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Effect of Organic and Inorganic Fertilizers on Growth and Yield of Lal Teer King Onion (*Allium Cepa* L.) in the Southern Part of Bangladesh

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Abstract

To investigate the effects of organic and inorganic fertilizers on the development and yield of onions, an experiment was carried out in the Inu Agro Farm in Sunapur, close to the Noakhali Science and Technology University, Noakhali-3814. Three replications of the experiment were set up using a randomized complete block design (RCBD). The unit plot measured 1.5 x 0.5 meters. To determine the effectiveness of onions in the coastal zone of Bangladesh, three different fertilizers—vermicompost, poultry manure, and inorganic fertilizer—were employed together with a control.

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Plant height (cm), number of leaves, length of leaves (cm), bulb length (cm), bulb breadth (cm), total soluble solid (TSS), number of roots, individual bulb weight (g), ten bulb weight (g), and yield of onion (t ha^{-1}) are the characteristics that were taken into account for this experiment. The results showed that the T_2 (Poultry Manure) treatment provided the highest yield (7.26 t ha^{-1}), followed by the T_3 (Inorganic Fertilizer) and T_1 (Vermicompost), which were 6.49 and 4.87, respectively, while the T_0 (Control) treatment only managed to produce 3.82 t ha^{-1}. Additionally, the T_2 (Poultry Manure) yielded higher plants and fruit with longer bulb lengths that measured 42.73 cm and 5.50 cm, respectively. T_2 (Poultry Manure) provided more growth and development than T_0 (Control) even among the other criteria. Additionally, plant^{-1} average single bulb weight was 48.98 g in T_2 (poultry manure), compared to 25.76 g in T_0 (control). The results of the trial showed that T_2 (poultry manure) may provide an overall improved performance. In order to improve the output of lal teer king onions in Bangladesh, poultry manure application is required.

Keywords: Onion, organic fertilizers, inorganic fertilizers, growth, yield.

INTRODUCTION

One of the most important vegetables in the world is the onion (*Allium cepa* L.) (Shigyo and Kik, 2008). It is a bulbous biennial herb and one of the most important spice and vegetable crops in the world (Dhaker *et al*., 2017). In salads and stews, it is frequently used as a vegetable or as flavoring. It is one of the diets richest in flavonoids, which have been linked to a lower risk of diabetes, heart disease, and cancer (FAO, 2011). In Bangladesh, onions are grown as a winter crop and are a significant spice in other parts of the world (Mohsin *et al*., 2016). Despite having few nutrients, onions are highly regarded for their flavor and are frequently used in cooking. They are also served as a cooked vegetable and provide taste to recipes like stews, roasts, soups, and salads (Britannica, 2021). The main barriers to improved onion production in Bangladesh are low yielding varieties, a lack of hybrid varieties, and insufficient fertilizer use. Bangladesh imports onion bulbs valued between BDT 400 and BDT 500 billion annually since there aren't enough high yielding varieties (Prothom Alo, 2004). In comparison to the global average yield (17.00 t ha^{-1}), the yield of onions in our nation is very low (3.94 t ha^{-1}), and it has been relatively stable over the past five years (FAO, 2003). Experience has taught us that Bangladesh constantly has a scarcity of onions. Less yield per unit area and an increase in population may be to blame for this. Our country's demand for onions cannot be met by this production. A total of 73587 tons at a cost of 18589651 dollars were permitted for import in 2010 (BBS, 2010). Inappropriate fertilizer uses and the cultivation of types that are inappropriate for the local agro climate are the causes of low onion output. The right manuring of soil can significantly increase its production, which is why it is so important (Islam *et al*., 2015). For an onion to produce well, proper fertilizer application and the cultivation of suitable hybrid kinds in a particular environment are required.

In order to choose the best fertilizer among organic and inorganic fertilizers that give higher yield with qualitative characteristics in Noakhali district, Chittagong, Bangladesh, a study was conducted to ascertain how the onion responded to applied organic and inorganic fertilizers as well as on growth, yield, and yield components of lal teer king hybrid onion.

MATERIALS AND METHODS

Experimental site

From October 2018 to March 2019, the study was conducted in the Inu Agro Farm in Sunapur, close to the Noakhali Science and Technology University, Noakhali-3814. Noakhali has a subtropical climate with heavy rainfall throughout most of the year. The average annual temperature is 25.6°C, and there are 3,302 mm of precipitation. In this region, a series of erosion and accretion processes were brought about by the Meghna river estuary. The soil of the research field is moderately salinous, with a range of 0.14 to 0.89 Ds m^{-1}.

