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## Effect of Different Organic Fertilizer on the Growth and Yield of Broccoli (*Brassica oleraceae* var. *italica*)

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### ABSTRACT

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The field experiment was conducted at Nabogram Agro Farm, Mannannagar, Sadar, Noakhali during the period from October 2020 to January 2021 to evaluate the effect of different organic fertilizer on the growth and yield of broccoli (*Brassica oleraceae* var. *italica*). The experiment was laid out in a Randomized Complete Block Design (RCBD) consisting five treatments with three replications. The five treatments were T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%) and T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Data were collected in respect of plant growth and yield indicating characters at harvest. All the recorded parameters were statistically significant. For 100% curd initiation, maximum time (61 days) recorded from T<sub>0</sub> (Control), while minimum days (55 days) recorded from T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>). At harvest the maximum plant height (64.70 cm), leaf length (35.05 cm), leaf breadth (32.32 cm), number of leaves per plant (14.66), weight of full plant (1158.27 g), marketable weight of curd (496.67 g), individual curd weight (320.67 g), diameter of curd (13.432 cm), marketable yield (19.242 t ha<sup>-1</sup>) were found in treatment T<sub>5</sub> (Cowdung 50% + Vermicompost 50%) whereas lowest data recorded from treatment T<sub>0</sub> (Control). So it is observed that T<sub>5</sub> (Cowdung 50% + Vermicompost 50%) provide the highest results which may be more economic for the farmer according to the findings of this experiment.

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## Introduction

Broccoli (*Brassica oleraceae* var. *italica*) is a vegetable belonging to the family brassicaceae and a member of cole group having 18 chromosomes (Amit et al., 2018). The edible plant parts are the stalk and large flowering head (Jaiswal, 2020). Although it originated in the Mediterranean region, this vegetable is now widely cultivated throughout the world. (Latté et al., 2011). Broccoli is temperature-sensitive to some extent. Bud clusters become loose quickly in warm weather. These are usually biennial, yet a mild cold can seriously harm the buds in certain annual cultivars (Salunkhe and Kadam, 1998). Vegetables are one of the most important crop in Bangladesh (Ali et al., 2022). One significant vegetable crop is broccoli. Recently, broccoli attracts growing interest because of its high nutritional value, wide range of use, and significant commercial value (Yoldas et al., 2008); Rangkadilok et al., 2004). Broccoli is an outstanding supplier of vitamins (E, A, B<sub>1</sub>, B<sub>2</sub>, B<sub>5</sub>, and B<sub>6</sub>), dietary minerals (Fe, Zn, Ca Mg), and antioxidant compounds that prevent the development of cancer causing agent (Abou et al., 2006). A sufficient quantity of plant nutrients is required for the cultivation of broccoli. The supply of nutrients depends on inorganic fertilizer that can only be fulfilled by organic fertilizer (Mehedi et al., 2018).

Organic manure or fertilizer play a direct role in plant growth as a source of all necessary macro and micronutrients in available forms during mineralization, improving the physical and physiological properties of soils (Ali et al., 2023; Mucheru-Muna et al., 2007; Abou et al., 2006 ; Supiati et al., 2003;). Recently, organic farming is appreciated by vegetable consumers as it increase the productivity, improve the quality of the produce and it has high market value. (Tindall et al., 2000). Vermicomposting is a simplistic biotechnological composting method that uses certain earthworm species to improve waste conversion and yield a higher-quality final product (Adhikary, 2012). By means of a sort of biological alchemy, earthworms may turn trash into "gold" (Ruz-Jerez et al., 1992). Vermicomposting has been described as a feasible, affordable, and quick method for managing solid wastes effectively (Baghel et al., 2018). It has the ability to provide easily accessible nutrients, chemicals that promote development, and a variety of beneficial microbes, such as those that fix nitrogen, solubilize phosphorus, and break down cellulose. (Khatun et al., 2023; Suthar et al., 2012). More organic matter, nitrogen, phosphorus, sulphur, calcium, and magnesium are found in vermicompost, which protects and enhances the topsoil's fertility to increase agricultural yield (Zahid et al., 2001).

