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Effect of Irrigation and Nitrogen Levels on Grain Yield and Quality of Wheat (*Triticum aestivum*)

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ABSTRACT

Effect of irrigation and different levels of nitrogen on grain yield and quality of wheat was investigated. The maximum grain yield (5.69 t ha^{-1}) was produced with four standard irrigation (at crown root, booting, anthesis and grain filling stage), and nitrogen @ 150 kg N-ha^{-1} produced maximum grain yield (4.19 t ha^{-1}) and grain protein content (12.91%). This was attributed to to more availability of plant food nutrient favorable for increase in number of fertile tillers m^{-2}, number of grain per spike and 1000-grain weight.

Key Words: Irrigation; Nitrogen; Yield; Pakistan

INTRODUCTION

Proper irrigation and nitrogen supply has a positive impact on the production of wheat. With increasing costs associated with irrigation, there is a need to ensure the maximum return from each unit of input applied. The need of corps for water is related to moisture sensitive periods. If moisture sensitive periods could be identified for wheat crop under field conditions, it would have important implications for irrigation practice. Nitrogen is one of the major element needed for normal plant growth. It performs several important physiological functions inside the plant body and is essential constituent of protein. The objective of this study was to determine the effect of irrigation and nitrogen levels on the yield of wheat.

MATERIALS AND METHODS

Study pertaining to the effect of irrigation and nitrogen levels on the yield of wheat cultivar "Pb-96" was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad during 1999-2000. The experiment was laid out in a split plot design having three replications. The irrigation treatments were randomized in the main plots and nitrogen levels in the sub plots. Net plot size measured 1.20m x 5m. The irrigation treatments were: I_0 = control no irrigation, I_1= irrigation stress at crown root stage, I_2= irrigation stress at booting stage, I_3= irrigation stress at anthesis stage, and I_4= standard four irrigation (at crown root, booting, anthesis and grain filling stage). The nitrogen treatments were: N_0= control (no nitrogen application), N_1= 100 kg N ha^{-1}, N_2= 150 Kg N ha^{-1}.

The crop was sown with the help of single row hand drill on a well prepared seed bed in the second week of November in 20 cm apart rows. Seed was used @ 100 kg ha^{-1}. Urea and Triple Super Phosphate was used as source of nitrogen and phosphorus, respectively. Nitrogen was applied in two splits, half at the time of sowing and half at the time of first irrigation except in I_0 treatment, in which whole of nitrogen was applied at the time of sowing. A basal dose of 100 kg P_2O_5 ha^{-1} was applied at the time of sowing. The data on the following parameters were recorded during the course of study. Number of productive tillers (m^{-2}, Number of grains $spike^{-1}$, 1000-grain weight (g), Grain yield (t ha^{-1}). The data were analysed using Fisher analysis of variance technique and treatment means were compared by LSD test at 0.05 P (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Number of productive tillers. Table I shows that both irrigation and nitrogen levels did affect the productive tillers per unit area. Among different irrigation levels maximum number of productive tillers at 330.33 m^{-2} was obtained in plots where standard four irrigations were applied, followed by I_3, I_2 and I_1. Ghazal *et al.* (1997) also noticed an increase in spike/m^2 as irrigation was increased. Treatment I_4, I_3 and I_2 did not differ significantly in spike population. Treatment I_0 resulted in lesser fertile tillers/m^2 (256.67) than all other treatments. As regards irrigation levels, I_0 produced significantly lesser 256.67 fertile tillers m^{-2} than all other treatments. As regards nitrogen levels, N_2 produced largest number of (322) productive tillers followed by N_1 (313), but these are statistically at par with each other. Treatment N_0 was found to be at the bottom (271). Al-Abdulsalam (1997) also observed that high nitrogen rates produced plants with more spikes.

