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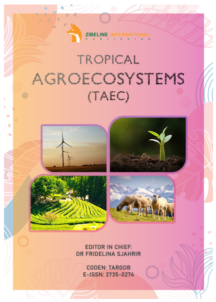


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*RESEARCH ARTICLE*

# EFFECT OF NITROGEN (N) FERTILIZER TO YIELD AND YIELD CONTRIBUTING CHARACTERS OF BARI gom30.

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## ABSTRACT

A field experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, from November 2015 to March 2016 to evaluate the effect of nitrogen (N) fertilizer on the yield and quality of wheat cv. BARI gom30. The experiment comprised four levels of Nitrogen (N) viz., 0, 50, 100, 150 kg/ha. The experiment was laid out in a randomized complete block design with three replications. The experimental result showed that there were significant differences in grain yield and straw yield due to the application of Nitrogen (N), although some of the yield attributes were not found significant. The highest plant height (96.23 cm), number of total tillers/plant (4.58), number of effective tillers/plant (4.00), spike length (10.16 cm), number of fertile spikelets/spike (48.92), number of grains/panicle (20.11), 1000-grain weight (49.78 g), grain yield (5.25 t/ha) and straw yield (6.30 t/ha) were obtained from 100 kg N/ha. The lowest plant height (84.00cm), number of effective tillers/plant (2.33), grain yield (4.25 t/ha) and straw yield (5.42 t/ha) were observed with the application of 0 kg N/ha. The highest number of sterile spikelets/spike (3.17) was found under control and highest harvest index (46.50%) was obtained from 150 kg N/ha. The overall results of the present study demonstrated that wheat may be grown successfully for obtaining maximum yield with the application of 100 kg N/ha.

## KEYWORDS

Nitrogen fertilizer, BARI gom30, plant height, effective tillers, grain yield

## 1. INTRODUCTION

Wheat (*Triticum aestivum L.*) is one of the world's most commonly consumed cereal grains. It comes from a type of grass (*Triticum*) that is grown in countless varieties worldwide. It is superior to rice for its higher protein content, nutritive value and lower cost of production. The land of Bangladesh is much suitable for wheat production. The total area under wheat crop was 4,36,814 ha in 2014 compared to 4,29,607 ha in 2015 (BBS, 2015). It occupies some 4% of the total cropped area and 11% of the area cropped in the *Rabi* season, contributing 7% to the total output of food cereals. This indicates that wheat cultivation may solve to a considerable extent the food problem and save huge foreign currency of the country as well. On the other hand, wheat yield in Bangladesh has increased with the introduction of high yielding varieties. A comparative study of wheat of Bangladesh with many other wheat growing countries have shown that its average yield in Bangladesh is very low which is even disappointingly equivalent to half of some other developed countries wheat productivity (FAO, 2013).

There are many factors which can help to increase wheat production, and among of them an efficient use of fertilizers management seems to be important one under Bangladesh context. There is no other nutrient as important as nitrogen (N) to attain high yields of wheat having acceptable grain protein. Proper N management requires an understanding of the seasonal N needs of the crop with a realistic estimate of the yield potential. Seed protein and milling property are two of the desirable qualities of wheat that depend primarily upon N fertilization.

N is an important constituent of amino acid molecules which are the building blocks of protein. Deficiency of N in wheat crop decreases seed protein content in general. Nitrogen available during early vegetative to boot growth stages affects yield potential, while N applications after the booting stage are primarily used to increase protein. Nitrogen is the most limiting nutrient for wheat production that affects the rapid plant growth and improves grain yield. Many researches showed that N application increased grain yield (GY) of wheat (Subedi *et al.*, 2007; Gorjanovic and Kraljevic-Balalic, 2008).

Nitrogen is a primary nutrient element for the production of wheat. It enhances the vegetative growth of wheat. Different rates of N applied as urea influenced the growth, yield and nutrient uptake of wheat cv. Raj 3077 was evaluated by Indira (2006). Proper supplies of N increase the tillering capacity, number of ear/plant, number of fruiting ears, number of grains/year, grain yield and dry matter yield (Filipov, 2000). Kumar and Sharma (1999) observed that dry-matter accumulation in wheat increased

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significantly when the rate of N application increased.

Nitrogen is one of the essential plant nutrient elements. Many researchers observed that N has positive influence on the yield and yield contributing characters of wheat. If N is limiting, it may limit the response to other plant nutrients and thus yield may be reduced. Asif *et al.* (2012) reported that increasing level of N fertilizer significantly increased the number of fertile tiller/unit area. Anita *et al.* (2005) reported that N levels higher than the recommended dose did not show significant effect on the growth and yield attributes, except the number of grains/spike. Noureldin *et al.* (2013) concluded that N up to 180 kg/ha increased grain yield and its components (NS/m$^2$, spike length [SL], weight of grain/spike, and total grain weight.

