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INFLUENCE OF VERMICOMPOST ON GROWTH AND YIELD OF OKRA (*Abelmoschus esculentus*) IN COASTAL AREA OF BANGLADESH

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ABSTRACT

An experiment was conducted at the research field in the Department of Agriculture, Noakhali Science and Technology University, Noakhali, Bangladesh during the period from March to July 2022 to study the effect of vermicompost on growth and yield of okra. The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising four treatments with three replications. The four treatments were T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1}). Green finger F_1 okra used as planting material. Data were recorded from different stages of plant growth viz, plant height, days of flowering, fruit per plant, fruit length, fruit diameter, fruit weight, fruit weight per plant, yield per plot and yield per hectare. All the recorded parameters were statistically significant (P<0.01). The maximum days to first flowering (47.31 days) was recorded from T_0 (Control), while the minimum days for first flowering (40.67 days) was found from treatment T_3 (Vermicompost 20 t ha^{-1}). The maximum height of okra plant (100.43 cm), number of fruits per plant (22.13), fruit length (13.60 cm), fruit diameter (2.01 cm), fruit weight (13.47 g), fruit weight per plant (198.02 g), yield per plot (1.78 kg), yield per hectare (17.8 t ha^{-1}) were found in treatment T_3 (Vermicompost 20 t ha^{-1}) whereas lowest data recorded in treatment T_0 (Control). Observing the results, it can be stated that application of vermicompost @ 20 t ha^{-1} for okra cultivation gave better growth and yield in the coastal area of Bangladesh.

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INTRODUCTION

Okra (*Abelmoschus esculentus*) is a popular vegetable throughout the tropical and subtropical parts of the world, as well as in Bangladesh (Shahriazzaman *et al*., 2014). It belongs to family of Malvaceae (Maurya *et al*., 2013). It is an annual crop grown mainly as fruits vegetables in the world (Chowdhury *et al*., 2014). It is critical in meeting the country's vegetable needs when vegetables are scanty in the market (Ahmed, 1995). Okra can be grown throughout the year but mainly grown in summer season of Bangladesh. It is a rich source of vitamins, minerals and is useful against various diseases (Gemede, 2015). The world's growing population has increased food demand and inundated current agricultural land resources. (Hussain *et al*., 2011). In most developing nations, higher food production has become an ultimate objective in order to meet the significant growth in population. (El-Shaikh and Mohammed, 2009). Vegetables are the most significant food crop in terms of cultivation and consumption (Ali *et al*., 2022a; Ali *et al*., 2023b). In general, vegetables are grown all over the world utilizing a variety of inputs such as chemical fertilizers and pesticides, organic fertilizers, biofertilizers and biopesticides, etc. In recent years, the use of various organic fertilizers, biofertilizers, and biopesticides has been suggested not only to reduce the use of dangerous chemical inputs but also for sustainable crop production notably in the cultivation of vegetables. (Gandhi and Sundari, 2012). Fertilizers provide the plant nutrients necessary for healthy growth. Plant nutrients are divided into two groups, one is known as macronutrient and other is known as micronutrient that plays important roles in the plants metabolism. Organic fertilizers such as compost or manure made from vegetative debris or animal excreta that also provide the plant nutrients for crop production.

Vermicompost is the droppings of earthworms following the intestinal digestion of organic materials. Vermicompost is a low-cost organic material produced by the bio-oxidation of organic substrates, which combines the synergistic effects of earthworms and microorganisms. (Lim *et al*., 2016; Baghel *et al*., 2018). Okra production is increased by the use of vermicompost. It increases microbial activity in soil by which increased the production of okra (Narkhede *et al*., 2011). It enhances soil bulk density, water retention capacity, pH, and electrical conductivity better than conventional compost or raw material (Doan *et al*., 2015). It plays an important role for sustainable soil fertility and productivity. It also enhances the growth and development of crops and increases the yield (Kaur *et al*, 2015). Numerous biotic and abiotic stress have a significant impact on okra production. Soil salinity is one of the factors influencing okra yield and cultivation in various regions of the world. Salinity in the soil has a detrimental influence on crop quality, production, and growth. (Ali *et al*., 2023; Ali *et al*., 2022; Dong, 2008). Okra is quite susceptible to soil salt, especially during the growing phases. Due to salinity in many coastal locations of Bangladesh, acceptable okra producing conditions are dwindling. Okra is one of the important vegetable but soil salinity hamper its cultivation. Vermicompost management is a factor that can be used to increase okra production in coastal area of Bangladesh. Keeping this in mind, the present research work has been undertaken to find out an optimum dose of vermicompost for yield maximization of okra in coastal area of Bangladesh.