Experimental treatments

The lal teer king hybrid variety, which was obtained from the Lal Teer Seed Company, was included in the study. T_0=Control, T_1 =Vermicompost, T_2 =Poultry Manure, T_3 =Inorganic Fertilizer.

Fertilizers application

The lal teer king experimental plots were fertilized with gypsum, magnesium sulfate, boron, triple super phosphate, urea, vermicompost, and poultry manure at a rate of 2700, 2700, 64.8, 59.4, 162, 43.2, 43.2, 30, 82, and 10 g ha^{-1}, respectively. Prior to the completion of the final land preparation, all fertilizers were applied, with the exception of muriate of potash. Three top dressings of muriate of potash were applied at 15, 30, and 45 days after transplanting (DAT).

Plant protection

To avoid pest and fungal infection, seedlings were sprayed with Antracol at 0.2 percent after one month of sowing, Rovral at 0.2%, and Tilt at 0.2% after 45 days after transplanting. The crop was harvested when more than 75% of the tops had collapsed. The tips were clipped off 2.5 cm from the bulb by severing the pseudo-stem.

Data collection

Five randomly chosen sample plants from each plot were used to collect data on yield and yield-contributing traits. The following conditions should be met for maximum yield: Height (cm) of the plant, number of leaves (cm), length of leaves (cm), number of roots, Total Soluble Solid (TSS), Bulb, Length and breadth (cm), Weight of a single bulb (g), the weight of ten bulbs (g), and onion yield (t ha^{-1}).

Statistical analysis

The data were statistically evaluated using the analysis of variance (ANOVA) were determined using the software called Statistix 10. Least Significant Difference (LSD) was used to distinguish between treatment means at 5% levels of probability.

RESULTS AND DISCUSSION

Effect of different fertilizers on vegetative traits and fruit yield of onions

The height of the plant is significantly influenced by various fertilizers. The outcome shown in (Figure 1) revealed a substantial variation in lal teer king onion plant height.

The plant that was tallest 42.73 was discovered in T_2 (poultry manure). On the other side, T_0 (Control) yielded the tiniest 32.77 plants. According to Farooq *et al*., (2015) plant height increases when organic fertilizer applications increase. The number of leaves onion^{-1} varied considerably between the various fertilizer treatments. The number of leaves plant^{-1} was recorded at a maximum of 6.96 when T_2 (Poultry Manure) was carried out, and at a minimum of 4.62 where T_0 (Control) was carried out, both of which were statistically significant (Figure 1). Mandal *et al*., (2013) reported that the application of organic fertilizers increased the number of leaves. Specifically, Mahmoud *et al*., (2000) examined the impact of organic manure on the vegetative growth parameters of onion plants 20 weeks after transplanting, as measured by plant length, leaf count, fresh and dry leaf weight, and bulb weight plant^{-1}. Different fertilizers had statistically significant effects on the length of leaves plant^{-1}. The treatment T_3 (Inorganic Fertilizer) produced leaves with a maximum length of 39.65 cm and a minimum length of 29.13 cm plant^{-1} from T_0 (Control) (Figure 1). Specifically, Mahmoud *et al*., (2000) examined the impact of organic manure on the vegetative growth parameters of onion plants 20 weeks after transplanting, as measured by plant length, leaf count, fresh and dry leaf weight, and bulb weight plant^{-1}. Different fertilizers had a noticeable impact on the number of onion roots (Figure 1). The plant with the most roots was T_1 (vermicompost), which had an average of 52.77 roots, while the plant with the fewest roots was T_0 (control), which had an average of 34.60 roots. Dapaah *et al*., (2014) suggested the higher mean bulb weight observed in response to the application of poultry manure over the control check could be explained by increases in the number of leaves plant^{-1}, plant height, total accumulation of dry biomass, and dry bulb biomass as a result of increased assimilate production and partitioning to the bulbs. In terms of the average bulb length plant^{-1}, this study found statistically significant differences between the treatments (Figure 1). According to the data, T_2 (Poultry Manure) had the maximum bulb length plant^{-1} (5.50 cm), whereas T_0 (Control) had the shortest (2.80 cm). According to Ali *et al*., (2007) organic manures boosted onion bulb size and weight. The bulb breadth result showed that there was no significant difference between the various fertilizer treatments in this investigation. Figure 1 showed that in the four treatments, the maximum bulb width was seen in T_2 (poultry manure), measuring 6.06 cm, while the smallest bulb width was shown in T_0 (control), measuring 3.92 cm. According to Adeyeye *et al*., (2017) the width of the onion bulb did not significantly differ, but the application of poultry had the highest mean value, followed by organic manure, and urea treatment had the lowest mean value. Total soluble solid (TSS) levels significantly varied between the treatments. According to Figure 1, the total soluble solid bulb^{-1} varied between 11.20 and 15.30 in four treatments. T_2 (Poultry Manure) produced the most total soluble solid plant^{-1} at a maximum of 15.30. Similarly, the T_0 (Control) had a minimum total soluble solid plant^{-1} of 11.20. Similar types of results were recorded by Khatun *et al*., (2022). The individual fruit weight of onions was greatly impacted by the fertilizer used. The application of T_2 (Poultry Manure) produced the highest individual fruit weight (48.98 g), while T_0 (Control) produced the lowest yield (25.76 g) (Figure 1). These results are consistent with those of Aisha *et al*., (2007) and Ngullie *et al*., (2011). The weight of ten bulbs varied somewhat across all treatments (Figure 1). The largest weight of ten bulbs was reported in T_2 (poultry manure) at 489.82 g, followed by T_3 (inorganic fertilizer) at 438.29 g. However, T_0 (Control) produced the lightest weight of 10 bulbs, 257.51 g, followed by T_1

