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Response of Irrigation Frequencies and Different Doses of N Fertilization on the Growth and Yield of Wheat

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Abstract: The study was conducted to investigated the effect of irrigation and irrigation on growth and yield of wheat (cv. Kanchan). The results revealed that both the irrigation and nitrogen gave significant ($p<0.05$) effect on all studied growth parameters such as plant height (90.09 and 90.42 cm), number of tillers plant^{-1} (3.21 and 3.20), leaf area index (LAI) (1.37, 1.55 at 60 DAS and 3.73, 4.77 at 75 DAS), crop growth rate (CGR) (282.10, 333.13 mg day^{-1} plant^{-1} at 60-75 DAS and 158.99, 177.35 mg day^{-1} plant^{-1} at 75-90 DAS) and relative growth rate (RGR) (0.108, 0.1098 mg mg^{-1} day^{-1} at 60-75 DAS and 0.021, 0.022 mg mg^{-1} day^{-1} at 75-90 DAS). Among the yield contributing characters the number of effective tillers plant^{-1} (2.89 and 2.92), number of non effective tillers plant^{-1} (0.52 and 0.67), number of non-fertile spikelets spike^{-1} (2.44 and 2.51), grain yield (2.69 and 2.50 t ha^{-1}) and harvest index (46.55% and 45.25%) were significantly influenced by irrigation as well as nitrogen level. The increments of grain yield mainly due to increase in number of effective tillers plant^{-1}.

Key words: Irrigation, N-fertilization, growth, yield, wheat

Introduction

Wheat is the second most important staple food crop of Bangladesh. Through wheat is an important cereal crop in Bangladesh, its average yield 2.16 t ha^{+} (BBS, 1999) is low as compared to the advanced countries of the world like Holland and UK, 7.30 and 8.05 t ha^{-1}, respectively (FAO, 1999). The yield of wheat is governed by many production factors including variety, level of availability of moisture. Adequate fertilization and selection of good variety in consistency which availability of moisture at the critical stage of the crop growth are vital for optimum production (Awasthi and Surajbhan, 1993). In Bangladesh, wheat is grown during the dry winter months from November to March (Rabi season) and as such the inadequate soil moisture in this season limits the use of fertilizers, especially nitrogen and consequently result in decreased grain yield. Irrigation frequency has a significant influence on growth and yield of wheat (Khajanji and Dwivedi, 1988). So, irrigation water should be supplied precisely at the peak period of crop growth, which may provide better yield of this crop. Nitrogen is considered to be the most important nutrient element for plants. As an essential element in protein, nitrogen is needed for growth and development of all living tissues. Among the different nutrients nitrogen is the key input for achieving higher production. Wheat requires nitrogen throughout its growing period. Irrigation water and nitrogenous fertilizer show great influence for maximum wheat yield. Increased yield of wheat unit^{-1} area can be achieved by the use of irrigation water among with nitrogen. Proper scheduling of irrigation and the use of opium doses of nitrogenous fertilizer are the important factors for boosting wheat production.

Considering the above facts, the present study has been undertaken to fulfil the following objectives:

I) to find out the proper irrigation frequencies with respect to growth stages of wheat for higher grain yield.

ii) to determine the optimum dose of nitrogen for better growth and higher yield of wheat and iii) to determine the interaction, if any, between irrigation and nitrogen for maximum yield of wheat.

Materials and Methods

The experiment was set up at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during November 1999 to March 2000. The experiment including irrigation and nitrogen treatments were: no irrigation (control) = I_0, irrigated 25 days after sowing (DAS) = I_1, irrigated 25 and 40 DAS = I_2 and irrigated 25, 40 and 55 DAS = I_3 and no nitrogen (control) = N_0, 74 = N_1, 92 = N_2 and 110 kg N ha^{-1} = N_3. The soil in the experimental site belongs to the Agro-ecological Zone (AEZ 9) of Old Brahmaputra Floodplain (UNDP and FAO, 1988). The experiment was laid out in a split plod design. The size of each unit plot was 10 m^2 (4.0 x 2.5m^2). Seeds of specific variety have sown continuously 20 cm apart rows