MATERIALS AND METHODS

Experimental site and soil

The experiment was conducted at the research field of the Noakhali Science and Technology University, Noakhali, Bangladesh during the period of March to July 2022. The field belongs to the agro-ecological region of the Young Meghna Estuarine floodplain (AEZ-18). The experiment field was a flat plot of land with sandy loam with having soil pH (7.5) and soil salinity of 4.32 dSm^{-1}.

Experimental treatments and design

Single factor experiment was designed using Randomized Complete Block Design (RCBD) with four treatments and three replications. The treatments were T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1}). The experimental area was split into three blocks, each indicating a replication. Each block was divided into 4 plots, there were 12 units plot altogether in the experiment. Each plot was 1m x 1m in size. The distance between two plots were kept 0.50cm.

Planting material and manure collection

Green finger F_1 (variety) of okra was used as experimental planting material. The seed was collected from the seed shop (Maruf Beez Bhander) at Sonapur in Noakhali District. Vermicompost was collected from the local market at Sonapur in Noakhali District.

Land preparation

The land was ploughed by power tiller and left exposed to the sun for a week. After one week the land was harrowed, ploughed and cross-ploughed several times followed by laddering to obtain until good tilth. The corners of the field were spaded, and weeds and stubbles were cleared. To minimize water logging due to rainfall during the research period, drainage canals were built around the area, and the site was ultimately prepared five days before seed sowing.

Application of manure

Vermicompost (10 t ha^{-1}), Vermicompost (15 t ha^{-1}) and Vermicompost (20 t ha^{-1}) was applied in the research plot. Vermicompost was applied during final land preparation as basal dose.

Seed sowing

Seeds were sown during kharif-1 season following line sowing method and seeds are sown on 16 March 2022. Before sowing, seeds are mixed with ash so that seeds placed in the field uniformly. After 7 DAS seeds were germinated at a uniform level.

Intercultural operations

The seedlings were kept under close observation and necessary intercultural operations were done through the cropping season for proper growth and development of the plant. Five to six days after germination only healthy seedling was kept to grow in each location and other seedling were removed. Dead, injured and weak seedlings were replaced by new vigour seedling from the stock kept on the border line of the experiment. Weeding was done three times in plots to keep plots free from weeds. Irrigations were given by hand sprayer when needed. For insect and fungal control, imidacloprid and mancozeb were administered three times. Green pods were harvested at 3 days interval when they attained edible stage (i. e. the tender young pods of 8-13 cm long). Green pod harvesting was started from 7 May and was continued up to 10 July.

Data collection

Data on plant height, days for first flowering, number of fruits per plant, fruit length, fruit diameter, fruit weight, fruit weight per plant, yield per plot and yield per hectare of okra were recorded from six plants being randomly selected from each plot.

Statistical analysis

The recorded data of different parameters in this study were analyzed statistically by using Microsoft excel and statistix 10 statistical software package to find out the significance of the differences among the treatments**.** All obtained data were analyzed by following Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Plant height

Height of okra plants were significantly (P<0.01) influenced by the application of vermicompost (Figure 1). The highest plant height (100.43 cm) was recorded in treatment T_3 (Vermicompost 20 t ha^{-1}) followed by treatment T_2 (88.23 cm), T_1 (78.47 cm), and T_0 (65.57 cm), respectively. This result showed that the application of vermicompost 20 t ha^{-1} gave the highest plant height of okra. Similar results were found that organic fertilizer improved plant height of okra (Kota *et al*., 2022; Bhandari *et al*., 2019).

