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ORIGINAL RESEARCH ARTICLE

Appraisal of different doses of nitrogen fertilizer on growth and yield of eggplant (*Solanum melongena* L.)

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ABSTRACT

Nitrogenous fertilizer could improve the growth, yield and yield contributing characters of eggplant. The present investigation was aimed to find out the effects of different doses of nitrogen fertilizer on growth and yield of eggplant (*Solanum melongena* L.) which was conducted at Noakhali Science and Technology University during November, 2018 to March, 2019. The experiment comprises on eggplant local variety named 'Tal begun'. There were four treatments of urea *viz*., 0, 12, 21 and 30 g urea pot^{-1} and the experiment were laid out in completely randomized design (CRD) with three replications. Different parameters were undertaken for the study like plant height (cm), number of leaves per plant, number of branches per plant, number of flowers per plant, number of fruits per plant, individual fruit weight (g). The variety showed significant variation for different doses. Among all treatments, 30 g urea pot^{-1} showed highest vegetative characteristics such as plant height (49.67 cm), number of leaves per plant (32.67), number of branches per plant (7.33) at 60 DAT and lowest vegetative characteristics was found from 0 g urea pot^{-1}. On the other hand, the application of 21 g urea pot^{-1} showed medium vegetative characteristics and highest reproductive characteristics such as number of flowers per plant (6.67), number of fruits per plant (6.67), individual fruit weight (138.67 g). Therefore, the results showed that, nitrogen fertilizer strongly influenced vegetative and reproductive characteristics of eggplant. The findings of this study suggested that 21 g urea pot^{-1} performed the best and it will be suitable for eggplant production.

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INTRODUCTION

Eggplant (*Solanum melongena* L.) commonly known as 'Brinjal' is one of the important vegetable crops of tropical and temperate parts of the world. It is a member of the Solanaceae family. It has been widely grown in southern Europe, the Middle East, Africa and Asia for hundreds of years (Ullio, 2003). The varieties of eggplant show a wide range of oval shaped to long club-shaped and colors are white, yellow, green, purple pigmentation to almost black (Aminifard *et al*., 2010). Eggplant fruits are known for its low in calories and having a mineral composition beneficial for human health and it is rich source of potassium, magnesium, calcium and iron (Michalojc and Buczkowska, 2008). It is a very common and favorite vegetable in Bangladesh which consumed regularly basis by the both rural and urban peoples. Brinjal is the second most important vegetable crop in Bangladesh in terms of production area as well as yield and it is cultivated all over the country in Rabi and Kharif seasons. In 2016-17, it is cultivated in 80195 and 45665 acres of land with an annual production of 347541 and 159891 tons in Rabi and Kharif seasons, respectively (BBS, 2018). But average yield of brinjal in Bangladesh is very low compared to other advanced countries of the world. The low yield of brinjal in Bangladesh is primarily due to the lack of high yielding varieties, inadequate

and imbalanced use of manure and fertilizers especially the nitrogenous ones (Sharmin and Rahman, 2019). Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield (Singh, 2003). So, nitrogenous fertilizer use has played a significant role in increase of vegetables yield. Thus, brinjal requires a large quantity of nitrogenous fertilizer for its proper growth, development and yield (Aminifard *et al.*, 2010). In Bangladesh, the farmers use huge amount of different chemical fertilizers unwisely for crop production especially for vegetables and among that urea is the top most. Nitrogenous fertilizer often has mobility in soils, which leads to soil pollution and ground water contamination, ultimately causing health hazards to the people (Begum *et al.*, 2014; Giannakoula *et al.*, 2010). Therefore, management of nitrogen fertilizers such as rate, type and application time are very important (De Pascale *et al.*, 2006). Nutritional stress is one of the main factors limiting crop productivity, this may occur due to an excess or a deficit of nutrients (Souza *et al.*, 2018). It is a well-known that satisfactory growth, development and high yield of eggplant could be obtained from sufficient application of nitrogenous fertilizer. Considering the above circumstances, the motive of this study was to evaluate of different doses of nitrogen requirement on vegetative growth, yield and yield contributing characters of eggplant variety namely 'Tal begun' for on-season production.

MATERIALS AND METHODS

Experimental design

The experiment was carried out during the period from 15th November, 2018 to 31st March, 2019 at net house of Agriculture department, Noakhali Science and Technology University, Bangladesh. The climate of the experimental area was temperate in nature. The soil was sandy loam in texture to slightly saline which pH was 7.5-8.3. Local variety 'Tal begun' is used in this experiment and the experiment was laid out in completely randomized design (CRD) with three replications. In this experiment there were four treatments of urea *viz.*, T_1(0 g pot^{-1}), T_2 (12 g pot^{-1}), T_3 (21 g pot^{-1}), and T_4 (30 g pot^{-1}). Urea was applied to the pot in three equal splits at 10, 30 and 50 days after transplanting.