on 18 November 1999. The seed was sown @ 120 kg ha^{-1} as recommended by Rashid *et al*., 1999. Standard cultural practices were followed as and when necessary. The study of growth parameters started from 60 DAS continued up to 90 DAS at 15 days interval. Each time 5 plants plot^{-1} were carefully uprooted randomly and carefully uprooted randomly and calculated the standard formulate (Radford, 1967; Hunt, 1978). Growth parameters such as plant height, number of tillers plant^{-1}, yield and yield variance was done with the help of computer package MSTAT. The mean differences among the treatments were adjudged as per tested with Duncan's multiple range test (Gomez and Gomez, 1984).

Results and Discussion

It was observed that all studied parameters differed significantly ($p < 0.05$) due to both treatments. In irrigation treatments, all growth parameters i.e. plant height (90.09 cm), number of tillers plant^{-1} (3.21), leaf area index (1.37 and 3.73 at 60 and 75 DAS, respectively), crop growth rate (282.10 and 158.99 mg day^{-1} plant^{-1} at 60-75 and 75-90 DAS, respectively) and relative growth rate (0.108 and 0.021 mg mg^{-1} at 60-75 and 75-90 DAS, respectively) were exhibited the highest value when irrigated thrice and corresponding the lowest value obtained from the control treatment (no irrigation) (Table 1). Singh *et al.* (1992) reported that significantly similar plant height (106.9 and 106.4 cm) was obtained from 2 (at tillering + flowering stage) and 3 (at tillering + flowering + dough stage) irrigation, respectively. In the present study, tallest plant obtained from 3 irrigations because during growth and efficient nutrient adsorption. Joshi and Singh (1983) started that number tiller plant^{-1} increased by irrigation. In respect of nitrogen treatments, application of N at 92 kg ha^{-1} exhibited the highest value in all growth parameters except plant height and number of tiller plant^{-1} (Table 1). Again all growth parameters showed the lowest value in control treatment (N_0 application). The tallest plant (90.42 cm) was obtained when N application at 110 kg ha^{-1}. Singh *et al.* (1992) noticed that plat height highest at 80 kg N ha^{-1}. Number of tillers plant^{-1} (3.20) was the highest at 110 kg N ha^{-1}. This result confirm with the finding of Singh *et al.* (1992) who reported that 120 kg N ha^{-1} gave significantly the highest tillers m^{-1} row length. The highest leaf area index (1.55 and 4.77 at 60 and 75 DAS, respectively), crop growth rate (333.13 and 177.35 mg day^{-1} plant^{-1} at 60-75 and 75-90 DAS, respectively) and relative growth rate (0.108 and 0.0222 mg mg^{-1} day^{-1} at 60-75 and 75-90 DAS, respectively) gave when nitrogen application @ 92 kg ha^{-1}. This is probably due to increase of higher N application to provide adequate N to the plant during growth stages, causing increase in vegetative growth.

Results (Table 2) revealed that excluding length of spike, number of spikelets spike^{-1}, number of grains spike^{-1} and 1000-grain weight, other characters differed significantly ($p<0.05$) due to both treatments. The highest value of number of effective tillers plant^{-1} (2.89), grain yield (2.69 t ha^{-1}), straw yield (3.09 t ha^{-1}), harvest index (46.55%) were observed when irrigation applied three times while the highest value of number of non-effective tillers plant^{-1} (0.52), number of non-fertile spikelets spike^{-1} (2.44) were used control treatment. Sing *et al.* (1991) reported that the tallest plant and the plant and the highest grain yield obtained from 3 irrigation and Sudhansu (1980) reported that 4 irrigation gave the highest straw yield. In nitrogen treatments, the highest value of number of effective tillers plant^{-1} (2.92), grain yield (2.50 t ha^{-1}), harvest index (45.25%) were obtained when application of N at 92 kg ha^{-1} and straw yield (3.10 t ha^{-1}) was found at 110 kg N ha^{-1}. Our data condraict those of Patel *et al.* (1995) who reported that except spike length all other yield contributing characters gave statistically the highest value at 150 kg N ha^{-1}. Ayoub *et al.* (1994) stated that except grain yield, total yield, total tillers m^{-2} and spike m^{-2} gave significantly the highest value at 120 kg N ha^{-1}.

