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Effect of Cowdung and NPK Chemical Fertilizer on Growth and Yield of Tomato (*Lycopersicon esculentum* Mill.) in the Coastal Area of Patuakhali District

Md. Nazmul Hasan[1*] and Md. Farid Hossain[1]

[1]School of Agriculture and Rural Development, Bangladesh Open University

[*]Correspondence E-mail**:** faridhossain04@yahoo.com, Mobile: +88-01712016889

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Abstract: The production of tomato is constrained in the coastal area of Patuakhali. Minimizing soil salinity through fertilizer management practices is very important for tomato cultivation in the saline soil. An experiment was carried out at a farmer's field in a coastal area at Rangabali upazila of Patuakhali district of Bangladesh from November 2025 to March 2026 to investigate the effects of cowdung and recommended NPK chemical fertilizer on the growth and yield contributing characteristics of tomatoes. The experiment was laid out in RCBD with three replications with comprised four fertilizer treatments, such as T_1 (No fertilizer), T_2 (cowdung @10 tha^{-1}), T_3 (100% Recommended NPK chemical fertilizer) and T_4 (cowdung @ 5 tha^{-1} + 50% recommended chemical NPK fertilizers). As per the recommended NPK chemical fertilizers (T_2), specific plots were fertilized at the rate of 300 kg of urea, 200 kg of triple super phosphate (TSP) and 250 kg of muriate of potash (MP) per hectare. A hybrid tomato variety, namely Bijli-11, was used as a test crop. Fertilizers have significant effects on plant growth and yield contributing characters of tomatoes. The combination of cowdung and NPK chemical fertilizer treated plots produced a higher yield. The highest yield (93.97 tha^{-1}) was observed in those plots which fertilized cowdung (5 tha^{-1}) with 50% recommended NPK chemical fertilizers (T_4) due to a greater average number of fruit $plants^{-1}$ (21.57) and average individual fruit weight (109.08g). Integrated nutrient management is the best option for higher tomato production in coastal areas. So, to get a higher yield of tomato in the coastal area of Patuakhali district, the application of cowdung @ 5 tha^{-1} in combination with the 50% recommended NPK chemical fertilizer is recommended.

Keywords: Tomato; Saline area; Chemical fertilizer; Manure; Growth; Yield

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important, popular and nutritious vegetable crops in Bangladesh. It belongs to the family Solanaceae. It is widely cultivated in tropical, subtropical and temperate climates and ranks third next to potato and sweet potato in terms of world vegetable production (FAOSTAT, 2019). The tomato is cultivated in almost all home gardens and also in the field for its adaptability to a wide range of soil and climate in Bangladesh (Islam et al., 2016). It is one of the most important vegetables and economically important crops around the world (Lahoz et al., 2016) and is an important constituent of human diets. It contains about 94% water, 2.5% total sugars, 2% total fiber, 1% proteins, and other nutritional compounds (Koh et al., 2012). The popularity of tomatoes and its products is rising day by day. It is a nutritious and delicious vegetable used in salads, soups and processed into stable products like ketchup, sauce, pickle paste, chutney and juice (Islam et al., 2016).

The climate and soil of Bangladesh is very suitable for growing vegetables round the year. Soil salinity problem is undoubtedly a major cause which limits the crop production in the coastal region of Bangladesh (Naher et al., 2020). It is one of the main obstacles to horticultural production, such as tomato cultivation, in the coastal and offshore areas of Bangladesh (Rahman et al., 2018). Salinity is an important determinant for soil capability, which puts restrictions on possible crop choices (Wilde, 2000). The production of tomato is constrained on the coast due to lack of knowledge of improved technology (Karim et al., 1990). Organic fertilizer is a major limiting factor in crop production, especially for vegetables during winter in Bangladesh. As saline soil is a problematic soil, hence it is difficult to cultivate tomatoes in the coastal zone (Saha et al., 2017). The cultivated tomato is moderately tolerant to salinity and is typically cultivated in regions that are exposed to soil salinization (Cuartero et al., 1999). The yield and quality parameters of tomato fruit increased significantly with the integrated use of compost and inorganic fertilizers (Khan et al., 2017). Poor soil fertility resulting from low organic matter content is a major production constraint in Bangladesh. Integrated nutrient management is the best option for higher tomato production in Bangladesh (Laily et al., 2021). There is hardly any research accomplished in southern Bangladesh with integrated nutrient management in tomatoes (Howlader et al., 2019). The addition of organic matter to soils is particularly important for maintaining long-term soil fertility. Organic fertilizers usually also provide some measure of N, P and K, as well as varying amounts of micronutrients. Tomatoes require large amounts of nutrients to grow well. Few studies have evaluated the growth and yield of commercial tomatoes grown under different fertilizer doses in coastal areas of Bangladesh. Nowadays, farmers are cultivating tomatoes in saline areas, and normally they do not use any cowdung in their fields as an organic fertilizer. Therefore, it is necessary to find the suitable dose of cowdung as an organic manure with NPK chemical fertilizers for maximizing the yield. Our main objective is to investigate the effects of cowdung and NPK chemical fertilizer applications on tomato growth and yield in the coastal area of Patuakhali district of Bangladesh.

