Ann. Bangladesh Agric. 1(2): 81-85, 1991

EFFECT OF POPULATION ON TILLERING, GROWTH, YIELD COMPONENTS AND YIELD OF WHEAT

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Abstract

Two experiments were conducted during 1987-88 and 1988-89 with 100, 200, 300, 400, 500 and 600 seeds/m^2 to study tillering, dry matter production, ear growth and yield components of wheat. Number of tillers increased steadily upto 40 days after sowing and 100 seeds produced the highest number of tillers (4/plant). Dry matter production per plant was highest (8g/plant) with 100 seeds/m^2. There was no significant difference in the production of ear dry matter between 100 and 200, 300 and 400 and 500 and 600 seeds/m^2. Number of grains/ear was the highest with 300 seeds/m^2 which was not significantly different with 400 seeds/m^2 for 1987-88 but for 1988-89 number of grains/ear was the highest with 100 seeds per m^2. Grain yield was significantly higher with 400 seeds/m^2. Grain yield was significantly higher with 400 seeds/m^2 for both years but straw yield was the highest with 500 seeds/m^2. There was significant correlation between grain yield and number of ears/m^2 and between grain yield and number of grains/m^2 suggesting possible yield increase with increased number of grains/m^2.

Key words : Yield components, Tillering, Ear growth, Seed rate, Wheat

Introduction

Grain yield/m^2 of wheat is the product of number of grains/m^2 and weight of individual grain. Total number of grain is the product of number of ears/m^2 and number of grains/ear (Langer, 1978). Weight of individual grain is difficult to increase beyond the potential (Fischer, 1979) but there is a scope of increasing the number of grains/m^2 by increasing the ear population (Darwinkel, 1978).

Wheat is terribly underpopulated in Bangladesh. This is resulted not only from poor seed quality but also from broadcast and dry seeding and bird damage during emergence. Thus there is a need to reconsider the seed rate or plant population that is to be established for a threshold yield of wheat under humid Bangladesh conditions.

As the winter is very short in Bangladesh, crop cannot attain proper vegetative growth. Hence getting increased ear population through increased tillering is remote (Roy *et al.*, 1990;

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Kirby and Faris, 1972) but it could possibly be achieved through increased seed rate (Panwar *et al.*, 1989; Sone *et al.*, 1989). However, increased seed rate beyond 400 kg/ha caused severe early competition among the seedlings and self thinning (Shinozaki *et al.*, 1971; Kirby and Faris, 1972). Besides, increased population causes competition among the ears in a plant which results in shrivelled grains (Osman and Mahmood, 1981). The present experiment was therefore, designed to investigate the effect of different plant population on tillering, dry matter production of individual plants and on number of ears of wheat. In addition, the effect of population on yield components, yield and harvest index was studied.

Materials and Methods

The experiments were conducted at the Regional Agricultural Research Station, Hathazari, Chittagong during 1987-88 and 1988-89 growing seasons. The soil was a silt loam with p^H 5.5. The monthly average temperatures during 1987-88 were 25.0, 20.5, 19.2, 22.4 and for 1988-89 were 25.5, 22.0, 17.4, 21.8 for November, December, January, February, respectively which was higher than any other parts of Bangladesh (BBS, 1989). The experiment was laid out in a randomized complete block design with four replications. The treatments were 100, 200, 300, 400, 500 and 600 seeds/m^2.

Wheat (*Triticum aestivum* L.) cv. Kanchan was used in this experiment. This was developed by Wheat Research Centre of Bangladesh Agricultural Research Institute and have prolific growth habit giving 5-6 tillers and 2-3 fertile ears/plant under normal growing conditions. Seeds were sown on 23 November during 1987-88 and 15 November during 1988-89 in solid rows of 20 cm wide. The plot size was 4 × 5 m with sufficient inter-plot space. The crop was fertilized with 100, 60, 40 and 20 kg N, P_2O_5, K_2O and S/ha supplied from, urea, TSP, MP and gypsum, respectively. One weeding at 20 days after sowing (DAS) and three irrigations were made at 25, 45 and 65 DAS to raise the crop.

A plant count was made 15 days after sowing. Plants within 50 linear cm were uprooted on 22, 36, 50, 62, 87 and 107 DAS. Roots were trimmed off and plants were separated and counted. Dry matter of the sample was taken after drying for 72 h at 80° C. At maturity data on yield components were taken from an area of 12 m^2. Harvest index was calculated by dividing grain yield with total above ground dry matter yield. Data were analyzed statistically and only the significant means were subjected to LSD-test.