Tricho-compost is the material that results when spores of a beneficial fungus, *Trichoderma* sp. are used in the composting process (Eliyanti et al., 2021). It works as a natural antifungal agent against harmful fungi and also provides resistance against bacterial wilt and nematode infestation (Chang, 1986). Numerous studies have examined at the effects of the *Trichoderma* species on seedling establishment, plant growth and yield enhancement, and defensive reaction elicitation in various vegetable crops (Inbar et al., 1994). Due to the above factors, the experiment was conducted to find out the effect of different organic fertilizer on the growth and yield of Broccoli cultivation in respect to increasing popularity of organic farming among the grower of Bangladesh.

## Materials and Methods

### Experimental Site and Soil

The experiment was conducted at the Nobogarm Agro Fram, Mannannagar, Noakhali, Bangladesh during the period from October 2020 to January 2021 in the agro ecological zone (AEZ-18) named Young Meghna Estuarine Floodplain. The soil of the experimental area was sandy loam in texture, moderately alkaline, with pH 7.5. General fertility is medium but low in organic matter.

### Experimental treatments and design

The experiment was laid out in a Randomized Complete Block Desgin (RCBD) comprising six treatment with three replications. The treatments were T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). An area of (10.67 m × 5.18 m) or 55 m<sup>2</sup> was divided into three equal blocks. Each block was divided into 6 plots where 6 treatments were allotted at random. Thus there were 18 unit plots altogether in the experiment. The size of each plot was (1.5 m × 1.5 m). The distance between two blocks and two plots were kept 0.3 m and 0.3 m, respectively.

### Planting material

Seed o of broccoli variety 'Bara Bara' was used as planting material.

### Seed bed preparation and seedlings

The 3m x 1m in size seed bed was selected. Seed beds were prepared with a mixture of sand, soil and compost. It was raised 15 cm from ground level. The seedbed is covered with a bow-shaped structure constructed of bamboo and polythene sheet to protect the seeds and seedlings. Seeds were sown on 03 October, 2020. Complete germination of seed took place in 7 days. When the seedlings were 37 days old they were transplanted in the experimental field on 09 November, 2020.

### Pot preparations and planting

The land which was selected to conduct the experiment was opened 2 November 2020 with the help of a power tiller and then it was kept open to sun for 6 days to further ploughing. Afterwards it was prepared by ploughing and cross ploughing followed by laddering. The weeds, stubbles were removed and the clods were broken. Then different organic manures applied for this experiment. 36 days old seedlings were transplanted on 9 November, 2020 in the afternoon and light irrigation was given around each seedling for their better establishment. Plant to plant spacing 50 cm and number of plants per plot 9.

### Intercultural operation and harvesting

Gap fillings were done by new vigorous seedling from the stock kept on the border line of the experiment and weeding was done time to time in the plots to keep the plot clean. Light irrigation was given just after transplanting the seedlings. A week after transplanting the requirement of irrigation was envisaged through visual estimation. Wherever the plants of a plot had shown the symptom of wilting the plots were irrigated on the same day with a hosepipe until the entire plot was properly wet. The harvesting of the crop was done plot wise when the curd become deep green with small, tightly packed buds .The compact matured marketable curd were harvested in different time because of their different maturation time. The crop under investigation was harvested for the first time on 13 January, 2020 and lasted on 20 January, 2020.

### Data collection

Data on plant height, number of leaves per plant, leaf length, leaf breadth, days required for total (100%) curd initiation, curd diameter, weight of full plant, marketable weight of curd, individual curd weight, marketable yield ( $t\ ha^{-1}$ ) were recorded from three plants being randomly selected from each plot.