MATERIALS AND METHODS

Study area: A field experiment was conducted during winter (October 2025 to March 2026) at a farmer's field at Rangabali upazila of Patuakhali district of Bangladesh. The geographical location of Rangabali Upazila is located between 21°46' and 22°05' north latitudes and between 91°15' and 90°37' east longitudes (Fig. 1). The experimental area that belongs to the AEZ-13, known as the Ganges Tidal Floodplain, is a major Agroecological zone in the southwestern coastal region of Bangladesh (UNDP and FAO, 1988).

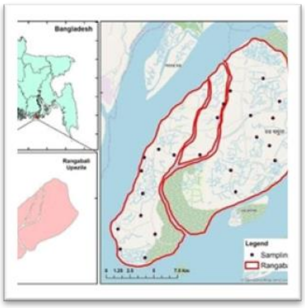

Fig. 1 Rangabali upazila of Patuakhali District, Bangladesh **(Google Earth)**

The experimental field soil pH was 7.4 and organic matter content was 1.23 %. Other major soil elements like N 0.061%, P 13.9 microgram/g soil, K 0.20 mEq/100g soil, S 70.5 microgram/g soil, Zn 0.26 microgram/g soil. The EC value was 6.29 dS/m, which means soil was moderately saline (SRDI, 2026). The weather status of the field experiment time is mentioned in Table 1.

Table 1. Monthly average day temperature, relative humidity, rainfall and sunshine hour of experimental area

Months	Aver. day Temp.(^{0}C)	Relative humidity (%)	Rainfall (mm)	Sunshine (hrs.)
Oct. 2025	27.8	84	206.3	7.6
Nov. 2025	25.3	83	54.2	7.8
Dec. 2025	21.1	81	12.7	7.1
Jan. 2026	19.8	79	8.4	7.4
Feb. 2026	21.8	77	21.1	8.1
Mar. 2026	26.3	78	78.5	8.3

Source: Weather station, Patuakhali, Bangladesh

Treatments: The experiment consisted of one hybrid variety (Bijli-11) and four fertilizer treatments, including 1. control (no fertilizer), 2. cowdung 10 tha^{-1}, 3. recommended 100% NPK chemical fertilizers (urea 300 kg/ha, TSP 200 kg/ha and MP 250 kg/ha, respectively) and 4. cowdung @ 5 tha^{-1}+50% recommended chemical NPK fertilizer (urea 150kg/ha, @100 kg/ha and @125 kg/ha, respectively). The experiment was carried out in Randomized Complete Block Designs (RCBD) with three replications.

Land preparation and seedlings transplanting: The unit plot size was 2m x 2m. Each plot received only the treatment doses of fertilizers. As per NPK fertilizer treatment (T_2), specific plots were fertilized with the rate of 300 kg of urea, 200 kg of TSP and 250 kg of MP per hectare. Cowdung, one third of N fertilizer and PK fertilizer with urea, TSP and MP respectively, were applied during the final land preparation. Remaining nitrogen fertilizer was applied in two equal splits at 20 and 40 days after transplanting. Transplanting of seedlings in all treatment plots was done on the same day, on 25 November 2025. Healthy and uniform-sized 30-day-old seedlings were taken separately from the seedbed and transplanted in the experimental field, maintaining spacing of 50 cm and 50 cm between the rows and plants, respectively. In each plot, 16 plants were grown. The tomato seedlings were irrigated uniformly at one-day intervals to ensure a good-standing establishment. All intercultural operations were done as per necessity.

Data collection: Ten plants from each plot were selected for data collection for plant height, number of branches per plant, number of flower clusters per plant, flowering starting time (50%), fruits per plant, individual fruit weight, fruit length, fruit diameter, fruit yield per plant, fruit yield per plot and yield in ton per hectare. The plant height and

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number of branches recorded at 60 DAT. Tomato fruit was harvested sequentially from the first week to last week of March 2026 and recorded the number and total fruit weight of each harvest. Recorded data on yield and yield-contributing characters were analyzed using an R studio software package to find out the analysis of variance and mean separation done following Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSIONS

The fertilizer treatments had a significant influence on the plant height (cm), number of branch plant^{-1}, number of flower clusters plant $^{-1}$, branch plant^{-1}, flowering time, fruit plant^{-1}, fruit yield plant^{-1}, fruit yield plot^{-1}, and the yield (tha^{-1}), fruit length, fruit diameter, individual fruit weight and harvesting time and harvesting duration of the studied tomato variety (Table 2 and 3).