Takahashi *et al*. (2007) observed that wheat (*Triticum aestivum L.)* grain yield and grain protein concentrations were depend on N availability and supply. Application of 150 and 180 kg N/hawas at par in significantly increasing grain yield (Yadav *et al.,* 2005). In Bangladesh, though numerous reports have been published on yield and yield attributes of wheat, very little research work has been carried out on increasing grain yield of wheat due to application of N fertilizer. In view of the limited information on the aforesaid problem, the present research work was undertaken to examine the effect of N fertilizer on the performance of BARI gom30.

## 2. MATERIALS AND METHODS

This chapter deals with the materials and methods which were used in performing the experiment. It includes a brief description of soil, crop, intercultural operations, treatment, layout, statistical design, data recording, data processing and chemical analysis. The experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from November 2015 to March 2016 to investigate the effect of different levels of nitrogen on the yield of wheat.

### 2.1 Location of Experimental Site

The experimental site lies at 24.75°N latitude and 90.50°E longitude. The experimental area is elevated about 18m above the sea level. The experimental site belongs to the 'Old Brahmaputra Floodplain' under Agro Ecological Zone-09 (UNDP and FAO, 1988).

### 2.2 Soil

The topography of the experimental plot was a medium high land which belongs to the 'Sonatola' series under the General Soil Type, Non-calcareous dark grey floodplain soils. The morphological, physical and chemical characteristics of soil are presented below.

**Table 1A:** Morphological characteristics of soil

| Constitution | Characteristics |
|---|---|
| Location | Agronomy Field Laboratory, BAU, Mymensingh |
| Soil tract | Old Brahmaputra Alluvium |
| Land type | Medium high land |
| General soil type | Non-calcareous dark grey floodplain |
| Soil series | Sonatola |
| Agro-ecological zone | Old Brahmaputra Floodplain (AEZ-9) |
| Topography | Fairly level |
| Flood level | Above flood level |
| Soil colour | Dark grey |
| Drainage | Moderate |
| Vegetation | Cropped with rice, wheat ,jute etc. |

**Table 1 B:** Physical characteristics of soil

| Soil properties/constituents | Values |
|---|---|
| Sand (%) (0.0-0.02 mm) | 20 |
| Silt (%) (0.02-0.002 mm) | 67 |
| Clay (%) (<0.002 mm) | 13 |
| Soil textural class | Silt loam |
| Particle density (g/cc) | 2.60 |
| Bulk density (g/cc) | 1.35 |
| Porosity (%) | 46.67 |

**Table 1 C:** The chemical characteristics of soil

| Soil properties/constituents | Values | Critical level |
|---|---|---|
| Soil pH | 6.7 | -- |
| Organic carbon (%) | 0.86 | -- |
| Total nitrogen (%) | 0.16 | 0.12 |
| Available phosphorus (ppm) | 17.05 | 10.00 |
| Available potassium (me/100g soil) | 0.10 | 0.15 |
| Zinc (ppm) | 10.35 | 1.15 |
| Sulphur (ppm) | 5.85 | 8.00 |
| Boron (ppm) | 1.12 | 0.20 |
| Molybdenum (ppm) | 0.063 | 0.10 |

Source: Humboldt Soil Testing Laboratory, Department of Soil Science, Bangladesh Agricultural University, Mymensingh.

### 2.3 Climate

The experimental site is situated under sub-tropical climate, characterized by heavy rainfall during *Kharif* season (April to September) and scanty rainfall in *Rabi* season (October to March). Temperature is generally low and there is plenty of sunshine in *Rabi* season. The atmospheric temperature tends to increase from February, as the season proceeds towards *Kharif.*

### 2.4 Description of the Planting Material

Wheat variety "BARI Gom30" was used as plant material. BARI developed this variety and released in 2014. It is a most popular variety now due to its high yielding potentials and suitable for late planting after harvesting *Aman* rice. This variety attains a height of 95-100 cm and takes 100-105 days to complete its life cycle. It is a short duration variety and resistant to leaf blight and leaf rust disease. It is also a heat tolerant variety. The numbers of tillers/plant are 4-6 and the leaves are wide and deep green in color. It requires 60-65 days to heading. Grains are white, light and middle in size. Its yield is 4.5-5.5 t/ha and 1000 grain weight is 44-48 g.

