 and 0.09, respectively. On the average 7.19 weeds competed against one wheat plant, of which 3.21 belonged to the family Chenopodiaceae, 2.10 to the family Gramineae and the remaining 1.88 to others (Table 1).

Weed Dry Weight

The weed dry weights recorded were comparable in all the weeding treatments at 20 days after sowing. Weed dry weight increased up to 60 days of sowing (Table 2a). The results also indicate

that there was active resurgence of weed infestations over the crop growing period (Table 2a). Seed rate had no significant effect in the weed dry weight per m^2 but there was a decreasing trend in weed dry weight with increasing seed rate (Table 2b). This is possibly as a result of higher plant population discouraged the growth of weed because of intra-crop competition. The dry weight of the weeds per m^2 was influenced by weeding treatments and responses were found to differ significantly. The maximum weed dry weight was recorded with the no weeding treat-

TABLE 1
Weeds in wheat and their intensity of infestation

Scientific Name	Weed population/m^2	Total weed vegetation (%)	Intensity of weed Infestation (no.)
Chenopodium album L.	166.77	44.60	3.21
Cynodon dactylon (L) Pers	53.11	14.20	1.02
Dactyloctenium aegyptium L.	44.66	11.94	0.86
Vicia sativa	33.33	8.91	0.64
Amaranthus viridis L	27.77	7.42	0.54
Cyperus rotundus	23.55	6.29	0.45
Digitaria sanguinalis	11.55	3.09	0.22
Polygonum hydropiper	8.22	2.19	0.16
Others	5.00	1.34	0.09
Total	373.96		7.19

TABLE 2(a)
Weed dry matter production at different stages of crop growth (g/m^2)

Treatments	20 DAS	40 DAS	60 DAS	At harvest
W_0 (No weeding)	-	-	-	79.25
W_1 (Weeding at 20 DAS)	10.43	-	-	33.83
W_2 (Weeding at 20+40 DAS)	11.33	20.51	-	23.65
W_3 (Weeding at 20+40+60 DAS)	10.11	21.53	30.55	19.68

TABLE 2(b)
Effect of seed rates and weeding treatments on weed dry weight at harvest (g/m^2)

Seed rate (S)	Weed (g/m^2)
S_1 (100 kg/ha)	44.68a
S_2 (125 kg/ha)	38.52a
S_3 (150 kg/ha)	37.29a
S_4 (175 kg/ha)	35.29a
Weeding (W)	
W_0 (No weeding)	79.25a
W_1 (Weeding at 20 DAS)	33.83b
W_2 (Weeding at 20+40 DAS)	23.65c
W_3 (Weeding at 20+40+60 DAS)	19.68c

Means within column bearing same letters are not significantly different.

ment up to harvest i.e. W_0 (79.25 g/m^2) which was followed by W_1 (33.83 g/m^2). The lowest weed dry weight was observed in treatments W_2 and W_3. These treatments were not significantly different (Table 2b).

Plant (Wheat) Population

Seed rates significantly influenced the plant population per unit area. The highest plant population (66.75 plant/m^2) was found in plots with highest seed rate (175 kg/ha) followed by 150 kg/ha seed rate (61.75 plant/m^2). The lowest plant population (50.83 plant/m^2) was observed in treatment S_1 (100 kg/ha). Weeding at different times had no significant influence on the wheat population per unit area (Table 4).

Number of Effective Tillers per Plant

Seed rate significantly influenced the number of effective tillers/plant. The highest number of effective tillers (4.32 and 4.19) was produced by treatments S_2 (125 kg/ha) and S_1 (100 kg/ha), respectively. The minimum number of effective tillers (3.23) was produced in highest seed rate i.e. S_4. The lower number of effective tillers in higher seed rates (150 and 175 kg/ha) might be due to competition for space and stress from nutrients or moisture condition of the soil. The number of effective tillers/plant recorded with weed control treatments W_0, W_1, W_2 and W_3 were 3.56, 3.72, 4.26 and 4.15, respectively. There were no significant differences between W_2 and W_3. Previous reports are in agreement with the present finding (Alam, 1992).

Plant Height (Wheat)

Seed rates of S_1, S_2, S_3 and S_4 produced plants with heights of 92.6, 93.08, 93.64 and 93.71 cm, respectively, which did not differ significantly (Table 3). Weeding treatments also did not influence plant heights (Table 4).

Panicle Length (Wheat)

Length of the panicle was found to be the highest at the seed rate of 125 kg/ha (9.52 cm) and 100 kg/ha (9.39 cm). Reported results (Gaffer and Shahidullah, 1985) are in partial agreement with the present finding. The longest panicle length was produced by treatment W_2 (9.55 cm) and W_3 (9.43 cm) i.e. where weeding was done at 20, 40 and 60 days after sowing (Table 4). The shortest panicle 8.79 cm was produced in the no weeding treatment (W_0).