Plant Height

The plant height ranged from 58.46 to 87.76 cm under different fertilizer treatments. The highest plant height (87.76 cm) was found in T_4 treatment, where cow dung (5 tha^{-1}) was applied with 50% recommended chemical NPK fertilizer. Lowest plant height (58.46 cm) was observed in control treatment (T_1). It might have happened due to the availability of plant nutrients, especially N. This finding was similar to Sabit (2020), where he stated that manure had the best effect on plant height.

Number of branches per plant

The number of branches per plant significantly differed within the different treatments of fertilizer (Table 2). The highest number of branches per plant was observed in treatment T_4 (9.63) and the minimum number of branches per plant (6.37) was found in treatment T_1. Number of branches per plant is an important result of better plant growth and a higher number of branches increases the possibility of higher yield (Sabit, 2020). Results show that 50% of the recommended NPK chemical fertilizer with cowdung (5 tha^{-1}) produced the maximum number of branches per plant. Similar findings were observed by several scientists (Premsekhar and Rajashree, 2009; Yoldas et al., 2009). They reported that chemical fertilizer with organic fertilizer increases the number of branches and yield of tomatoes.

Number of flower clusters per plant

The number of clusters per plant of tomato plants significantly differed among the different types of fertilizer treatments (Table 2). Higher number of clusters per plant is an important parameter which shows the possibility of higher production (Sabit 2020). The maximum number of clusters per plant (5.13) was found with the T_4 treatment where cowdung was applied with 50% recommended NPK fertilizer, which was statistically similar to T_3 and T_2 treatments. The minimum number of flower clusters per plant (3.93) was found in control treatment (T_1). These findings are similar to other researchers (Olaniyi and Ajibola, 2008; Dhanasekaran and Bhuvaneswari, 2007). They stated that chemical fertilizer and organic fertilizer combined application increases the number of clusters per plant. Nutrient supply is a prerequisite for the development of plants, which may result in a higher number of clusters. Production of higher numbers of clusters results in a higher number of flowers. A better fruit setting of flower produces a higher number of fruits per cluster. Ultimately, the higher number of fruits per cluster results in a higher number of fruits per plant (Sabit, 2020).

Flowering time (DAT)

Flowering (≥50%) starting time was varied due to fertilizer treatment (Table 2). Comparatively, early flowering (50.33 DAT) was observed in control plot (T_1) and flowering was delayed (63 DAT) in NPK chemical fertilizer treated plots (T_3). Cowdung @ 10 tha^{-1} treated plots (T_2) needed 55 days and 60 days required in T_4 treatment (cowdung @5 tha^{-1} + 50% recommended NPK). It may happen due to a supply of nutritional elements that impact on vegetative growth stages. Karim et al. (2025) stated that different times for the start of blooming were noted in the developmental process of the tomato. Days to flowering are an important indication of the crop duration. Earlier flowering helps in early harvesting, which is very important for the farmer as it is related to the crop market and environment (Sabit, 2020).

Number of fruits per plant

The number of fruits plant^{-1} was significantly influenced by the application of different levels of fertilizers (Table 2). The highest number of fruit plant^{-1} (21.57) was recorded in cow-dung (5 tha^{-1}) with 50% recommended NPK chemical fertilizer treatment, and the lowest number of fruits per plant (13.74) was recorded in T_1 (control) treatment. The combined application of chemical and organic fertilizer increases the number of fruits per plant. Similar findings were observed by several researchers (Sabit 2020; Solaiman and Rabbani, 2006; Dhanasekaran and Bhuvaneswari, 2007; Ltoo and Manivannan, 2004; Patil et al., 2004). Turkmen et al. (2004) reported that compost is an important ingredient in increasing the mineral nutrient uptake in tomatoes cultivated in saline medium.

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Table 2: Effect of cowdung and NPK chemical fertilizer on growth and yield contributing attributes of tomato.

