Influence of Irrigation and Nitrogen Level on the Yield of Wheat

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Abstract: An experiment was conducted during the period from November 2001 to April 2002 to determine the optimum irrigation time and nitrogen level of wheat. Highest grain yield (3.71 t ha⁻¹) was obtained with three irrigations at crown-root initiations (CRI)+maximum tillering (MT)+grain filling (GF) stages which was identical with two irrigations at crown-root initiations (CRI)+maximum tillering (MT) stages and at crown-root initiations (CRI)+grain filling stages. The highest grain yield (3.61 t ha⁻¹) was obtained from 120 kg N ha⁻¹ which was followed by 100 kg N ha⁻¹ treatment and the lowest grain yield (2.81 t ha⁻¹) was recorded under 40 kg N ha⁻¹ treatment. No significant effect was observed on yield due to interaction of irrigation and nitrogen level. The highest grain yield (4.33 t ha⁻¹) was found by three irrigation at crown-root initiations (CRI)+maximum tillering (MT)+grain filling (GF) with 120 kg N ha⁻¹. However, grain yield of wheat was significantly influenced by irrigation and nitrogen level but not due to interaction of irrigation and nitrogen level.

Key words: Irrigation, nitrogen level, yield, wheat

INTRODUCTION

Wheat is the second major cereal crop of Bangladesh but first both in area and production among the grain crops of the world[1]. Wheat grain is used as food for men and feed for animals. Bangladesh facing acute food shortage for long time due to high population pressure. It is necessary to produce more and more food to achieve the goal of self-sufficiency in food. Increasing production per unit area is the only way to minimize the food deficit by applying modern cultivation knowledge and technology in Bangladesh. Wheat yield and production are less than other countries due to proper water and nitrogen fertilizer management. Specially the farmers have no attention to the irrigation schedule and nitrogen application rates. Wheat yield was reduced by 50% due to soil moisture stress[3]. Number of irrigation also influences on the yield of wheat[3]. It has been observed that water requirement of a crop varies with the stage of its growth. Under limited water supply the critical growth stages are taken into account for irrigation schedule. The critical growth stages are most sensitive to shortage of water and the yield of the crop is reduced drastically if the crop is not irrigated at these stages. The application of irrigation at all the critical stages significantly increased the grain yield of wheat over control[5]. The critical growth stages are different for different crops[5]. The importance of available soil nitrogen to wheat crop has been recognised. Rate of N application has an influence on growth, development and yield of wheat[6]. Not only may the acre yield be greatly influenced but also the protein content of the grain. The wheat best for flour milling are high in protein. The yield grain due to irrigation was confounded by increased nitrogen usages[7]. High availability of nitrogen during the reproductive stages of growth are necessary for a high protein grain. Therefore the present experiment was conducted to find out the influence of irrigation and different levels of nitrogen on the yield of wheat.

MATERIALS AND METHODS

The experiment was conducted at the Agronomy Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh during the period from November 2001 to April 2002 to find out the optimum time of irrigation and nitrogen level of wheat. The soil of the experimental site was sandy loam with pH value of 6.5 to 7.5. Organic matter content was moderate and general fertility was low[8]. The experiment was laid out in split-plot design with three replication. Keeping four irrigation treatments in main plots and five nitrogen levels in subplots. The irrigations schedules treatments were as follows: I₁ = crown-root initiations (CRI), I₂ = crown-root...
initiations (CRI)+maximum tillering (MT), \( I_1 = \) crown-root
initiations (CRI)+ grain filling (GF) stages and \( I_2 = \) crown-root
initiations (CRI)+maximum tillering (MT)+ grain filling
(GF) stages. The five nitrogen levels were \( N_0, N_1, N_2, N_3,
N_4 \) and \( N_5 \) application of nitrogen at 40, 60, 80, 100 and
120 kg N ha\(^{-1}\), respectively. The unit plot size was 4.0 x 2.5 m.
Kanchon cultivar of wheat was used as materials for the
study. Seed was sown on 20 November in 20 cm apart
rows using a seed rate of 120 kg ha\(^{-1}\). The crop was
fertilized with half of nitrogen as per schedule of the
experiment along with 60 kg P\(_2\)O\(_5\), 40 kg K\(_2\)O ha\(^{-1}\) through
urea, TSP and MP, respectively were at the time of
sowing. Remaining half of nitrogen was top dressed at the
time of first irrigation at Critical Root Initiation (CRI) stage.
Before harvesting 10 sample plants were selected randomly from each plot and data were recorded on plant
height, tiller per plant, fertile tiller per plant, spikelets per
spike, grain per spike, 1000 grain weight, grain yield and
straw yield. The collected data were analyzed statistically
and the significance of the mean differences was adjusted
by the Duncan's New Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Effect of irrigation: Number of total tiller and fertile tiller
per plant significantly increased by variation in irrigation
time. Maximum number of fertile tiller per plant (4.93) was
obtained in three irrigation at crown-root initiations
(CRI)+maximum tillering (MT)+ grain filling (GF) stages
(Table 1). Similar result was found by Rahman\(^{[9]}\). Number
of spikelets per spike (30.94) and number of filled grain
(30.24) per spike were maximum with three irrigations at
crown-root initiations (CRI)+maximum tillering (MT)+ grain
filling (GF) stages (Table 1). Kushta and Ragha\(^{[13]}\) also
reported similar result in wheat. The maximum plant height
(99.98 cm) was observed by \( I_4 \) and the lowest plant height
(93.78 cm) was found from \( I_3 \) irrigation. This result is in
consistent with that of Shahidullah\(^{[1]}\). Highest 1000 grain
weight (53.17 g) was found under \( I_1 \) treatment which
followed by \( I_5, I_2, I_2 \) and treatment and the lowest 1000 grain
weight (51.90 g) was obtained from \( I_4 \). Highest grain yield
(3.71 t ha\(^{-1}\)) was obtained with three irrigations at crown-root
initiations (CRI)+maximum tillering (MT)+ grain filling
(GF) stages followed by two irrigations at crown-root
initiations (CRI)+maximum tillering (MT) and crown-root
initiations (CRI)+ grain filling (GF) stages (Table 1). Similar
response was found by Pal et al.\(^{[12]}\) and Eunus et al.\(^{[13]}\). This
best yield was supported by the yield contributing
characters such as number of effective tillers per plant,
number of grains per spike and 1000 grain weight.