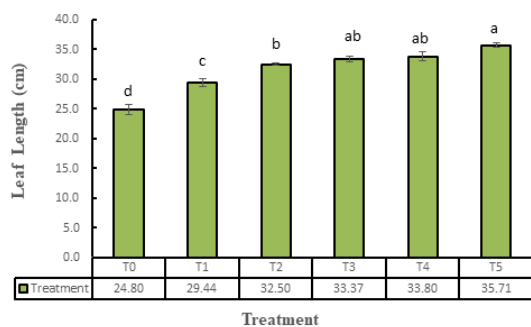
### Statistical analysis

The data collected from the experimental plots were statistically analyzed by using Microsoft excel and Minitab 17 statistical software package to find out difference among the treatments.

## Results and Discussion

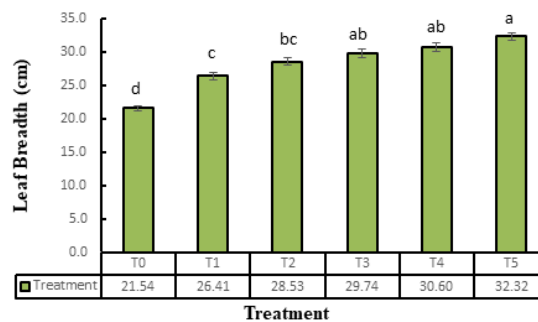
### Leaf length

The combined effect of different sources of organic fertilizer at harvest (Figure 1). At harvest  $T_5$  (35.71 cm) showed highest leaf length followed by  $T_4$  (33.80 cm),  $T_3$  (33.37 cm),  $T_2$  (32.50),  $T_1$  (29.44 cm) and the lowest leaf length recorded from  $T_0$  (24.80 cm) respectively. Combined application of vermicompost with cowdung provided the best leaf length of broccoli. Mohaptra et al. (2014) and Singh et al. (2018) were also reported the similar findings due to effect of integrated nutrient management.



**Figure 1.** Effect of different organic fertilizer on leaf length of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.



**Figure 2.** Effect of different organic manure on leaf breadth of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.

### Leaf breadth

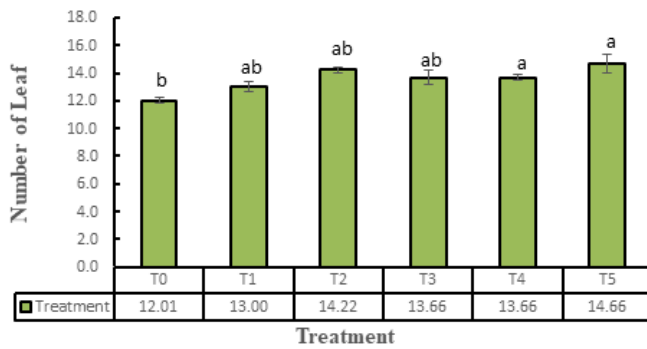
Leaf breadth was significantly influenced by application of different sources of organic manures of broccoli (Figure 2). At harvest highest leaf breadth was recorded T<sub>5</sub> (35.71 cm) followed by T<sub>4</sub> (33.80 cm), T<sub>3</sub> (33.37 cm), T<sub>2</sub> (32.50), T<sub>1</sub> (29.44 cm) and the lowest leaf breadth recorded from T<sub>0</sub> (24.80 cm) respectively. This result showed that combined application vermicompost and cowdung gave highest leaf breadth of broccoli. Alam (2006) reported that vermicomposting with recommended doses of fertilizers yielded the biggest leaf breadth of cabbage.

### Number of leaves per plant

Application of different doses of organic manures showed statistically significant variation on the number of leaves per plant of broccoli plant (Figure 3). At harvest T<sub>5</sub> (14.66) showed highest leaf number followed by T<sub>2</sub> (14.22), T<sub>4</sub> (13.66), T<sub>3</sub> (13.66), T<sub>1</sub> (13.00) and the lowest leaf number recorded from T<sub>0</sub> (12.01) respectively. This result showed that combined application vermicompost and cowdung gave better number of leaves of broccoli. Ara et al., (2009) reported that the use of various composts in conjunction with mineral fertilizers influenced number of leaves per plant in cauliflower.