Eggplant cultivation practices

Eggplant seedlings were raised in two seedbeds of 3.0 m × 1.0 m size. The soil was well prepared and all weeds as well as stubbles were removed from the seedbeds and well rotten cow dung was mixed with the soil. In each seedbed seeds were sown on 15 November, 2018. After sowing, seeds were covered with light soil. The emergence of the seedlings took place with 6 to 7 days after sowing. The soil used for pot preparation was exposed the sun for a week. After that, the soil mixed with organic manure and kept the material for 1-2 weeks for stabilized the organic matter with soil. Then the pot was filled with soil mixture as lightly and fluffy for provide plenty of space for air and moisture move through the soil and also good root initiation. Then the pot was placed in a spot where they received at least six hours of sun. 30 days old seedlings were transplanted to the pot. The pot size was (20 × 22) cm. Intercultural operations was done when necessary.

Collection of data

Data on the following parameters were recorded from the experimental pot. The height of each plant was measured (cm) from the base of the plant to the apex with a tape measure. Height of the eggplants were recorded at 15, 30, 45 and 60 days after transplanting. Randomly selected branches of eggplants were used for the measurement of leaves number per plant at 15, 30, 45, and 60 days after transplanting. The number of branches per plant was recorded at 30, 45 and 60 days after transplanting. The number of flowers per plant was recorded at 50, 60, and 70 days after transplanting. The number of fruits per plant was recorded at 75, 85, and 95 days after transplanting. The individual fruit weight (g) was done at 110 days after transplanting. All of the data were recorded by counting through eye estimation.

Statistical analysis

The recorded data on the different parameters of the study were analyzed using SPSS statistical software (Version 25, Chicago, IL, USA) and Microsoft Office Excel 2013 to find out the significance of the difference among the treatments. The analysis was performed by F-test and means were compared by Least Significant Different (LSD) test at 5% level of probability.

RESULTS AND DISCUSSION

Plant height (cm)

The eggplant variety has the significant effect on the plant height. The result presented in Figure 1 that showed significant difference at 15, 30, 45, 60 days after transplanting. The tallest plant was found from T_4 (49.67 cm) at 60 DAT, On the other hand, the smallest plants was found from T_1 (36.67 cm) at 60 DAT. From this result it can be inferred that, at later stage of growth (*i.e.* 60 DAT) nitrogen levels showed remarkable change in plant height compared to the initial stage of growth of eggplants. Wange and Kale (2004) who reported that significant improvement in plant height of eggplant occurred due to over recommended rate of nitrogenous fertilizers. Bar-Tal *et al.* (2001) and Prabhu *et al.* (2003) said that, increase in plant height with increasing level of fertilizer application. Ge *et al.* (2008) observed that nitrogen application increased plant height at vegetative, flowering and reproductive stages. So, it can be said that, the more nitrogenous fertilizer is given to the plant, the more increased plant height.

Number of leaves per plant

Number of leaves per eggplant varied significantly among the different treatments of nitrogen. The leaves per plant was recorded maximum (31.67) at 60 DAT where 30 g urea pot^{-1} was

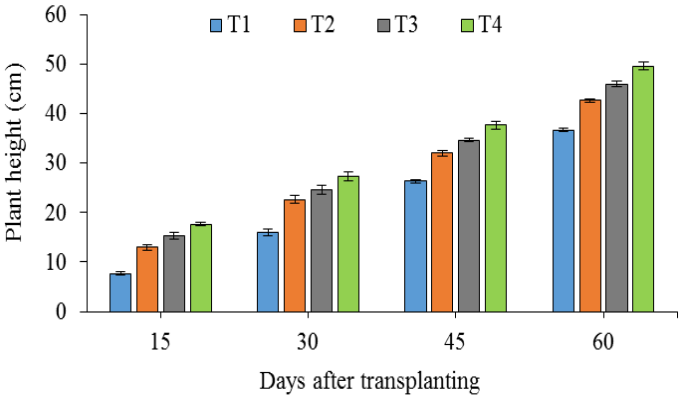

Figure 1. *Effect of different levels of urea on plant height of eggplant at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