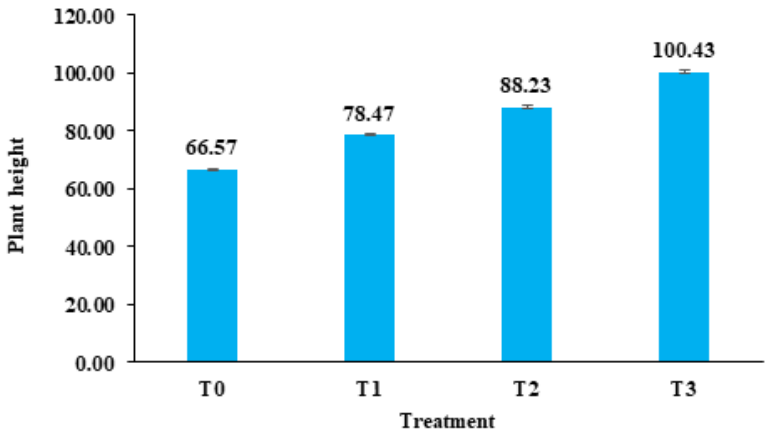

Figure 1. Effects of vermicompost on plant height of okra
Legends, T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Days for first flowering

Days for first flowering of okra plants varied significantly (P<0.01) due to the application of vermicompost (Figure 2). The maximum days to first flowering (47.31 days) was recorded from T_0 (Control), while the minimum days for first flowering (40.67 days) was found from treatment T_3 (Vermicompost 20 t ha^{-1}). This result showed that the application of vermicompost 20 t ha^{-1} gave early flowering of okra. These results were supported by the findings of Kota *et al*. (2022).

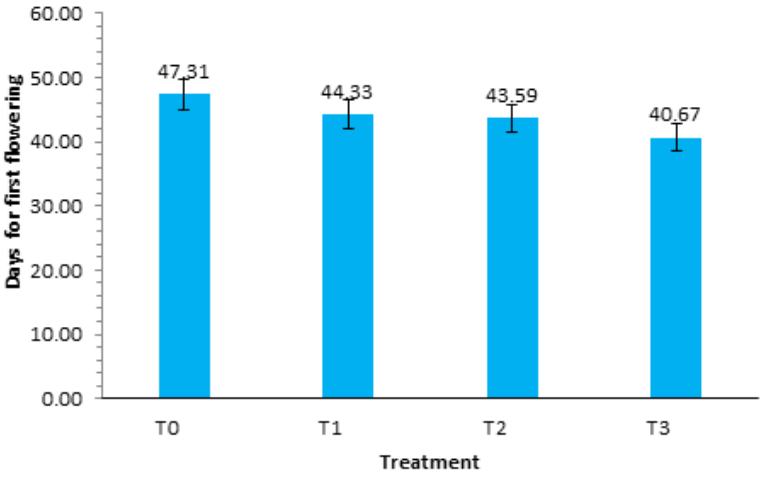

Figure 2. Effects of vermicompost on days for first flowering of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Number of fruits per plant

Application of different doses of vermicompost showed statistically significant (P<0.01) variation on the number of fruits per plant of okra (Figure 3). The maximum number of fruits per plant (22.13) was recorded in T_3 (Vermicompost 20 t ha^{-1}) followed by T_2 (Vermicompost 15 t ha^{-1}) which was (18.33). While the minimum number of fruits per plant was recorded in T_0 (Control), which was (11.63). This result showed that the application of vermicompost 20 t ha^{-1} had the

highest mean number of fruits per plant of okra. Similar result was claimed that application organic fertilizer produced significantly increased number of fruits per plant of okra (Kota *et al*., 2022; Bhandari et al., 2019).