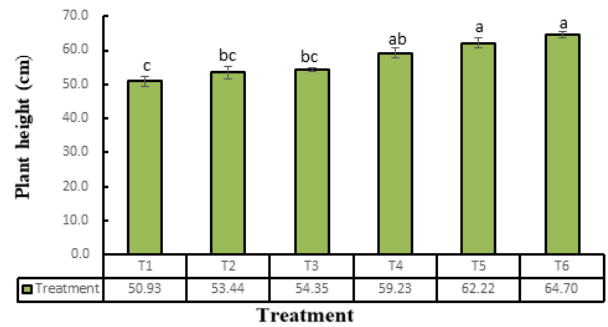
### Plant height

Different sources of organic manures had significant effect on plant height of broccoli at harvest (Figure 4). At harvest T<sub>6</sub> (64.70 cm) recorded highest plant height followed by T<sub>5</sub> (62.22 cm), T<sub>4</sub> (59.23 cm), T<sub>3</sub> (54.35 cm), T<sub>2</sub> (53.44 cm) and the lowest plant height recorded from T<sub>1</sub> (50.53 cm) respectively. This result showed that the combined application of vermicompost with cowdung provided the best plant height of broccoli. These findings are in line with the findings of Mehedi et al. (2018).



**Figure 3.** Effect of different organic manure on number of leaves per plant of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.

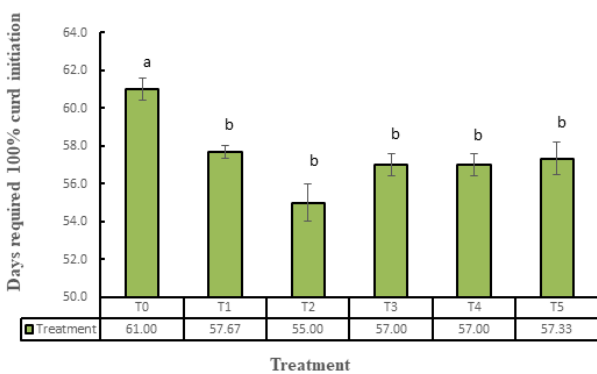


**Figure 4.** Effect of different organic manure on plant height of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.

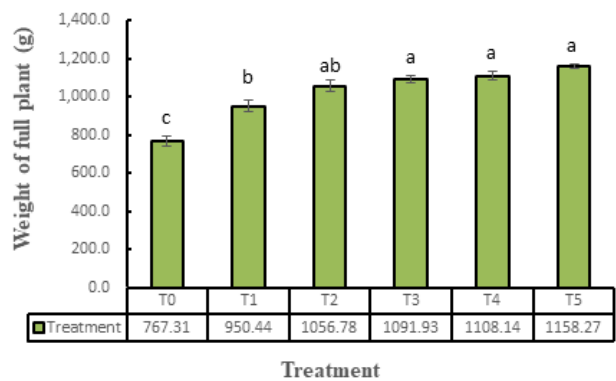
**Days required to 100% curd initiation**

Number of days required for 100% curd initiation after transplanting was significantly influenced by application of the different sources of organic manures (Figure 5). The longest time recorded in T<sub>0</sub> (61.00 days) and the shortest time recorded in T<sub>2</sub> (55.00 days) followed by T<sub>3</sub> (57.00 days), T<sub>4</sub> (57.00 days), T<sub>5</sub> (57.33 days) T<sub>1</sub> (57.67 days) respectively. This result showed that the application of trichocompost gave early 100% curd initiation of broccoli.



**Figure 5.** Effect of different organic manure on days required to 100% curd initiation of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.



**Figure 6.** Effect of different organic manure on weight of full plant.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.