Number of grains per spike. The data revealed significant differences in the number of grain $spike^{-1}$ among irrigation levels. Treatment I_4 produced the maximum number of grains $spike^{-1}$ (45.58) as against minimum (19.93) produced in I_0. Nitrogen levels also showed significant effect on the number of grains $spike^{-1}$. The highest number of grains $spike^{-1}$ (44.28) was obtained from the plots subjected to N_2 followed by N_1 or N_0. Ezzat *et al.* (1999) reported that nitrogen application enhanced grain yield by increasing the

Table I. Effect of irrigation levels and nitrogen rates on the yield and yield components of wheat

Irrigation level	No. of productive tillers (m^{-2})	No. of grains per spike	1000-grain weight (g)	Grain yield (t ha^{-1})	H.I (%)	Protein content (%)
I_0	256.67 c	19.93 d	22.82 d	0.91 d	30.44 c	1.62
I_1	289.44 v	43.47 b	38.16 b	2.59 c	34.75 b	12.46
I_2	315.78 a	39.36 b	38.39 b	4.12 b	34.79 b	12.51
I_3	317.78 a	42.25 c	36.43 c	4.21 b	34.89 b	12.49
I_4	330.33 a	45.58 a	39.69 a	5.69 a	36.53 a	12.47
Nitrogen level						
N_0	271.00 b	30.91 c	33.06 c	2.70 b	33.89 b	12.10 c
N_1	313.27 a	39.17 b	35.66 b	3.62 a	34.44 a	12.52 b
N_2	321.73 a	44.28 a	36.57 a	4.19 a	34.54 a	12.91 a

Any two means not sharing a letter in common significantly.

number of kernels $spike^{-1}$. The interaction of both factors was also significant. Wheat plots under N_1 and irrigated at botting, anthesis and grain filling stage produced more number of grains per spike.

1000-grain weight. Irrigation level showed significant affect on 1000-grain weight. Maximum test weight (39.69 g) was obtained in I_4 followed by I_2, I_1, I_3 and I_0. McMaster *et al*. (1994) also reported similar results that irrigation at late jointing or anthesis significantly increased grain weight $plant^{-1}$. Increasing nitrogen rate significantly affected 1000-grain weight over control but not on 100 kg N ha^{-1}. The average grain weight varied from 33 to 37 g/1000 grains among different nitrogen application rates (Table I).

Grain yield. Irrigation levels showed significant effect on grain yield. Treatment I_4 gave higher grain yield (5. 69 t ha^{-1}) than I_3 (4.21 t ha^{-1}). Sarwar (1994) also reported that moisture stress at all growth stages significantly reduced the yield. Different nitrogen rates also significantly affect grain yield. Increasing nitrogen rate from 0 to 150 kg ha^{-1} increased grain yield and maximum grain yield at 4.19 t ha^{-1} was recorded in plots fertilized @ 150 kg **N** ha^{-1}. The interactive effect of irrigation and nitrogen levels on grain yield per hectare was also significant (Table **I**). The interaction N x I showed that N_2 x I_4 treatment combination showed superiority (6.62 t ha^{-1}) over rest of combinations. Zbiec *et al*. (199**8**) also found that grain yield of wheat was increased with increasing rate of N fertilization and number of irrigation.

Harvest index. It is clear from the data (Table I) that maximum harvest index (HI) (36.53%) was recorded in I_4 against the minimum (30.4%) in I_0 among the nitrogen levels, plots received 150 kg N ha^{-1} and 100 kg N ha^{-1} gave the highest value of HI 34.5 and 34.4%, respectively and were at par when compared statistically. The lowest HI value of 33.9% was recorded from plots without any nitrogen treatment (control). Similar results were reported by Hussain *et al.* (1997) reported that grain yield of irrigated crop was 5.13 and 6.31 t ha^{-1} in 1989-1990 and 1992-93, respectively, about 80% higher yield than the yield of un-irrigated crop. The increase in yield due to irrigation was mainly associated with an increase in total dry matter production as the harvest index varied a little within each treatment.

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