Straw yield increased with increasing irrigation.
Maximum straw yield (7.24 t ha\(^{-1}\)) was obtained from
\( I_4 \) irrigation and lowest straw yield (5.13 t ha\(^{-1}\)) from
\( I_1 \). Similar findings were also reported by Shamsuddin et al.\(^{[16]}\). The response of straw yield showed
similar trend as in grain yield due to the better response of
plant height and total number of tiller per plant.

Effect of nitrogen level: Plant height increased gradually with the increased level of nitrogen from 0-120 kg ha\(^{-1}\).
Highest plant height (97.88 cm) was obtained from 100 kg N ha\(^{-1}\) (Table 1). Similar result was found by Gami et al.\(^{[10]}\). The highest number of tiller per plant (5.80), spikelet per spike (31.94), filled grain per
spike (32.22) were obtained from 120 kg N ha\(^{-1}\) (\( N_5 \)) treatment. The results are agree with the Malik et al.\(^{[11]}\) and
Singh et al.\(^{[14]}\). Highest 1000 grain weight (52.00 g) in
120 kg N ha\(^{-1}\) treatment which statistically similar to
60, 80 and 100 kg N ha\(^{-1}\), respectively. Similar result
was showed by Malik et al.\(^{[6]}\). Minimum 1000 grain weight
(50.46 g) was obtained from 40 kg N ha\(^{-1}\) (\( N_1 \)). The highest
grain yield (3.61 t ha\(^{-1}\)) was found from 120 kg N ha\(^{-1}\)
which was statistically similar to 100 kg N ha\(^{-1}\). This result
was supported by Malik et al.\(^{[8]}\). The lowest grain yield
(2.81 t ha\(^{-1}\)) was recorded under 40 kg N ha\(^{-1}\) (\( N_1 \)) treatment.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Tiller/plant</th>
<th>Effective tiller/plant</th>
<th>Spikelet/spike</th>
<th>Grain/spike</th>
<th>1000 grain weight (g)</th>
<th>Grain yield (t ha(^{-1}))</th>
<th>Straw yield (t ha(^{-1}))</th>
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In a column, means having similar letter(s) do not differ significantly at 5% level of probability
Table 2: Interaction effect of irrigation and nitrogen level on the yield and yield contributing characteristics of wheat

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<tr>
<th>Treatments</th>
<th>Plant height (cm)</th>
<th>Tiller/plant</th>
<th>Effective tiller/plant</th>
<th>Spikelet/spike</th>
<th>Grain/spike</th>
<th>1000 grain weight (g)</th>
<th>Grain yield (t ha⁻¹)</th>
<th>Straw yield (t ha⁻¹)</th>
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<td>3.41i</td>
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</table>

In a column, means having similar letter(s) do not differ significantly at 5% level of probability.

Interactoin effect of irrigation and nitrogen level: The interaction effect of irrigation and nitrogen level had a significant influence on the number of tiller per plant and the number of effective tiller per plant but on plant height, number of spikelet per spike, filled grain per spike, 1000 grain weight, grain yield and straw yield were not statistically significant (Table 2). The highest grain yield (4.33 t ha⁻¹) was produced by I₁N₁, and the lowest yield (2.21 t ha⁻¹) obtained from I₃N₅. Grain yield was not significantly affected by the interaction of irrigation and nitrogen level. Similar result was found by Malik et al.[6]. It was concluded that grain yield of wheat was significantly influenced by irrigation and nitrogen level but not due to interaction of irrigation and nitrogen level. Maximum grain yield was obtained from three irrigation at crown root initiations (CSI)+Maximum tillering (MT)+ Grain filling (GF) stages with 120 kg N ha⁻¹.

REFERENCES