### Weight of full plant

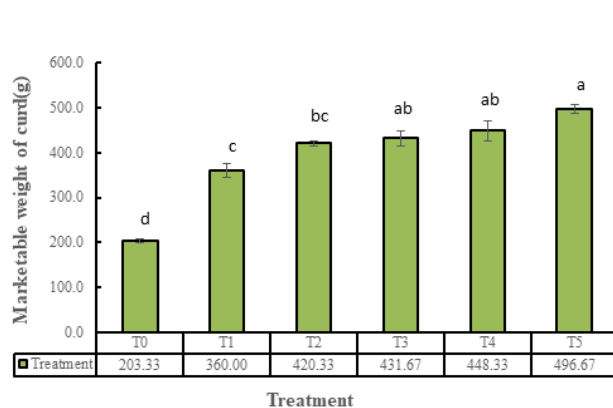
Effects of different organic manures significantly influenced the weight of the full broccoli plant (Figure 6). At harvest, the maximum full weight of plant was recorded from T<sub>5</sub> (1158.27 g) followed by T<sub>4</sub> (1108.14 g), T<sub>3</sub> (1091.93 g), T<sub>2</sub> (1056.78 g) and T<sub>1</sub> (950.44 g) and the lowest weight was obtained from T<sub>0</sub> (767.31 g) respectively. The combination of vermicompost and cowdung provide the best weight of full plant compared to others.

### Marketable weight of curd

Application of different organic manures was significantly increased the marketable weight of broccoli curd (Figure 7). Among different types of organic fertilizers treatment the highest marketable weight was recorded from T<sub>5</sub> (496.67 g) followed by T<sub>4</sub> (448.3g), T<sub>3</sub> (431.7g), T<sub>2</sub> (420.33 g), T<sub>1</sub> (360.0 g) respectively and the lowest marketable weight was observed from T<sub>0</sub> (203.33 g). This result showed that the application of organic fertilizer gave maximum marketable weight of curd compared to the no fertilizer application. These results were supported by the findings of Singh et al. (2016)

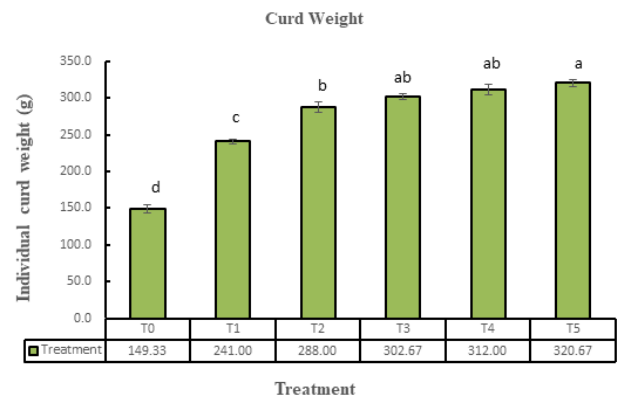
### Individual curd weight

Curd weight of individual broccoli varied significantly among different sources of organic manures management (Figure 8). At harvest, the maximum curd weight was recorded from T<sub>5</sub> (320.67 g) followed by T<sub>4</sub> (312.00 g), T<sub>3</sub> (302.67 g), T<sub>2</sub> (288.00 g), T<sub>1</sub> (241.00 g) and the lowest weight was obtained from T<sub>0</sub> (149.33 g) respectively. This result showed that combined application vermicompost and cowdung increased the curd weight of broccoli. Similar results were found that the combined application of different organic fertilizer gave maximum curd weight Akter (2021).



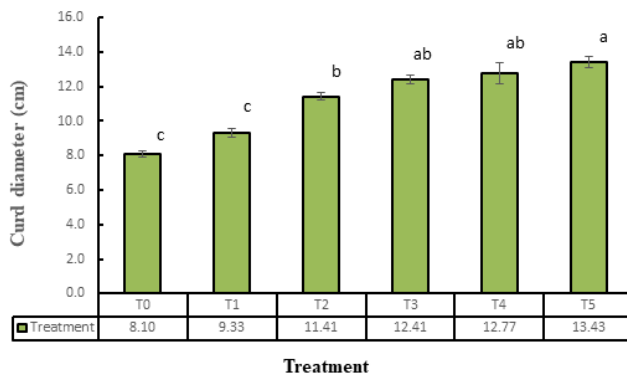
**Figure 7.** Effect of different organic manure on marketable weight of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.