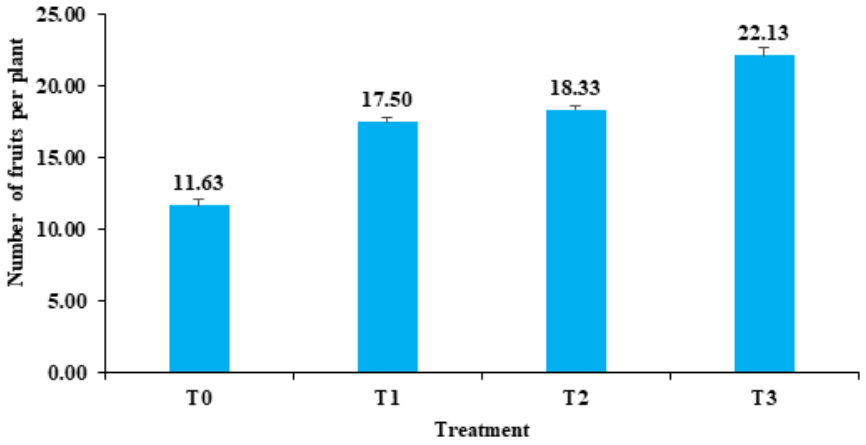

Figure 3. Effects of vermicompost on number of fruits per plant of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Fruit length

Statistically significant (P<0.01) variation was recorded on fruit length of okra for different levels of vermicompost management practices (Figure 4). The longest fruit (13.60 cm) of cucumber was measured in T_3 (Vermicompost 20 t ha^{-1}), and the lowest fruit (8.77 cm) was recorded in the treatment T_0 (Control) followed by the treatment T_1 (11.40 cm), and T_2 (12.47 cm), respectively. This result showed that the application of vermicompost 20 t ha^{-1} gave longest fruit of okra. Similar results were found that organic fertilizer increased fruit length of okra (Kota *et al*., 2022).

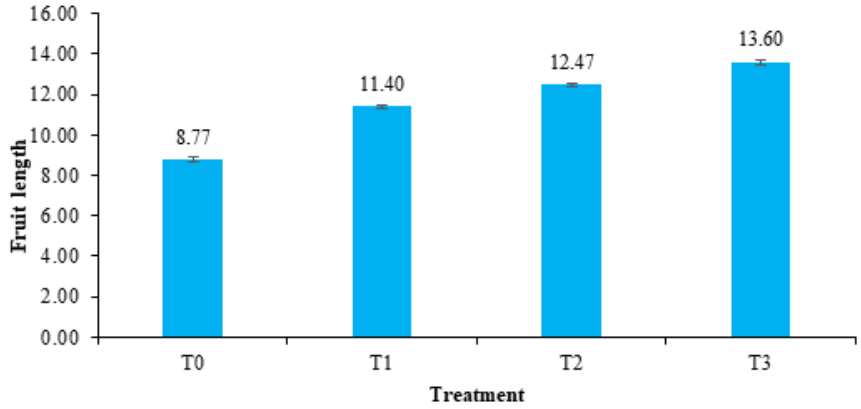

Figure 4. Effects of vermicompost on fruit length of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Fruit diameter

Fruit diameter of okra was significantly (*P*<0.01) influenced by the application of vermicompost (Figure 5). The highest fruit diameter of okra (2.01 cm) was recorded in treatment T_3 (Vermicompost 20 t ha^{-1}) followed by treatment T_2 (1.85 cm), T_1 (1.71 cm) and T_0 (1.40 cm), respectively. Similar results were found that fruit diameter of okra were increased as the application of organic fertilizer (Kota *et al*., 2022).