Number of Filled Grain per Panicle

It was observed that seed rate of 125 kg/ha (S_2) produced maximum number of filled grains/panicle (33.02), which was similar with S_1 (100kg/ha) and S_3 (150kg/ha) treatments (Table 3). The lowest number of filled grains/panicle (29.69) was obtained at the seed rate 175 Kg/ha (S_4). The lowest number of filled grains/panicle (28.82) was produced in the unweeded plots which was significantly different from other weeding treatments. It was also reported that weeding of wheat crops up to 42 days after emergence showed a tendency towards a higher number of filled grains/panicle (Alam, 1992).

TABLE 3
Effect of seed rate on crop growth and yield

Treatments	Plant population /m^2	Effective tillers/plant	Plant height (cm)	Panicle length (cm)	Filled grains/ panicle	Grain yield (t/ha)	Straw yield (t/ha)
S_1 (100 kg/ha)	50.83b	4.19a	92.60a	9.39ab	32.95a	3.19bc	4.10a
S_2 (125 kg/ha)	58.17ab	4.32a	93.08a	9.53a	33.02a	3.63a	4.35a
S_3 (150 kg/ha)	61.75a	3.95b	93.64a	8.98b	31.89a	3.44ab	4.47a
S_4 (175 kg/ha)	66.75a	3.23c	93.71a	8.97b	29.69b	3.11c	4.42a

Means within columns bearing same letters are not significantly different.

TABLE 4
Effect of weeding treatments on crop growth and yield

Treatments	Plant population /m²	Effective tillers/plant	Plant height (cm)	Panicle length (cm)	Filled grains/ panicle	Grain yield (t/ha)	Straw yield (t/ha)
W_0 (No weeding)	56.67a	3.56c	92.21a	8.79c	28.82c	3.10c	3.60c
W_1 (Weeding at 20 DAS)	58.33a	3.72bc	92.93a	9.09b	31.16b	3.30b	4.06b
W_2 (Weeding at 20+40 DAS)	60.75a	4.26a	93.08a	9.55a	34.18a	3.51a	4.95a
W_3 (Weeding at 20+40+60 DAS)	61.75a	4.15a	94.81a	9.43a	33.40a	3.46a	4.74a

Means within columns bearing same letters are not significantly different.

Grain Yield

The highest grain yield (3.63 t/ha) was obtained from the treatment S_2 (125 kg/ha). There was no significant variation in grain yield with seeding rates of 125-150 kg/ha (Table 3). The lowest grain yield (3.11 t/ha) was produced by the highest seeding rate (175 kg/ha) likely due to over population causing high competition for space, sunshine, moisture and plant nutrients. Weeding at 20 and 40 days after sowing produced highest grain yield (3.51 t/ha) which was not significantly different from weeding at 20, 40 and 60 days after sowing (3.46 t/ha) (Table 4). The lowest grain yield (3.10 t/ha) was obtained from the treatment with no weeding (W_0). This study shows that the grain yields increase when weeding was done at 20 and 40 days after sowing. Weed infestations before and after this critical period will not cause yield loss. According to some researchers grain yield reduction in cereals due to weed competition was associated with reduced crop vigour, tillering, filled grains per panicle and the individual grain weight (Gupta and Lamba, 1978). The highest grain yield (3.97 t/ha) was obtained in treatment S_2W_2 i.e. a combination of 125 kg seed/ha and weeding at 20 and 40 days after sowing which was followed by S_2W_1 (3.8 t/ha), S_2W_3 (3.77 t/ha) and S_3W_3 (3.70 t/ha). The treatment combination of S_3W_0 produced the lowest grain yield (2.78 t/ha) which was similar to treatments S_1W_0, S_2W_0 and S_4W_0 which produced grain yields of 2.87, 2.97 and 2.95 t/ha, respectively.

Straw Yield

Seed rates of 175, 150, 125 and 100 kg/ha produced straw yields of 4.42, 4.47, 4.35 and 4.10 t/ha, respectively (Table 3). They were not significantly different. Weeding at 20 and 40 days of sowing (W_2) produced higher straw yield (4.95 t/ha) which was followed by W_3 (4.74 t/ha) (Table 4). The lowest straw yield (3.60 t/ha) was obtained in the no weeding treatment (W_0).

CONCLUSION

Weeding of wheat field at 20 to 60 days after emergence together with moderate seed rates ranging between 125 to 150 kg/ha was suitable for higher grain yield of wheat. Weed removal over a period of 20-40 days after wheat emergence at a seeding rate of 125 kg/ha was the best combination for maximum yield.

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