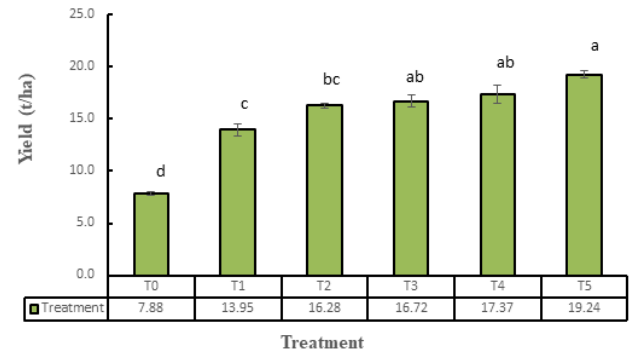
**Figure 8.** Effect of different organic manure on individual curd weight of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.



**Figure 9.** Effect of different organic manure on curd diameter of broccoli.

Legends: T<sub>0</sub> (No manure), T<sub>1</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>3</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Cowdung 50% + Trichocompost 50%), T<sub>5</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.



**Figure 10.** Effect of different organic fertilizer on marketable yield of broccoli.

Legends: T<sub>1</sub> (No manure), T<sub>2</sub> (Cowdung 5 t ha<sup>-1</sup>), T<sub>3</sub> (Trichocompost 5 t ha<sup>-1</sup>), T<sub>4</sub> (Vermicompost 5 t ha<sup>-1</sup>), T<sub>5</sub> (Cowdung 50% + Trichocompost 50%), T<sub>6</sub> (Cowdung 50% + Vermicompost 50%). Vertical bars indicate the standard error of the mean against each variety. The different letter indicates a significant difference among data at 5% level of probability.

### Curd diameter

Diameter of curd was significantly influenced by application of different organic fertilizer (Figure 9). The highest diameter of curd was obtained from T<sub>5</sub> (13.432 cm) followed by T<sub>4</sub> (12.766 cm), T<sub>3</sub> (12.407 cm), T<sub>2</sub> (11.413 cm), T<sub>1</sub> (9.335 cm) and the lowest curd diameter was obtained from T<sub>0</sub> (8.104) respectively. These results were in close conformity with the findings of Akter (2021).

### Marketable yield

Application of different sources of organic fertilizer and their combination showed significant variation on the marketable yield of curd (Figure 10). Among different types of organic fertilizers treatment the highest marketable yield was recorded from T<sub>5</sub> (19.242 t ha<sup>-1</sup>) followed by T<sub>4</sub> (17.370 t ha<sup>-1</sup>), T<sub>3</sub> (16.724 t ha<sup>-1</sup>), T<sub>2</sub> (16.285 t ha<sup>-1</sup>), T<sub>1</sub> (13.947 t ha<sup>-1</sup>) respectively and the lowest marketable weight of curd was observed from T<sub>0</sub> (7.878 t ha<sup>-1</sup>) treatment (Figure 10). This finding showed that combined application of vermicompost with cowdung provided the best marketable yield which had also supported by Akter (2021) and (Ola et al., 2019).

### Conclusion

The results indicated that combined effects of cowdung and vermicompost had significant impact on all the parameters. On the basis of this result T<sub>5</sub> was the best treatment because of the maximum plant height (28.37 cm), number of leaf (14.66), leaf length (35.71 cm), leaf breadth (35.71 cm), weight of full plant (1158.27 g), marketable weight of curd (496.67 g), curd weight (320.67 g), diameter of curd (13.432 cm), marketable yield (19.242 ton ha<sup>-1</sup>) was recorded from T<sub>5</sub> (Cowdung 50% + Vermicompost 50%) while the minimum plant height (21.93 cm), leaf number (12.01), leaf length (24.80 cm), leaf breadth (24.80 cm), weight of full plant (767.31 g), marketable weight of curd (203.33 g), curd weight (149.33 g), curd diameter (8.104), marketable yield (7.878 ton/ha) and, maximum time (61 days) for 100% curd initiation was recorded from treatment T<sub>0</sub> (control). But minimum days of 100% curd initiation (55 days) was recorded from T<sub>2</sub> (Trichocompost 5 t ha<sup>-1</sup>). Observing the results, it can be stated that using the combination of vermicompost and cowdung is convenient as well as efficient practice for the production of organic broccoli.