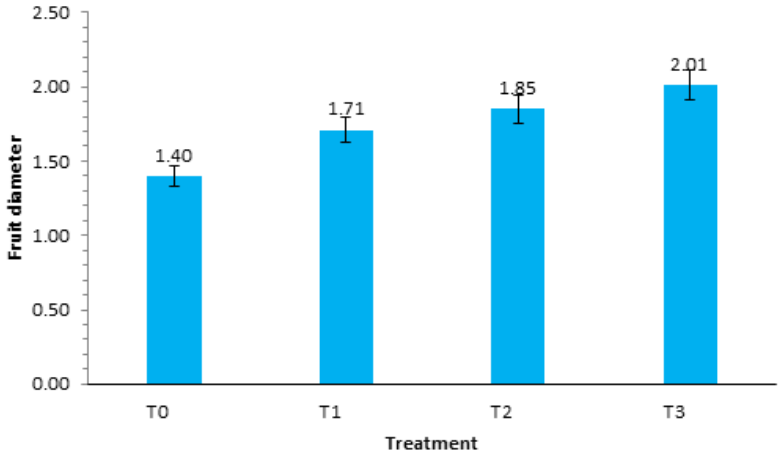

Figure 5. Effects of vermicompost on fruit diameter of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Fruit weight

Fruit weight of okra was significantly (P<0.01) varied by the application of different levels of vermicompost (Figure 6). The maximum weight of fruit (13.47 g) was observed in treatment T_3 (Vermicompost 20 t ha^{-1}) followed by treatment T_2 (11.43 g), T_1 (9.31 g) where the minimum weight of fruit (7.48 g) was obtained from the treatment T_0 (Control). This result showed that the application of vermicompost 20 t ha^{-1} gave maximum fruit weight of okra. Similar results had also been reported by Kota *et al.* (2022).

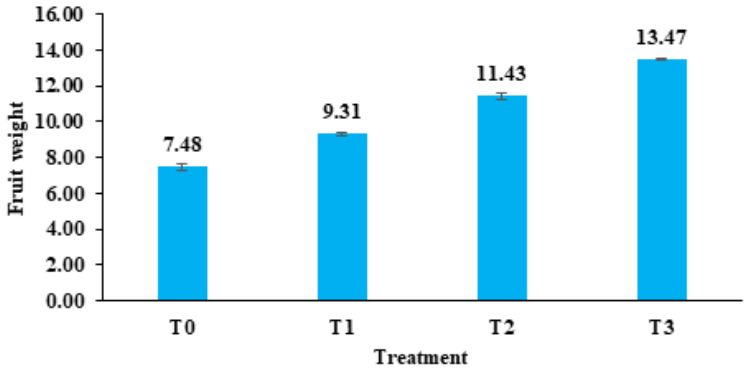

Figure 6. Effects of vermicompost on fruit weight of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Fruit weight per plant

Fruit weight per plant of okra was significantly (p<0.01) influenced by the application of vermicompost (Figure 7). The highest fruit weight per plant of okra (198.02 g) was recorded from T_3 (Vermicompost 20 t ha^{-1}) and the lowest fruit weight per plant of okra (87.03 g) was recorded from T_0 (Control). This result showed that the application of vermicompost 20 t ha^{-1} gave maximum fruit weight per plant of okra. These results were supported by the findings of Kota *et al*. (2022).

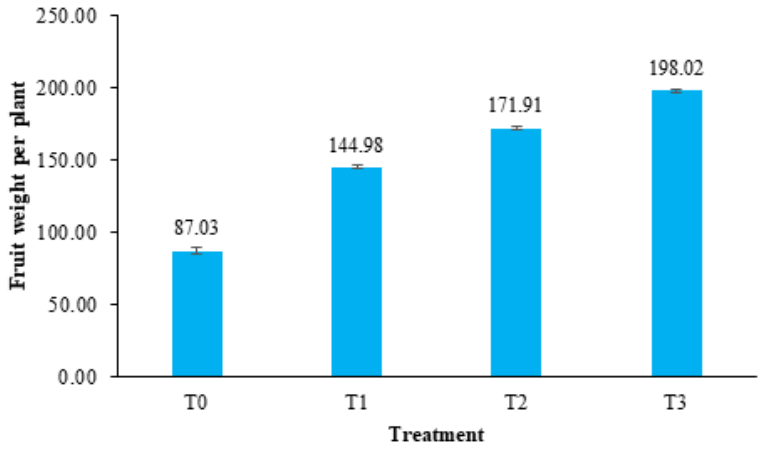

Figure 7. Effects of vermicompost on fruit weight per plant of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Yield per plot

Yield per plot of okra showed significant variation due to the application of vermicompost (Figure 8). The maximum yield per plot (1.78 kg) was recorded from T_3 (Vermicompost 20 t ha^{-1}), while minimum yield per plot (0.79 kg) was recorded from T_0 (control). This result showed that the application of vermicompost 20 t ha^{-1} gave maximum yield per plot.