### 2.5 Treatments

The experiment consisted of the following treatments:

Nitrogen Dose (N):

i.0 kg N/ha ($N_0$)
ii.50 kg N/ha ($N_1$)
iii.100 kg N/ha ($N_2$)
iv.150 kg N/ha ($N_3$)

### 2.6 Experimental Design

The experiment was laid out in a randomized complete block design with three replications; each representing a block. Each block was divided into 16 unit plots where 16 treatment combinations were allocated at random. The total number of unit plots in the experiment was (16×3) 48. The size of each plot was 4.0m×2.5m. Inter block and inter plot spacings were 1 m and 0.5m, respectively.

### 2.7 Land Preparation

For land preparation, the experimental field was opened with a tractor drawn disc harrow 10 days before sowing followed by ploughing four times with country plough and laddering for breaking the clods and leveling the land. Weeds, stubble and crop residues were removed from the field and left for some days to complete the decomposition. Finally the unit plots were prepared with spade before sowing.

### 2.8 Fertilizer Application

The unit plots were fertilized with 150 kg/ha Triple Super Phosphate, 100 kg/ha Muriate of Potash, 110 kg/ha gypsum. Nitrogen and zinc were applied as per experimental specification through urea and zinc sulphate, respectively. The total amount of TSP, MOP, gypsum, zinc sulphate and one third of the urea were applied at the time of final land preparation prior to sowing. The remaining two-thirds of urea were top-dressed in two equal splits on 20 and 55 days after sowing (DAS).

### 2.9 Sowing of Seeds

The seeds were collected and sown on 29 November 2015 at the rate of 120 kg/ha in 25 cm apart rows.

### 2.10 Intercultural Operations

Intercultural operations were done in order to ensure and maintain the normal growth of the crops. Manual weeding was done twice at 20 and 50 DAS. The plots were irrigated twice after first weeding and then at 55 DAS.

### 2.11 Harvesting and Processing

The crop was harvested plot-wise at full maturity on 25 March 2016 and carried to the threshing floor for drying, threshing and cleaning. The grains and straw were then dried in the sun for five days.

### 2.12 Sampling and Data Recording

For collecting data on crop characters, ten sample plants/plot were selected at random and uprooted prior to harvesting. The grain and straw yields were recorded plot-wise at 14% moisture level in t/ha.
The data on the following crop parameters were recorded from each plot:

i. Plant height
ii. Number of total tillers/plant
iii. Number of effective tillers/plant
iv. Length of spike
v. Number of fertile spikelets/spike
vi. Number of sterile spikelets/spike
vii. Number of grains/spike
viii. Weight of 1000 grains (g)
ix. Grain yield (t/ha)
x. Straw yield (t/ha)
xi. Biological yield (t/ha)
xii. Harvest index (%)

### 2.13 Data Collection Techniques

A brief outline of the data recording procedure is as follows:

#### *2.13.1 Plant height*

Height of the plant was measured from the ground level to the tip of the uppermost spike lets of the panicle and their average was calculated.

#### *2.13.2 Number of total tillers/plant*

Number of total tillers/plant from each plot was counted from ten sample plants one week before harvest and their averages were taken.

#### *2.13.3 Number of effective tillers/plant*

Number of effective tillers/plant from each plot was counted from ten plants one week before harvest and their average was taken.

#### *2.13.4 Length of spike*

Length of spike was measured from the sample plants and their averages were calculated.

#### *2.13.5 Number of spikelets/spike*

Number of spikelets/spike was counted taking ten spikes from the ten selected plants of each plot and the average number was recorded.

#### *2.13.6 Number of grains/spike*

Number of grains/spike was counted taking ten spikes from the sample plants of each plot and the average number was recorded.

#### *2.13.7 Number of sterile spikelets/spike*

Number of sterile spikelets/spike was counted taking ten spikes from the ten selected plants of each plot and the averages were recorded.

#### *2.13.8 Thousand grain weight (g)*

The weight of 1000 seeds from each plot was measured in gram taking ten plants at random from each unit plot.

#### *2.13.9 Grain yield (t/ha)*

Grains obtained from each unit plot were sun dried and weighed carefully. The dry weight of grains of selected plants was added to the respective unit plot to record the final yield/plot. The grain yield was finally converted to t/ha.

#### *2.13.10 Straw yield (t/ha)*

Straw obtained from each unit plot including the straw of sample plants of respective unit plot was dried in sun and weighed to record the final straw yield/plot and finally converted to t/ha.

#### *2.13.11 Biological yield (t/ha)*

Total weight of aerial biomass (including the grain) at maturity was measured from 10 m$^2$ area of each plot and expressed as t/ha.

#### *2.13.12 Harvest index*

The harvest index was calculated as follows:
Biological yield = Grain yield + Straw yield

$$\text{Harvest} = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

### 2.14 Statistical Analysis

The collected data were analyzed statistically using the analysis of variance (ANOVA) technique and significances of mean differences were adjudged by Duncans New Multiple Range Test (Zaman *et al.,* 1982).