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## Conflict of interest

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

## References

1. Abou El-Magd, MM, AM El-Bassiony, and ZF Fawzy. 2006. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. *J. Appl. Sci. Res*, 2(10): 791-798.
2. Adhikary S, 2012. Vermicompost, the story of organic gold: A review. *Agricultural Sciences*, 03(07): 905–917.
3. Akter T, 2021. Effect of organic and inorganic fertilizers on the growth and yield of broccoli (*Brassica oleracea* var. *italica* L). MSc. Thesis, Bangladesh Agricultural University, Mymensingh.
4. Alam MN, 2006. Effect of vermicompost and some chemical fertilizers on yield and yield components of selective vegetable crops. Ph.D. Thesis, Faculty of Agriculture, University of Rajshahi, Bangladesh, pp: 122-176
5. Ali MS, D Majumder, N Mohammad, MM Islam, R Ahmed and K Hossen, 2022. Short term growth of red amaranth (*Amaranthus gangeticus*) by using urea fertilizer and Gibberellic acid. *Research in Agriculture Livestock and Fisheries*, 9(2): 97-102.
6. Ali MS, ZH Zahid, MN Siddike, ZH Bappi, NA Payel, T Islam, MJ Rahman and GM Mohsin, 2023. Effect of different levels of organic fertilizer on growth, yield and economic benefits of radish (*Raphanus sativus* L.). *Journal of Bioscience and Agriculture Research*, 30(02): 2533-2540
7. Ara, N, MO Kaisar, KM Khalequzzaman, HOSNA Kohinoor, and KU Ahamed, 2009. Effect of different dates of planting and lines on the growth, yield and yield contributing characteristics of cauliflower. *J. Soil Nature*, 3(1): 16-19.
8. Baghel B, R Sahu and D Pandey, 2018. Vermicomposting an economical enterprise for nutrient and waste management for rural agriculture. *International Journal of Current Microbiology and Applied Sciences*, 7(2): 3754-3758.
9. Chang YC, 1986. Increased Growth of Plants in the Presence of the Biological Control Agent *Trichoderma harzianum*. *Plant Disease*, 70(2): 145.
10. Eliyanti E, B Ichwan, AP Lestari and Z Zulkarnain, 2021. The Induction of Biotic Stress-Resistance and Increasing Growth and Yield of Chili Pepper (*Capsicum Annuum* L.) Using Cow Bio-Urine and Tricho-Compost. In *The 3rd Green Development International Conference*, pp: 129-135. Atlantis Press.
11. Garg P, A Gupta and S Satya, 2006. Vermicomposting of different types of waste using *Eisenia foetida*: A comparative study. *Bioresource Technology*, 97(3): 391–395.
12. Ghimire R, A Khanal, BP Kandel, and Lb Chhetri, 2018. Effect of nitrogen and pre-planting treatment of seedling with *Azotobacter* on growth and productivity of broccoli (*Brassica oleracea* var. *italica*). *World Scientific News*, 109: 267-273.
13. Inbar J, M Abramsky, D Cohen and I Chet, 1994. Plant growth enhancement and disease control by *Trichoderma harzianum* in vegetable seedlings grown under commercial conditions. *European Journal of Plant Pathology*, 100(5): 337–346.
14. Jaiswal AK, 2020. Nutritional composition and antioxidant properties of fruits and vegetables. Academic Press.
15. Khatun R, MS Ali, DR Islam, S Rahaman, T Islam, N Mohammad, MJ Rahman, MN Siddike and GM Mohsin, 2023. Influence of vermicompost on growth and yield of okra (*Abelmoschus esculentus*) in coastal area of Bangladesh. *Research in Agriculture Livestock and Fisheries*, 10(2): 165-173.