(Vermicompost), which produced 328.75 g. Results of a similar nature were noted by Kandil *et al*., (2013). All treatments showed variation in the yield metrics. According to Figure 1, T_2 (poultry manure) recorded the highest production (7.26 t ha^{-1}), followed by T_3 (inorganic fertilizer), which was 6.49 t ha^{-1}. In contrast, T_0 (control) produced the least amount (3.82 t ha^{-1}), followed by T_1 (vermicompost), which was 4.87 t ha^{-1}. According to Sankar *et al*., (2009), the addition of organic manures and the use of organic growth stimulants greatly increased the output of marketable bulbs. Yoldas *et al*., (2011), Fatideh and Asil (2012), Soleymani and Shahrajabian (2012) and Dina *et al*., (2010) came out similar conclusions.

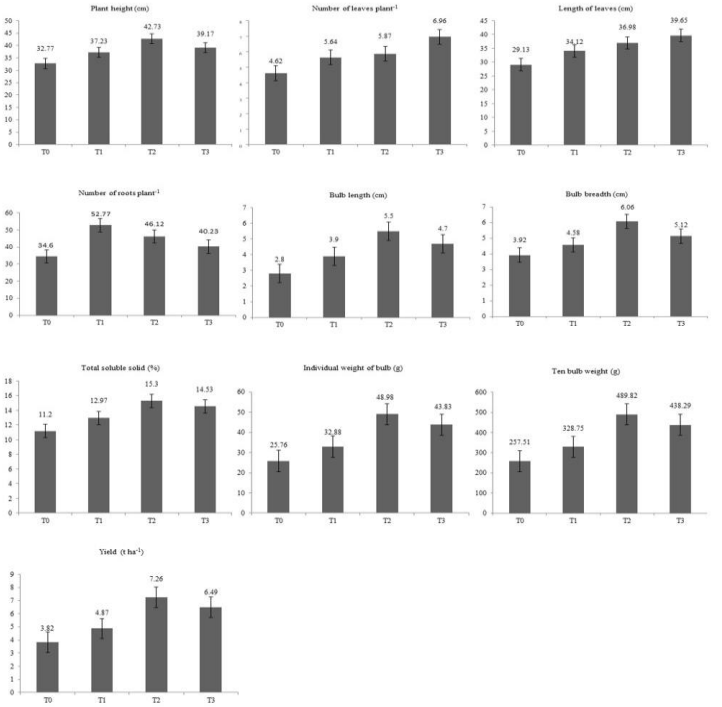

Figure 1. Performance of treatments on vegetative traits and fruit yield.

CONCLUSION

The results showed that various fertilizers significantly affected the vegetative and reproductive characteristics of plants. Higher yields and ideal onion development can be achieved when organic and inorganic fertilizers are applied separately. However, organic fertilizer in particular can help increase the development and output of onion plants. To maintain a high level of soil fertility, organic fertilizers are frequently used. Additionally, it enhances the ecological and physical properties of the soil. Comparing T_2 (Poultry Manure) fertilization to the other treatments, T_0 (Control) fertilization produced the lowest yield, while T_2 (Poultry Manure) fertilization led to the proper

vegetative development and output. Our results show that the application of organic fertilizer, such as poultry manure, significantly affects the yield of lal teer king onions. It improves the soil's nutrient and structural status, which affects the emergence of onion seeds, plant development, and yield characteristics. The latest study's findings showed that poultry excrement produced the best onions. As a result, poultry manure is advised since it is easily accessible, environmentally safe, and economical. To increase productivity, additional study should be conducted in Bangladesh's many agro-ecological zones and growing seasons, and fertilizer recommendations in the future should be specific to region, site, and variety.

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