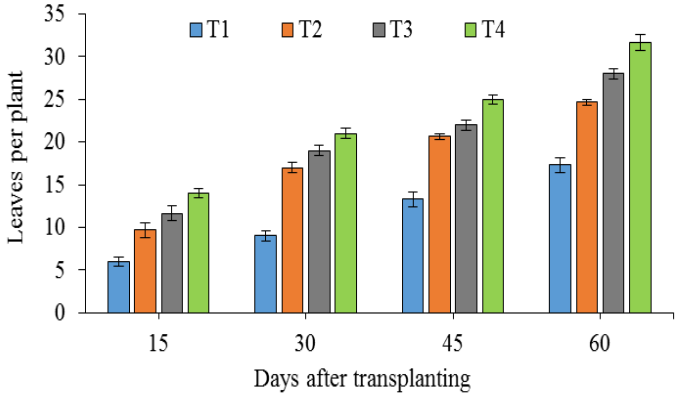

Figure 2. *Effect of different levels of urea on leaves per plant at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

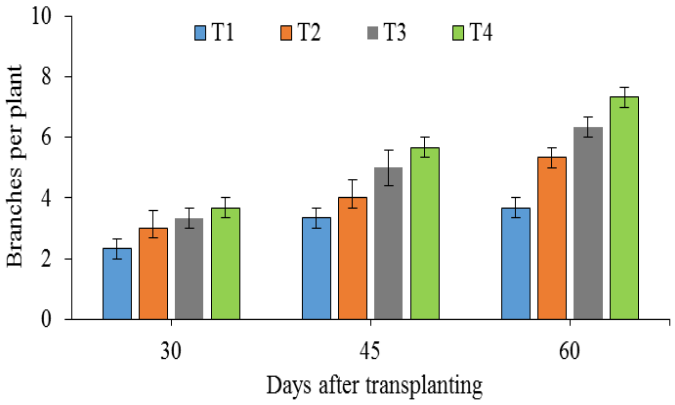

Figure 3. *Effect of different levels of urea on branches per plant at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

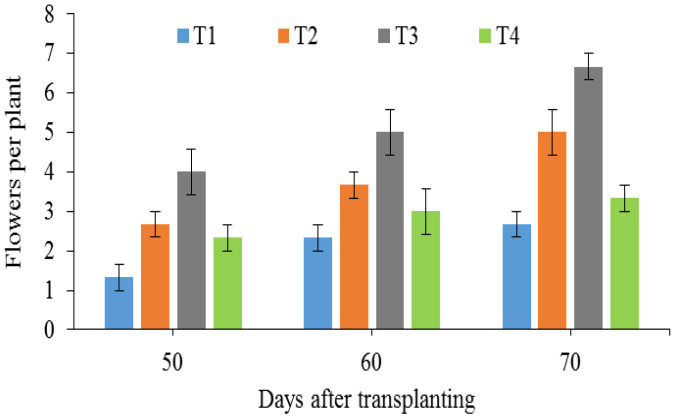

Figure 4. *Effect of different levels of urea on flowers per plant at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

done and the minimum number of leaves (17.33) per plant was found at 60 DAT where 0 g urea pot^{-1} was done which was statistically significant (Figure 2). Similar result was found by Wange and Kale (2004), and they reported that over recommended rate of nitrogenous fertilizer significantly increased number of leaves in eggplant. Jilani *et al.* (2008) stated that application of nitrogen at the rate of 150 Kg ha^{-1} increased number of leaves of brinjal. Mohammad *et al.* (2010) stated that nitrogen is found to promote growth and increases biomass production, and nitrogen fertilization has been used to increase growth of eggplants. Thus, it can be inferred from this result that application of different levels of nitrogen significantly affected the number of leaves per plant.

Number of branches per plant

Effect of different levels of nitrogen on number of branches per eggplant was statistically significant. The maximum number of branches per plant was obtained from the treatment T_4 (7.33), while the minimum was found from T_1 (3.67) at 60 DAT (Figure 3). Hussain *et al.* (2010) reported number of branches per plant of brinjal varied from by the application of different types of nitrogenous fertilizers. Sharmin and Rahman (2019) reported that highest number of branches per plant was obtained from the application of 375 Kg ha^{-1} urea, while the lowest number of branches per plant was found from the control treatment. Therefore, it can be inferred from this result that eggplant required higher amount of nitrogen for its better growth and development.

Number of flowers per plant

Flower number at eggplant was significantly affected by different doses of nitrogenous fertilizer (Figure 4). The highest flower number at plant was observed in 21 g urea pot^{-1} having 6.67 flowers in average, while the least number of flowers was recorded at 0 g urea pot^{-1} having 2.67 flowers at 70 DAT. Aminifard *et al.* (2010), proved that nitrogen fertilizer affected flower number and the days to first flowering. Mirdad (2011) stated that the eggplant plants responded well to fertilization by using high levels of nitrogen, and gave the most favorable performances for all studied characters.