## 3. RESULTS AND DISCUSSION

A field experiment was carried out to study the effect of Nitrogen (N) fertilizer application on the yield of wheat (cv. BARI Ghom30) including yield contributing characters. The effect of Nitrogen (N) on yield and yield contributing characters of wheat have been presented below.

### 3.1 Plant height

It was observed that the plant height was affected significantly with different levels of N. The maximum plant height (96.23 cm) was found when the crop was fertilized with 100 kg N/ha ($N_2$) and the shortest plant height (84.00 cm) found from control ($N_0$) (Figure 1). From the above findings, it is shown that plant height was greatly affected by N application. Several researchers showed that application of different level of N affected the plant height. Razib (2010) observed that by applying 120 kg N/ha the highest plant height (100.23 cm) was obtained. Mizan (2010) reported that the plant height (83.32 cm) was highest which was obtained from 160 kg N/ha followed by 120 kg N/ha. This statement was also in conformity with many researchers (Kumar *et al., (*2003); Kumpawat and Rathore, (2003) and Patel *et al.,* (1995).

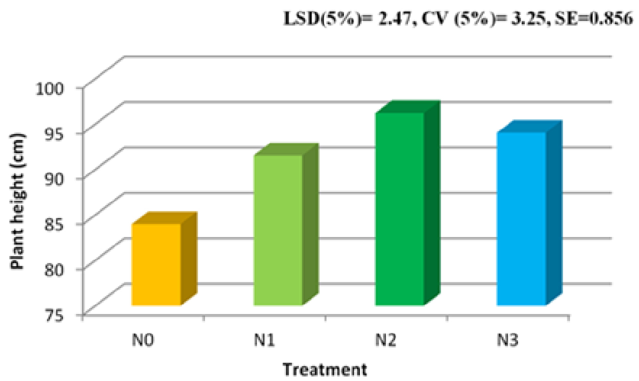


**Figure 1:** Effect of Nitrogen on plant height (cm)

### 3.2 Number of total tillers/plant

The total number of tillers/plant was significantly influenced by different level of N application. The highest number of total tillers/plant (4.58) was produced under $N_2$ treatment (100 kg N/ha) while the lowest value (2.83) was obtained from the treatment $N_0$ (control) (Figure 2). Razib (2010) reported that maximum number of total tillers/hill (18.66) was produced when 120 kg N/ha was applied. Iqtidar *et al.* (2006) reported that by applying 200 kg N/ha, highest number of total tillers/plant was obtained.

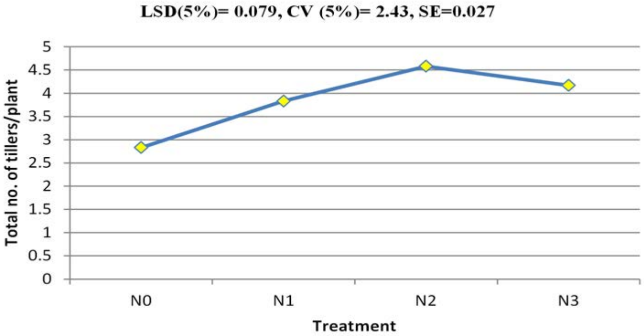


**Figure 2:** Effect of Nitrogen on total no. of tillers/plant

### 3.3 Spike length (cm)

Spike length was significantly affected by different levels of N application. The longest spike length (10.16 cm) was obtained from 100 kg N/ha ($N_2$) and the shortest figure (8.70 cm) was noticed in control ($N_0$) (Figure 3). Ashoush and Toaima (2004) published that the longest spike length was obtained from highest N fertilizer level and shortest from control. Spike length significantly increased with N application up to 120 kg/ha (Imran *et al.* (2005). Kumar *et al.* (1999) observed that length of spike of winter wheat increased with increasing level of N.