Treatment	Plant height (cm)	Branches plant^{-1} (no.)	Flower clusters plant^{-1} (no.)	50% flowering time (DAT)	Fruits plant^{-1} (no.)	Fruit yield plant^{-1} (g)	Fruit yield plot^{-1} (kg)	Yield (t ha^{-1})
T_1	58.46c	6.37d	3.93b	50.33d	13.74c	1127.30c	18.02c	45.09c
T_2	68.48b	7.73c	4.70a	55.00c	16.10bc	1418.52c	22.69c	56.74c
T_3	85.02a	8.39b	4.83a	63.00a	18.06ab	1804.36b	28.69b	71.72b
T_4	87.76a	9.63a	5.13a	60.00b	21.57a	2348.99a	37.58a	93.97a
Level of sign.	***	***	**	***	**	**	***	***
CV (%)	6.34	3.27	4.92	1.01	10.29	9.52	8.75	8.77

In the column figures having common letter(s) do not differ significantly as per DMRT. **Significant at 1% level of probability, ***Significant at 0.1% level of probability. [T_1=Control (no fertilizer), T_2 = cow-dung @10 tha^{-1}, T_3 =100% recommended NPK chemical fertilizer (urea @ 300 kg, TSP@ 200 kg and MP@ 250 kg), T_4 = cow-dung @ 5 tha^{-1} + 50% recommended NPK chemical fertilizer].

Fruit yield per plant (kg) and per plot (kg)

The fruit yield per plant and per plot were significantly influenced by the application of different levels of fertilizers (Table 1). Among the all-fertilizer treatments, T_4 produced the highest fruit yield per plant (2348.99g), whereas the lowest fruit yield per plant (1127.30g) was found in control treatment (T_1). This can be due to the role of organic fertilization in plant physiology and improving the quantity and quality growth characterization and can provide plants with essential elements required (Sun et al. 2003; Lin et al. 2010; Ferdous et al. 2014). The combination of organic and inorganic fertilizer treated plots produced higher yield than plots without a combination of organic and inorganic fertilizer (Anwar et al. 2012; Ferdous et al. 2017a). Similar results are reported by Ahmed et al. (2017) and Anil et al. (2008), who report increased fruit yield with phosphorus and organic manure application. Anil et al. (2008) observed an increase in yield with combined application of organic and inorganic fertilizers. Sabit (2020) stated that chemical fertilizer in combination with manure produces more clusters, fruits per cluster, and bigger sized fruit, ultimately resulting in higher fruit yield per plant. From this finding, it was observed that the highest calculated yield per plot (37.58 kg) was found in T_4 treatment, where cowdung applied (5 tha^{-1}) with 50% recommended NPK chemical fertilizer treatment (T_4) at the rate of urea 300kg, TSP 200kg and MP 250kg respectively. The lowest calculated yield per plot (18.02 kg) was observed in control treatment (T_1). This might happen due to respect of the number of fruit plant^{-1} and individual fruit weight.

Yield (tha^{-1})

Tomato plants expressed significant differences among the different types of fertilizer management practices in the case of calculated yield per hectare (Table 2). From this research, it was observed that the highest calculated yield per hectare (93.97 t) was found in T_4 treatment, where cowdung applied (5 tha^{-1}) with 50% recommended NPK chemical fertilizer treatment (T_4). The lowest calculated yield per hectare (45.09 t) was observed in control treatment (T_1). This finding is agreed with Akande and Adediran (2004). They stated that manure at 5 tha^{-1} significantly increased tomato and dry matter yield, soil pH, N, P, K, Ca and Mg and nutrient uptakes. The application of no fertilizers providing the lowest yield of tomato might be due to a shortage of nutrients throughout the growth period. This happened due to adequate nutrient supply along with a favorable soil environment. Similar kinds of results are found from many research studies (Sabit, 2020; Taiwo et al., 2007; Ltoo and Manivannan, 2004; Solaiman and Rabbani, 2006; Dhanasekaran and Bhuvaneswari, 2007; Patil et al., 2004). The results revealed that there was a significant difference between the treatments in respect of fruit yield due to the number of fruit plant^{-1} and individual fruit weight. Soliman and Rabbani (2006) stated that cowdung, at the rate of 5 tha^{-1}, in combination with half the recommended dose of inorganic nutrients, appeared to be the best combination of fertilizer and natural nutrients which provided maximum benefit to the cultivator. Hasan et al. (2017) reported that the variation in fruit yield of tomato was found due to the variation in characteristics of the studied cultivars and their adaptability in the selected site. Islam et al. (2018) stated that integrated nutrient management in a combination of organic and inorganic fertilizer is the best option for higher tomato production in Bangladesh. A similar statement was made by Ferdous et al. (2017b) for groundnut production in char areas of Bangladesh. Babu (2024) reported that a combination of organic and inorganic fertilizers led to higher yields and profitability compared to using chemical fertilizers alone.