Table 1: Effect of irrigation and nitrogen level on the growth parameters of wheat

Treatments		Plant height (cm)	Number of tillers plant^{-1}	Leaf area index (LAI)		Crop growth rate (CGR) (mg day^{-1} plant^{-1})		Relative growth rate (RGR) (mg mg^{-1} day^{-1})	
				60 DAS	75 DAS	60-75 DAS	75-90 DAS	60-75 DAS	75-90 DAS
Levels of irrigation	I_0 (control)	74.72c	2.95bc	1.24b	3.01c	250.25b	147.55ab	0.081c	0.020b
	I_1	81.37b	3.00b	1.29ab	3.37b	267.40ab	152.67a	0.088bc	0.021a
	I_2	86.99a	3.02b	1.34a	3.50ab	278.29a	156.89a	0.097ab	0.021a
	I_3	90.09a	3.21a	1.37a	3.73a	282.10a	158.99a	0.108a	0.021a
Levels of nitrogen (kg ha^{-1})	N_0 (control)	71.68c	2.84b	0.09c	1.39c	157.40d	112.35c	0.084b	0.020c
	N_1	84.35b	2.97b	1.37b	3.41b	269.69c	152.66b	0.090b	0.020c
	N_2	86.72.ab	3.19a	1.55a	4.77a	333.13a	177.35a	0.108a	0.022a
	N_3	90.42a	3.20a	1.43ab	4.04ab	317.83b	173.74a	0.093b	0.021b

Mean followed by different letters differ significantly at P<0.05

Table 2: Effect of irrigation and nitrogen level on the yield and yield components of wheat

Treatments		Number of effective tillers plant^{-1}	Number of non effective tillers plant^{-1}	Length of spike (cm)	Number of spikelets spike^{-1}	Number of non spikelets spike^{-1}	Number of grains spike^{-1}	Weight of 1000 gain (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)
Levels of irrigation	I_0 (control)	2.43c	0.52a	8.60	17.37	2.44a	31.27	41.93	1.59c	2.10d	43.08c
	I_1	2.60bc	0.40b	8.90	17.12	2.18b	31.32	42.85	1.96b	2.59c	44.29b
	I_2	2.70ab	0.32c	9.20	18.15	1.95c	34.26	43.35	2.50a	3.05b	44.60b
	I_3	2.89a	0.32c	9.54	18.89	1.81c	37.01	43.77	2.69a	3.09a	46.55a
Levels of nitrogen (kg ha^{-1})	N_0 (control)	2.17c	0.67a	8.80	17.14	2.51a	32.70	41.96	1.60c	2.05c	43.85c
	N_1	2.68b	0.29b	8.95	17.15	2.22b	33.35	42.72	2.15b	2.72b	44.14b
	N_2	2.92a	0.27b	9.44	18.47	1.73d	34.61	44.35	2.50a	3.03a	45.25a
	N_3	2.87ab	0.33b	9.05	18.16	1.91c	34.21	42.85	2.45a	3.10a	44.20b

Mean followed by different letters differ significantly at $P<0.05$

They also stated that kernels spike^{-1}, 1000 kernel weight (g) and harvest index were gave insignificant results in N application. The lowest values of all parameters were observed at control treatment while the highest value of number of non-effective tillers plant^{-1} and number of non-fertile spikelets spike^{-1} found at similar N fertilization. Interaction effects between irrigation and N application showed insignificant result. From the present experiment it seems that cultivar showed better performance on growth and yield receiving irrigation and N-fertilizer application than control. Higher seed yield of wheat can be obtained by using 92 kg N ha^{-1} with three irrigations. It is suggesting that environmental differences between Agro-ecological Zones may play an important role in the effectiveness of wheat production in Bangladesh.

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