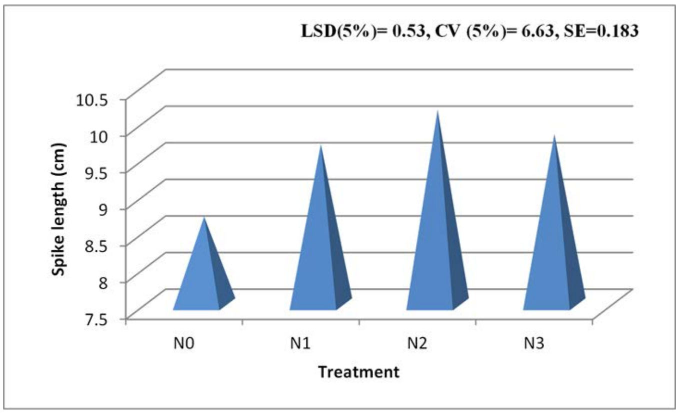


**Figure 3:** Effect of Nitrogen on spike length (cm)

### 3.4 Number of effective tillers/plant

Number of effective tillers/plant differed significantly due to the different levels of N application. The highest number of effective tillers/plant (4.00) was observed when the crop was fertilized with 100 kg N/ha ($N_2$). On the other hand the lowest number of effective tillers/plant (2.33) was recorded from $N_0$ (control) (Table 2). The highest number of effective tillers/plant was obtained from 120 kg N/ha and supported by Kumpawat and Rathore (2003). Number of effective tillers/plant/m2 increased with bio-fertilizer inoculation, FYM application and increase in the level of N up to 120 kg/ha (Bindia *et al.,* 2005).

**Table 2:** Effect of Nitrogen on Number of effective tillers/plant

| Level of nitrogen | Number of effective tillers/plant |
|---|---|
| $N_0$ | 2.33d |
| $N_1$ | 3.168c |
| $N_2$ | 4.003a |
| $N_3$ | 3.665b |
| $LSD_{0.05}$ | 0.126 |
| SE | 0.043 |
| Level of significance | ** |
| CV (%) | 4.64 |

In a column, figures with same letter (s) do not differ significantly as per DMRT
** = Significant at 1% level of probability

### 3.5 Number of fertile spikelets/spike

The application of N significantly increased the number of fertile spikelets/spike. Nitrogen at the rate of 100 kg/ha ($N_2$) produced the maximum number of fertile spikelets/spike (20.11) whereas control treatment produced the lowest one (Table 3). Therefore, it is clear that the number of fertile spikelets/spike was influenced by N fertilization. Imran *et al.* (2005) reported that number of fertile spikelets/spike significantly increased with N application up to 120 kg/ha. Indira (2006) reported that number of fertile spikelets/spike significantly increased with the application of 125 kg N/ha.

**Table 3:** Effect of Nitrogen on Number of fertile spikelets/spike

| Level of nitrogen | Number of fertile spikelets/spike |
|---|---|
| $N_0$ | 16.81b |
| $N_1$ | 19.02a |
| $N_2$ | 20.11a |
| $N_3$ | 19.41a |
| $LSD_{0.05}$ | 1.07 |
| SE | 0.370 |
| Level of significance | ** |
| CV (%) | 6.82 |

In a column, figures with same letter (s) do not differ significantly as per DMRT
** = Significant at 1% level of probability

### 3.6 Number of sterile spikelets/spike

The result showed that number of sterile spikelets/spike was significantly influenced by N fertilization. The highest number of sterile spikelets/spike (3.17) was obtained from the control and the lowest (2.87) was found in 100 Kg N/ha which was statistically identical with 150 kg N/ha (Figure 4). It is may be to explain that the deficiency of N causes sterile spikelets/spike. Filipov (2000) reported that the removal of N supply had little effect on total number of spikelets/spike. More significant effects were observed on sterile spikelets/spike. Kataki *et al.* (2001) reported that there was no significant effect of number of sterile spikelets/spike.

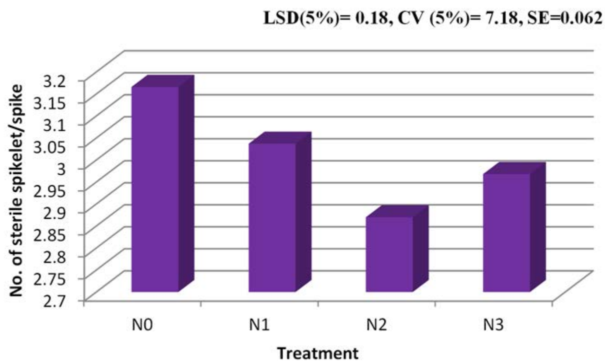


**Figure 4:** Effect of Nitrogen on sterile spikelet/spike

### 3.7 Number of grains/spike

Significant variation was observed in case of number of grains/spike due to effect of different level of N application. The highest number of grains/spike was found (48.92) when 100 kg N/ha was applied. In case of control the lowest (42.81) number of grains/spike was found (Figure 5). Indira (2006) reported that application of 125 kg N/ha significantly increased number of fertile spikelets/spike which is slightly high with the experimental result. Iqtidar *et al.* (2006) observed that the PH, total number of plants/m², number of grain/spike, number of spike/m², spike weight, and grain yield were significantly increased with the increasing level of N from 50 to 200 kg/ha compared to 0 kg N/ha.