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Table 3: Effect of cowdung and NPK chemical fertilizer on physical characteristics and harvesting time of tomato

Treatment	Fruit length (cm)	Fruit diameter (cm)	Individual fruit weight (g)	First harvest time (DAT)	Last harvest time (DAT)	Harvesting duration (days)
T_1	4.63d	4.19d	81.88c	74.66c	105.00c	30.66a
T_2	6.29c	4.63c	88.52bc	80.00b	112.33b	32.33a
T_3	8.02b	5.65b	99.57ab	86.33a	109.33b	23.00b
T_4	9.14a	7.71a	109.08a	85.00a	119.66a	34.66a
Level of sig.	***	***	**	**	***	*
CV (%)	3.81	2.00	6.72	2.49	1.63	9.45

In the column figures having common letter(s) do not differ significantly as per DMRT. * Significant at 5% level 0f probability, **Significant at 1% level of probability, ***Significant at 0.1% level of probability. [T_1=Control (no fertilizer), T_2 = cow-dung @10 tha^{-1}, T_3 =100% recommended NPK chemical fertilizer (urea @ 300 kg, TSP@ 200 kg and MP@ 250 kg), T_4 = cow-dung @ 5 tha^{-1} + 50% recommended NPK chemical fertilizer].

Fruit length (cm) and diameter (cm)

Fruit length and diameter differed significantly among the treatments (Table 3). The longest fruit (9.14 cm) was found in cow dung (5 tha^{-1}) with 50% NPK fertilizer treatment (T_4) and the shortest fruit (4.63 cm) was found in control (T_1). Fruit length of a tomato of 8.02 cm was found in 100% NPK (T_3) and 6.29 cm length was found in cowdung @ 10 tha^{-1} (T_2). The highest fruit diameter (7.71 cm) was found in cowdung (5 tha^{-1}) with 50% NPK fertilizer treatment (T_4) and the lowest fruit diameter (4.19 cm) was obtained in control treatment (T_1). Dauda (2005) reported that the fruit diameter may increase with an increase in manure application. The tomato diameter gradually decreased with an increasing salt concentration (Umara et al., 2013).

Individual fruit weight (g)

Individual fruit weight of mature tomatoes was varied under different fertilizer treatments (Table 3). All individual fruit weights were observed between 81.88g and 109.08g. The highest individual fruit weight (109.08g) was found in cowdung (5 tha^{-1}) with 50% NPK fertilizer treatment (T_4) and the lowest individual fruit weight (81.88g) was obtained in control treatment (T_1). Cowdung applications with NPK chemical fertilizers increased individual plant fruit weight. This happened due to adequate nutrient supply along with a favorable soil environment.

Harvesting time and harvesting duration

The harvesting, starting and finishing time and duration of mature tomato fruits were varied under different fertilizer treatments (Table 3). All harvesting starting time days after transplanting (DAT) between 74.66 and 86.33 days. First harvesting was done in control plots (74.66 DAT), whereas, a delay in the first harvesting (86.33 DAT) was observed in NPK chemical fertilizer treated plots (T_3), which was statistically similar to T_4. Harvesting duration was found higher (34.66 days) in integrated fertilizer treatment plots, which were fertilized by cowdung @ 5 tha^{-1} with 50% recommended NPK fertilizer (T_4). Harvesting duration was short (23.00 days) in NPK chemical fertilizer treated plots (T_3). Harvesting time finished early in control plots (105 DAT) and field stay was longer (119.66 DAT) as found in T_3 (100% NPK chemical fertilizer) treatment. Chemical fertilizer may be a factor that delayed the start of flowering and harvesting. On the other hand, it can cause all fruits to mature within a short time. Chemical NPK fertilizer with organic matter can reduce the time taken to start harvesting than sole application of NPK chemical fertilizer.

CONCLUSION

The application of cowdung with chemical fertilizers was good regarding the fruit yield of tomatoes. Among the treatments, the maximum tomato fruit yield was recorded under cowdung (5 tha^{-1}) with 50% NPK fertilizer treatment. It may therefore conclude that the tomato (CV. Bijli-11) showed better growth and yield performance under combined application of cowdung (5 tha^{-1}) with 50% NPK chemical fertilizer (urea @150 kg, TSP @100 kg and MP @125 kg per hectare) in the coastal area at Rangabali upazila of Patuakhali district. To select the appropriate fertilizer management practices and crop variety in coastal areas, further research will be required on the basis of soil and salinity status in specific areas.

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Conflict of Interest

There are no conflicts of interest declared by the authors.

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