16. Kumar V, R Shankar and PK Singh, 2016. Effect of vermicompost, cow dung and different organic manure combination on growth and yield of chilli crop (*Capsicum annuum* L) in India. International Journal of Advances in Agricultural Science and Technology, 3(3): 14-19.
17. Latté, KP, KE Appel and, A Lampen, 2011. Health benefits and possible risks of broccoli – An overview. Food and Chemical Toxicology, 49(12): 3287–3309.
18. Mehedi MNH, F Mohosina, A Khanom, MI Ali and MN Peda, 2018. Effects of organic manures on the growth and yield of broccoli. Bangladesh J, 35: 47-50.
19. Mohapatra SK, P Mahapatra and PS Munsu, 2014. Effect of organic manures, bioinoculants and inorganic fertilizers on yield, nutrient uptake and nutrient recovery by broccoli. Indian Journal of Horticulture, 71(4): 584-587.
20. Mucheru-Muna M, D Mugendi, J Kung'u, J Mugwe and A Bationo, 2007. Effects of organic and mineral fertilizer inputs on maize yield and soil chemical properties in a maize cropping system in Meru South District, Kenya. Agroforestry Systems, 69: 189-197.
21. Ola AL, LN Bairwa, OP Garhwal and OP Regar, 2019. Effect of Integrated Nutrient Management and Bio-regulators on Yield and Economics Attributes of Sprouting Broccoli (*Brassica oleracea* (L.) var. *Italica*). Current Journal of Applied Science and Technology, 35 (5): 1–8.
22. Rangkadilok N, ME Nicolas, RN Bennett, DR Eagling, RR Premier and PWJ Taylor, 2004. The Effect of Sulfur Fertilizer on Glucoraphanin Levels in Broccoli (*B. oleracea* L. var. *Italica*) at Different Growth Stages. Journal of Agricultural and Food Chemistry, 52(9): 2632–2639.
23. Ruz-Jerez BE, PR Ball and RW Tillman, 1992. Laboratory assessment of nutrient release from a pasture soil receiving grass or clover residues, in the presence or absence of *Lumbricus rubellus* or *Eisenia fetida*. Soil Biology and Biochemistry, 24(12): 1529–1534.
24. Salunkhe DK, and SS Kadam, 1998. Handbook of vegetable science and technology: production, compostion, storage, and processing. CRC press.
25. Singh AK, D Singh, NK Tiwari, D Singh and LV Singh, 2018. Effect of NPK, vermicompost and spacing on growth, yield and quality of broccoli (*Brassica oleracea* L. var. *italica*). Journal of Pharmacognosy and Phytochemistry, 7(6): 2254-2258.
26. Singh V, KN Shah and DK Rana, 2016. Combined effect of organic manures and bio-fertilizers on growth and yield of broccoli under Garhwal Himalayan region. HortFlora Research Spectrum, 5(4): 345-347.
27. Supiati, 2003. Chemical analysis on cows' feces using probiotic technique. Proceedings of the Conference of National Technician of Agriculture, pp: 43-49.
28. Suthar S, 2009. Impact of vermicompost and composted farmyard manure on growth and yield of garlic (*Allium stivum* L.) field crop. International Journal of Plant Production, 3: 27-38.
29. Tindall M, 2000. Mineral and organic fertilizing in cabbage. Residual effect for commercial cultivation on yield and quality performance with organic farming. Hort. Bras, 6(1): 15-20.
30. Yoldas F, S Ceylan, B Yagmur and N Mordogan 2008. Effects of Nitrogen Fertilizer on Yield Quality and Nutrient Content in Broccoli. Journal of Plant Nutrition, 31(7): 1333–1343.
31. Zahid HM, 2001. Production of vermicompost and its use in Upland and Horticultural crops. Annual reports of Bangladesh Agricultural Research Council, Farmgate, Dhaka.