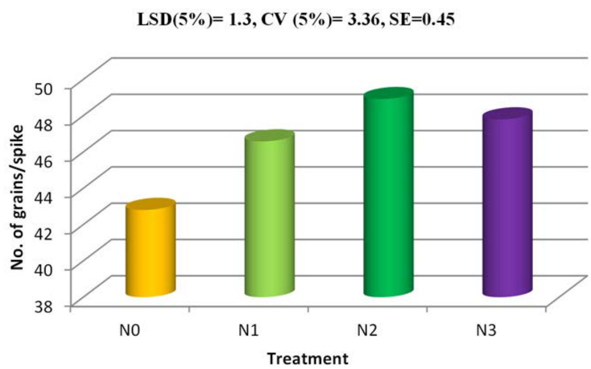


**Figure 5:** Effect of Nitrogen on grains/spike

### 3.8 1000-grain weight

The response of 1000 grain weight to application of N fertilizer was significant (Appendix III). The highest 1000 grain weight (49.78 g) of wheat was found under $N_2$ treatment (100 kg N/ha) The lowest 1000 grain weight (41.76 g) of wheat was found under $N_0$ treatment i.e. under control ($N_0$) (Figure 6). This result is supported by Abedi *et al.* (2011). But Ali *et al.*, (2003) stated that 1000–grain weight of wheat increased with the application of 150 kg N/ha.

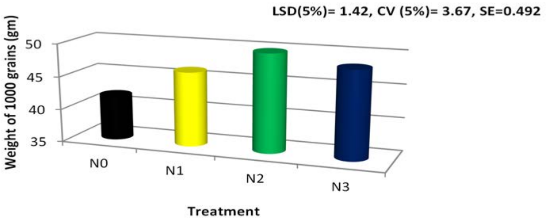


**Figure 6:** Effect of Nitrogen on weight of 1000 grain (gm)

### 3.9 Grain yield

#### *3.9.1 Grain yield (t/ha)*

Generally, the five components influence the grain yield namely, number of effective tillers/plant, number of spike/plant, number of spikelets/spike, number of grains/spike and individual grain weight. The $N_2$ (100 kg N/ha) treatment gave the highest grain yield (5.25 t/ha) and the lowest grain yield (4.25 t/ha) was observed under the treatment of $N_0$ (control) (Figure 7). Indira (2006) conducted a field experiment with wheat and observed that application of 125 kg N/ha significantly increased grain yield which is approximately identical with the highest grain yield obtained from treatment $N_2$ (100 kg N/ha). Bellido *et al.* (2000) also reported that grain yield of wheat increased significantly when the seed rate was increased from 100 to 150 kg N/ha. Noureldin *et al.* (2013) conducted a field experiment and found that increasing N up to 180 kg/ha increased grain yield. Jiang *et al.* (2011) reported that grain yield, grain protein content, and grain protein yield all increased significantly with increasing nitrogen fertilization rate. Halvorson *et al.* (2000) reported that increasing level of N gave significantly higher grain yield.

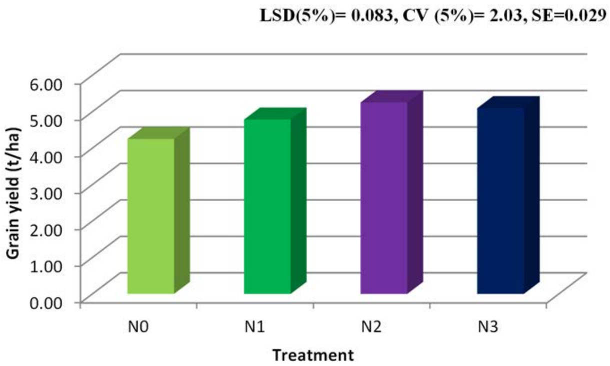


**Figure 7:** Effect of Nitrogen on grain yield (t/ha)

### 3.10 Straw yield

The effect of different doses of N also showed significant effect on straw. The production of highest straw yield was (6.30 t/ha) in 100 kg N/ha might be due to the fact that N tend primarily to encourage vegetative growth. The highest straw yield of 6.30 t/ha (Figure 8) was recorded under $N_2$ treatment and the lowest straw yield of 5.42 t/ha was recorded under $N_0$ treatment. El-Desoky *et al.* (2000) examined the split N using with 15 treatments. Each treatment comprised 100 kg N/feddan applied in one full dose, or in 2, 3 or 4 equal splits 3 weeks after sowing, stem elongation, heading and/or milk ripening stages. The splitting application of N at 3 weeks after sowing and stem elongation produced highest straw and grain yield. Kumpawat and Rathore (2003) reported significant increase in straw yield with Napplication up to 160 kg/ha. Straw yield increased with biofertilizer inoculation and application of FYM and N fertilizer (Bindia *et al.,* 2005). The highest straw yield was obtained from the highest N fertilizer level of 80 kg/fed (Ashoush and Toaima, 2004).