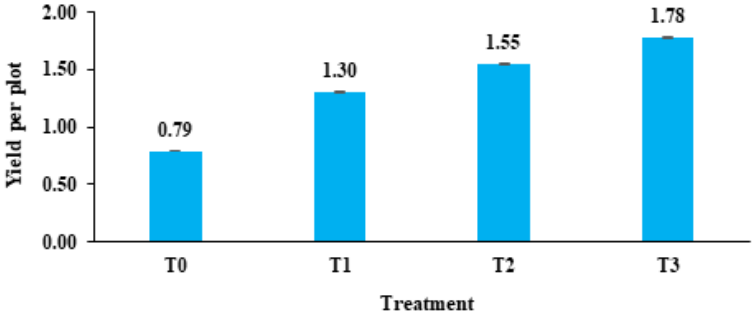

Figure 8. Effects of vermicompost on yield per plot of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

Yield per hectare

Significant variation was recorded on yield per hectare of okra due to the application of different levels of vermicompost (Figure 9). The maximum yield per hectare of okra (17.83 t ha^{-1}) was recorded from T_3 (Vermicompost 20 t ha^{-1}), while minimum yield per plant (7.88 t ha^{-1}) was recorded from T_0 (control). This result showed that the application of vermicompost 20 t ha^{-1} gave maximum yield per hectare. These results were in close conformity with the findings of Kota *et al*. (2022).

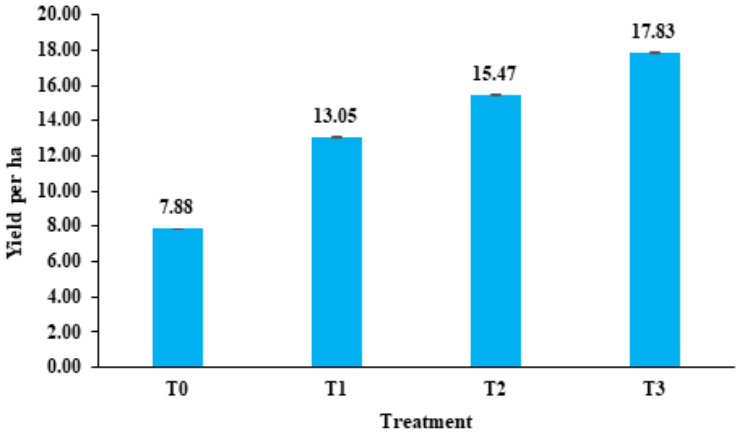

Figure 9. Effects of vermicompost on yield per hectare of okra

Legends: T_0 (Control), T_1 (Vermicompost 10 t ha^{-1}), T_2 (Vermicompost 15 t ha^{-1}) and T_3 (Vermicompost 20 t ha^{-1})

CONCLUSION

The results indicated that application vermicompost had a positive impact on the growth and yield parameters of okra. The current investigation's comparative results of many parameters evaluated showed that T_3 was the best treatment because the maximum plant height of okra (100.43 cm), number of fruits per plant (22.13), fruit length (13.6o cm), fruit diameter ((2.01 cm), fruit weight (13.47 g), fruit weight per plant (198.02 g), yield per plot (1.78 kg) yield per hectare (17.8 t ha^{-1}) were found in treatment T_3 (Vermicompost 20 t ha^{-1}). Observing the results, it can be stated that application of vermicompost @ 20 ton ha^{-1}) for okra cultivation gave better growth and yield in the coastal region of Bangladesh.

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Data availability

The figures in this article contain the data that support the findings of this study.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

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