Results and Discussion

Plant count result showed that 80-85%, 73-78%, 75-76%, 75-77%, 70-72% and 66-70% seedlings were emerged from 100, 200, 300, 400, 500 and 600 seeds/m^2 sown, respectively (Table 1). The number gradually lowered as the plants approached maturity due to self thinning. This is consistent with the results of Kirby and Faris (1972) who reported serious competition among the seedlings of barley when planted at a rate more than 400 seeds/m^2.

Number of tillers increased steadily upto 40 DAS (Fig. 1) and the tillering pattern was comparable to that of a normal spring wheat crop of Australia (Fischer, 1975). Plants grown in 100 seeds/m^2 produced the highest number of tillers and ears (final number of tillers) per 10 plants followed by 200 seeds/m^2. Tillering decreased with increased number of seeds sown.

Dry matter production pattern was sigmoid and is comparable to that of a normal spring wheat crop (Fischer, 1975). Like that of tillering 100 seeds/m^2 produced the highest dry matter per 10 plants followed by 200 seeds/m^2 (Fig. 2). There was no significant difference in dry matter production per plant between 400 and 600 seeds/m^2.

Table 1. Effect of seed rate (seeds/m^2) on seedling emergence, plant height, yield component, yield & harvest index of wheat.

Treat-ments	Number of seedling emerged		Plant height (cm)		Number of Ears/m		Number of Grains/ear		Weight/1000 grain (g)		Yield (t/ha) Grain		Yield (t/ha) Straw		Harvest index	
	87-88	88-89	87-88	88-89	87-88	88-89	87-88	88-89	87-88	88-89	87-88	88-89	87-88	88-89	87-88	88-89
Seed/m^2																
100	85	80	75	76	197	151	30	26	43.8	53.1	1.99	1.57	3.22	2.55	0.38	0.50
200	160	155	75	77	245	221	30	25	44.2	52.8	2.27	2.19	3.18	3.75	0.41	0.51
300	225	251	77	78	273	276	34	22	45.1	53.2	2.36	2.60	3.21	4.55	0.43	0.50
400	300	307	78	78	279	307	32	21	45.4	52.9	2.55	2.67	3.20	4.36	0.44	0.50
500	358	348	77	77	273	378	31	19	44.6	54.0	2.25	2.55	3.34	4.66	0.41	0.48
600	418	400	78	77	285	397	30	17	45.4	52.5	2.02	2.53	3.23	4.38	0.39	0.45
LSD(.95)	15.3	13.2	NS	NS	15.9	18.5	1.2	1.8	NS	NS	0.262	0.058	NS	0.200	0.027	0.043
CV(%)	12.8	10.4	4.4	2.9	6.5	7.6	2.9	6.8	3.0	2.8	19.4	17.8	6.4	4.9	11.5	7.1

After ear emergence, ear growth pattern was typical of a normal wheat crop (Fischer, 1975). There was no significant difference in ear dry matter between 100 and 200, 300 and 400, and 500 and 600 seeds/m^2 (Fig. 3a, b). But the ears had a linear phase of growth from 15 to 45 days after anthesis irrespective of plant population.

Plant height was not significantly different for different plant population although 100 seeds/m^2 produced 9-10% shorter plants than other treatments (Table 1). Number of ears/m^2 was the highest with 600 seeds/m^2 and the lowest with 100 seeds/m^2. Number of grains/ear between the two years did not show

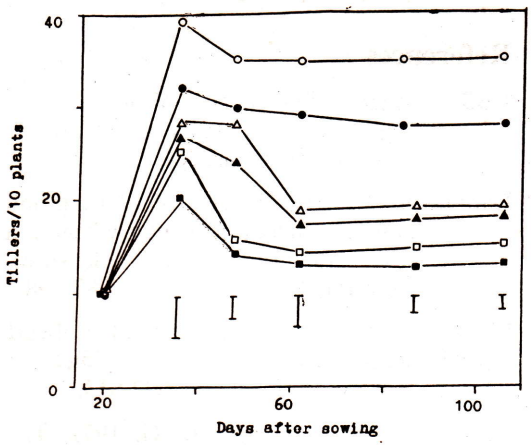

Fig. 1. Effect of population on tillering of wheat. o, ●, Δ, ▲, □, and ■ are 100, 200, 300, 400, 500 and 600 plants m^{-2} and the bars indicate LSD (0.05).