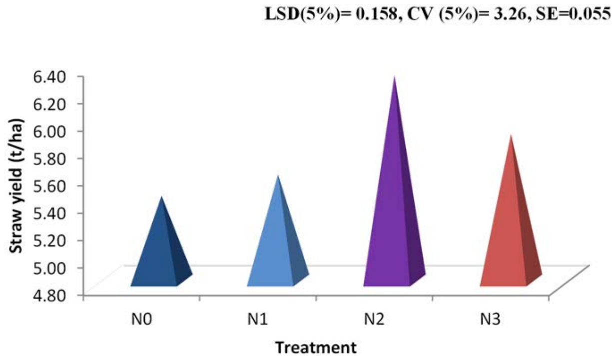


**Figure 8:** Effect of Nitrogen on straw yield (t/ha)

### 3.11 Biological yield

Biological yield was significantly influenced by N fertilization. Treatment $N_2$ (100 kg N/ha) showed the maximum biological yield (11.56 t/ha) as against the lowest (9.66 t/ha) from control (Table 4). From the above results, it is clear that increase in N levels biological yield was increased. This is possibly due to significant effects of N in all vegetative and reproductive growth of wheat. Marino *et al.* (2009) reported that increase the N rate increased hulled and unhulled grain yield and biomass accumulation. This result is also agreement with the findings of Ottman *et al.* (2000), Bellido *et al.* (2000), Hossain (2005) and Bindia *et al., (*2005).

**Table 4:** Effect of nitrogen on biological yield (t/ha)

| Level of nitrogen | Biological yield (t/ha) |
|---|---|
| $N_0$ | 9.66 d |
| $N_1$ | 10.36 c |
| $N_2$ | 11.56 a |
| $N_3$ | 10.97 b |
| $LSD_{0.05}$ | 0.207 |
| SE | 0.072 |
| Level of significance | ** |
| CV (%) | 2.34 |

In a column, figures with same letter (s) do not differ significantly as per DMRT
** = Significant at 1% level of probability

### 3.12 Harvest index

Harvest indices achieved by using N were always higher than that of the control and the mean differences for a number of treatments were significant. The highest harvest index (46.50%) produced by $N_3$ treatment and the lowest harvest index (43.90) was observed under the treatment of $N_0$ (Table 5). Bindia *et al.* (2005) reported that the harvest index increased with FYM application and increasing level N up to 120 kg/ha. Mehasen (1999) reported that harvest index increased with increasing N levels and application of bio-fertilizers in comparison to the untreated control. Asif *et al.* (2012) reported that increasing levels of N fertilization had significantly increased the harvest index. Hossain (2005) conducted an experiment and he reported that harvest index increased significantly with each increase in N rate.

**Table 5:** Effect of nitrogen on harvest index (%)

| Level of nitrogen | Harvest index (%) |
|---|---|
| $N_0$ | 43.92 c |
| $N_1$ | 46.21 ab |
| $N_2$ | 45.49 b |
| $N_3$ | 46.50 a |
| $LSD_{0.05}$ | 0.862 |
| SE | 0.298 |
| Level of significance | ** |
| CV (%) | 2.28 |

In a column, figures with same letter (s) do not differ significantly as per DMRT
** = Significant at 1% level of probability

### 3.13 Correlation and regression studies

The degree of statistical relationship between grain yield and number of effective tillers/plant, grain yield and number of fertile spikelets/spike, grain yield and number of grains/spike, grain yield and straw yield of wheat has been found out significant relationship at 1% level of probability. The positive slopes exhibited positive relationship.

### *3.13.1 Grain yield and number of effective tillers/plant*

The degree of relationship between grain yield and number of effective tillers/plant of wheat was studied (Figure 9). The result revealed that grain yield and number of effective tillers/plant have a direct significant positive relationship at 1% level of significance which has been confirmed with correlation co-efficient r = 9989 (Figure 9). The relationship was more evident by the equation Y= and sowing gradual Y = 0.6082x + 2.8434 increase in grain yield with the increase of number of effective tiller/plant.

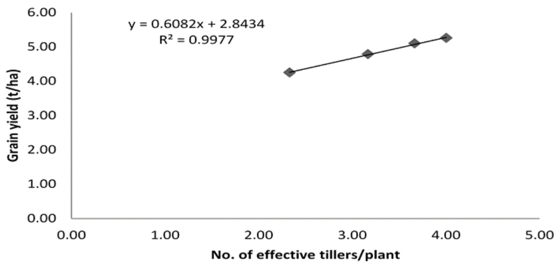


**Figure 9:** Relation between grain yield and no. of effective tillers/plant of wheat cv. BARI Gom30

### *3.13.2 Grain yield and number of fertile spikelets/spike*

A correlation matrix was done in order to observe the degree of interrelationship between grain yield and number of fertile spikelets/spike. The result showed that the grain yield and number of fertile spikelets/spike have a significant relationship at 1% level of significance. The correlation coefficient r = 0.9822** (Figure 10) and the regression line of Y (grain yield) on X (number of fertile spikelets/spike) having the equation Y = 0.3051x - 0.9022.The positive slope indicates that grain yield and number of fertile spikelets/spike are directly correlated, i.e. increase in number of fertile spikelets/spike.