Number of fruits per plant

This study revealed that statistical significances differences existed among the treatments for average number of fruits per plant (Figure 5). Data showed the highest fruits number per plant (6.67) was observed from 21 g urea pot^{-1}, while the lowest (1.67) related to 0 g urea pot^{-1} at 95 DAT. Mirdad (2011) reported that increasing the application of nitrogen to the

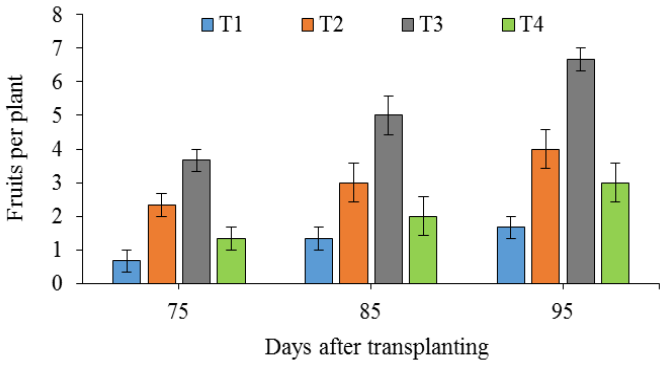

Figure 5. *Effect of different levels of urea on fruits per plant at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

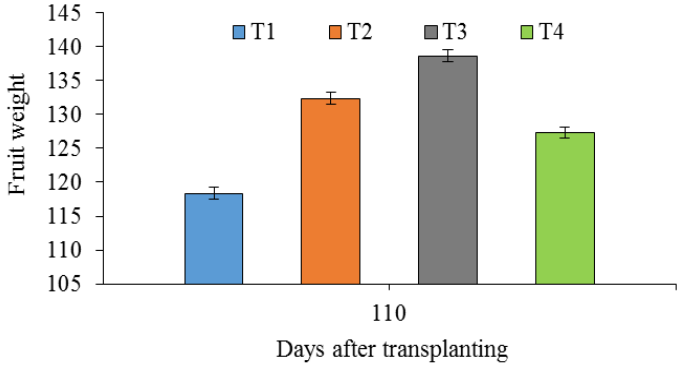

Figure 6. *Effect of different levels of urea on individual fruit weight at different days after transplanting. Vertical bar indicates LSD at 5% level of significance. (T_1= 0 g urea pot^{-1}, T_2= 12 g urea pot^{-1}, T_3= 21 g urea pot^{-1}, T_4= 30 g urea pot^{-1}, DAT= Days after transplanting).*

grown plants, then significantly increasing all reproductive and yield components of brinjal. Rosati *et al.* (2002), Akanbi *et al.* (2007) and Aujla *et al.* (2007) reported that increments in the nitrogen rate of the fertilizers increased the yield and number of fruits. Increasing the levels of nitrogenous fertilizer to 21 g urea pot^{-1} significantly increased the yield of eggplant while yield decreased at the highest rate of nitrogen. This decrease in yield might be due to excess levels of nitrogenous fertilizer applied to the plant. Optimum level of nitrogen fertilization significantly increased yield per plant compared to control.

Individual fruit weight

The application of different levels of nitrogen significantly affected the individual fruit weight of brinjal. The highest individual fruit weight (138.67 g) was obtained from the application of T_3 treatment, while the lowest yield (118.33 g) was found from the T_1 treatment (Figure 6). Devi *et al.* (2002) and Aujla *et al.* (2007) also reported that increasing the rate of nitrogen fertilizers increased the average fruit weight and fruit volume. Consequently, it can be inferred from this result that fruits yield and weight increased significantly with increasing nitrogen levels, but excess levels of nitrogen decreasing yield and weight of fruits.

Conclusion

From the result it was found that nitrogen significantly affected plant vegetative characteristics and reproductive characteristics. Excess nitrogen application increased vegetative characteristics and decreased the reproductive characteristics. Fertilization with 21 g urea pot^{-1} resulted in the medium vegetative growth with better yield than the other treatments, while the lowest yield was found from 0 g urea pot^{-1}. Hence, the present study results showed that, 21 g urea pot^{-1} performed the best for eggplant production. However, fertilizer recommendation in future should be location, site and variety specific and further study should be continued in different seasons and agro-ecological zones of Bangladesh for better production.

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Conflict of interest

The authors have done this research and wrote the article and there is no conflict of interest including any financial, personal or other relationships with other people or organizations.

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