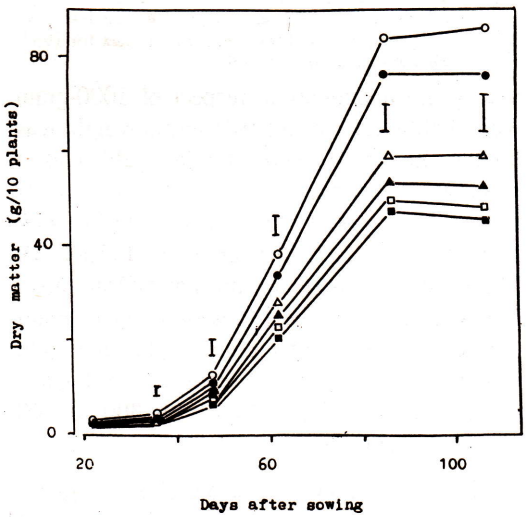

Fig. 2. Effect of population on dry matter production of wheat. o, ●, Δ, ▲, □, and ■ are 100, 200, 300, 400, 500, 600 plants m^{-2} and the bars indicate LSD (0.05).

consistent results. During 1987-88 number of grains/ear showed a quadratic response with the number of seeds sown which is consistent with the results of Osman and Mahmood (1981) but during 1988-89 number of grains/ear decreased linearly with increasing number of seeds sown (Table 1). There was no significant difference

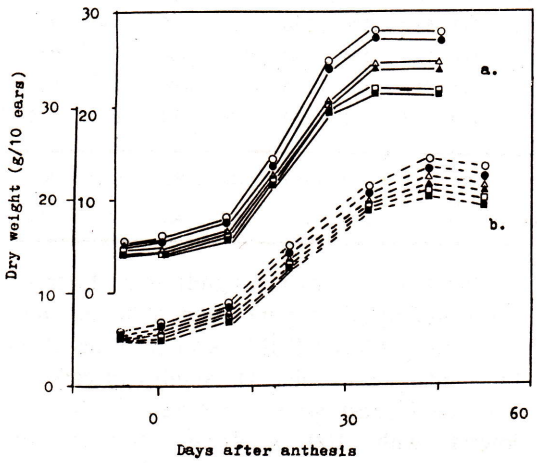

Fig. 3. Effect of population on ear dry matter production of wheat. 0, ●, Δ , ▲ , □ , and ■ are 100, 200, 300, 400, 500, and 600 seeds m^{-2} a. data for 1987-88 and b. data for 1988-89.

among the treatments in respect of 1000-grain weight although overall 1000-grain weight was higher during 1988-89. Grain yield had a quadratic response with number of seeds sown/m^2 for both years and 300 to 400 seeds/m^2 gave the highest grain yield (Table 1). The result is consistent with that of Darwinkel (1978) who grew wheat in wide range of plant population under Dutch condition. Straw yield was the highest with 500 seeds/m^2 but highest harvest index was achieved with 300 to 400 seeds/m^2 (Table 1).

There was a significant positive correlation between grain yield (GY) and number of ears/m^2, GY and number of grains/ear for 1988-89 only. However, there was significant correlation between GY number of grains/m^2 (a product of number of ears/m^2 and number of grains/ear) for both years (Table 2). This is consistent with the results of Darwinkel (1978) who suggested as many as 18000 grains/m^2 for a threshold yield of wheat under Dutch conditions.

Table 2. Correlation coefficients of grain yield with number of ears/m^2, number of grains/ear, 1000-grain weight and number of grains/m^2 of wheat for 1987-88 and 1988-89.

Components	Grain yield	
	1987-88	1988-89
Number of ears/m^2	0.497 ns	0.809 *
Number of grains/ear	0.657 ns	0.753 *
1000-grains weight	0.458 ns	0.077 ns
Number of grains/m^2	0.83 *	0.921 *

Thus it appeared from the results that it was not possible to increase ear population of wheat in Chittagong region through tillering. However, by planting 300 to 400 seeds through a seed rate of 150 to 180 kg/ha, a threshold yield is possible to achieve in hot and humid Chittagong region of Bangladesh.

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