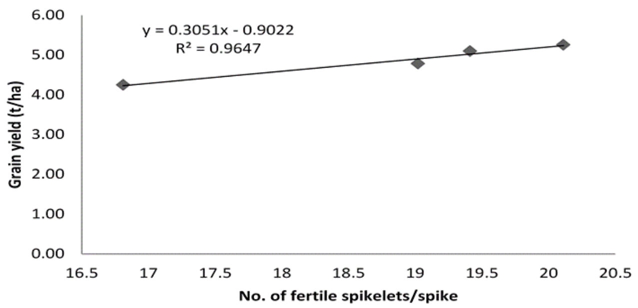


**Figure 10:** Relation between grain yield and number of fertile spikelets/spike of wheat cv. BARI Gom30

### *3.13.3 Grain yield and number of grains/spikelet*

The degree of relationship between grain yield and number of grains/spike of wheat was studied (Figure 11). It is shown from the result that there was a direct significant and positive relationship at 1% level of significance between grain yield and number of grains/spike. The correlation co-efficient r = 0.9936** and the regression line of y (grain yield) on number of grains/spike having Y = 0.1656x – 2.8587. The positive slope indicates that grain yield and number of grains/spike are directly correlated, i.e. increase in number of grains/spike

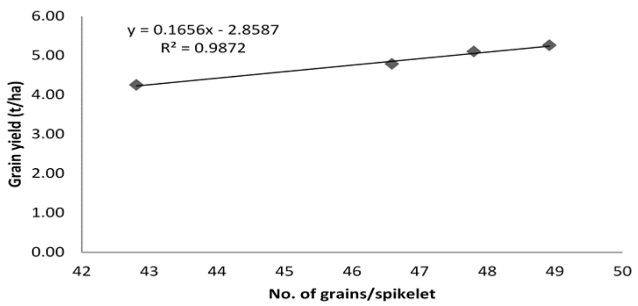


**Figure 11:** Relation between grain yield and number of grains/spikelet of wheat cv. BARI Gom30

### *3.13.4 Grain yield and straw yield*

From the results of experiment it is observed that grain yield showed significantly positive correlation with its straw yield (r = 0.8998**). The regression equation of Y (grain yield) vs (straw yield) was found to be Y = 0.5383x + 1.7237 (Figure 12). It means that an increase in straw yield will lead to an increase in grain yield. The present experiment was undertaken with some objectives. The need of such a study under field conditions was justified by presenting and amplifying the review of literature. The overall results represented that the application of N and Zn played a significant role in efficient wheat production. The definite information from above discussion will be useful for national policy making to achieve optimum yield production of wheat in Bangladesh.

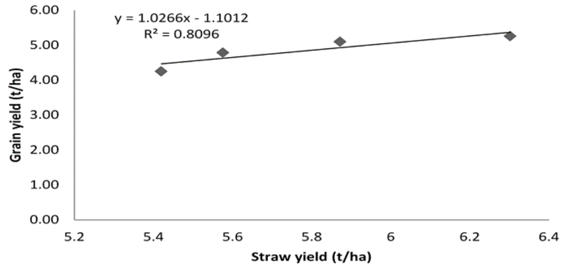


**Figure 12:** Relation between grain yield and straw yield of wheat cv. BARI Gom30

## 4. CONCLUSION

The effect of different levels of N was significant in relation to yield. Yield and yield attributing characters were significantly influenced with the application of nitrogen. The highest plant height (96.23 cm), number of total tillers/plant (4.58), number of effective tillers/plant (4.00), grain yield (5.25 t/ha), straw yield (6.30 t/ha) were obtained from 100 kg N/ha. The highest spike length (10.16 cm), number of fertile spikelets/spike (48.92), number of grains/panicle (20.11) and 1000-grain weight (49.78 g) were found at 100 kg N/ha. The highest number of sterile spikelets/spike (3.17) was found under control and highest harvest index (46.50%) was obtained from 150 kg N/ha. The overall results of the present study demonstrated that wheat may be grown successfully for obtaining maximum yield with the application of 100 kg N/ha.


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## CONFLICT OF INTEREST

The authors have no conflict of interest to report.

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