J. Hortic. Sci.
Vol. 19(2), 2024

https://doi.org/10.24154/jhs.v19i2.3194

Original Research Paper

Optimizing growth, yield, and nutritional quality of Chinese cabbage through vermicompost and reduced fertilizer application in organic farming systems

Islam N., Chowdhury M.K., Biswas S. and Uddain J.*
Department of Horticulture, Faculty of Agriculture,
Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh
*Corresponding author Email: jasimhort@sau.edu.bd

ABSTRACT

Chinese cabbage, though less prominent in Bangladesh, has shown potential for successful cultivation in the region. This study aimed to assess various cultivars' efficacy on Chinese cabbage growth, yield, and quality within an organic farming system. A field experiment employed a for two consecutive years, investigating the combined impact of cultivar and vermicompost with reduced fertilizer levels on yield. Three cultivars *viz.*, BARI Chinakopi 1, Blues, and Retasi, were tested along with four fertilizer levels namely, recommended NPK (control); 80% NPK + vermicompost 6 t/ha; 70% NPK + vermicompost 8 t/ha; and 50% NPK + vermicompost 10 t/ha. Results demonstrated that cv. Blues, treated with 50% NPK + 10 t/ha of vermicompost, exhibited significant enhancements in various parameters compared to the control group. Notably, the treated var. Blues showcased increased plant height (43%), head diameter (46.3%), dry matter (71.2%), and gross yield (72.2%) at harvest. Moreover, var. Blues treated with vermicompost at 10 t/ha displayed elevated levels of vitamin C (28%), β-carotene (96.3%), Ca (7.1%), Mg (18.4%), P (5%), K (10.5%), Fe (13.1%), and Zn (21%) compared to control. These findings suggest that utilizing 50% NPK + vermicompost at 10 t/ha significantly enhances Chinese cabbage growth and quality, particularly in cv. Blues. Incorporating this treatment method could effectively elevate both production yield and crop quality, providing valuable insights for organic farming practices.

Keywords: Chinese cabbage, organic farming, vegetables, vermicompost

INTRODUCTION

Chinese cabbage (*Brassica campestris* var. *pekinensis*) belonging to the family Brassicaceae, is a significant vegetable that is widely consumed and grown in several Asian countries. Brassica products are gaining popularity because of their nutritional content and their ability to prevent cancer, act as antioxidants, and reduce inflammation. Chinese cabbage contains carotenoids, polyphenols, and glucosinolates and these compounds have strong antioxidant properties (Song et al., 2023). Chinese cabbage is abundant in vitamins mainly B3 (niacin) which aids in the treatment of gastrointestinal issues and neurological system illnesses, minerals like calcium, potassium, and fiber, which promotes digestive motility (Seong et al., 2016).

Chinese cabbage is somewhat obscure in Bangladesh and is cultivated to a limited extent due to a lack of adequate production techniques and less popularity as a vegetable. The main reason for such poor development and production could be attributed to the absence of high yielding varieties and suitable cultural management approaches. Most seed corporations acquire crop types from foreign countries and distribute them to farmers without completing adaptation experiments. Therefore, it is crucial to find a suitable variety in order to achieve higher output levels and financial gains. Moreover, Bangladesh has a high demand for agricultural products, and limited arable land puts pressure on farmers to maximize productivity and they mostly rely on chemical fertilizer. Research has shown that organic fertilizers are more beneficial for human health compared to inorganic fertilizers due to their residual effect. Limited research on adapting organic practices specifically to the soil types, climate, and crop varieties in Bangladesh. Organic fertilizer improve soil structure, organic matter and water retention, bacterial diversity which boosts macro and micro-organism activity (Francioli et al., 2016).

A wide variety of macro and micronutrients can be found in vermicompost. The problems of waste management and organic fertilizer scarcity can be efficiently tackled by using vermicompost in large-scale vegetable cultivation. Multiple studies indicate that vermicompost is a highly effective soil conditioner that enhances growth around 50-100% compare to inorganic fertilizer of various vegetables, including Chinese cabbage (Nurhidayati et al., 2016; Šimon and Czakó, 2018). Based on the aforementioned information, this study aimed to determine the most appropriate Chinese cabbage cultivar affected by varying levels of vermicompost and reduced fertilizer levels, and its impact on the growth, yield, and quality of the Chinese cabbage cultivars.

MATERIALS AND METHODS

Experimental site and materials

The experiment was conducted at a horticultural farm situated in Sher-e-Bangla Agricultural University (SAU), Dhaka, Bangladesh. The experimental site was situated at a geographical coordinate of 23°77¹ N latitude and 90°33¹ E longitude, at an altitude of 8.6 m above sea level. The experiment was conducted during the winter season in two consecutive years, from October 2021 to January 2023. This experiment employed three cultivars of Chinese cabbage, specifically C_1: BARI Chinakopi 1, C_2: Blues, C_3: Retasi, and four levels of fertilizer: VC_0: recommended NPK 250 kg/ha N; 200 kg/ha P; 250 kg/ha K)-control, VC_1: 80% NPK + vermicompost 6 t/ha, VC_2: 70% NPK + vermicompost 8 t/ha, VC_3: 50% NPK + vermicompost 10 t/ha, in two-factor study employing randomized complete block design (RCBD) with three replications. The seeds of these types were obtained from Siddique Bazar in Dhaka. A soil sample was collected from experimental field at the beginning of experiment. The physical and chemical properties of the collected soil sample are given at Table 1.

To reduce border effects, data were collected from each treatment's middle plant rows. The average weight of six plants was calculated at random from each unit plot. Every parameter was documented throughout the time of harvest. The specified parameters have been established for the purpose of capturing data and analyzing outcomes. Plant height and head diameter measured using a meter scale and stated in cm. By weighing all the plants in a plot, the gross yield of Chinese cabbage was calculated in kg.

For measuring dry matter, six plants were selected randomly and chopped into small pieces. A 100 g sample of small pieces was dried in direct sunlight for 48 hours and then dried in an oven at 65°C until it attained a steady weight. Dehydrated sample weight was measured in g, and the average was calculated.

Chemical analysis

Chinese cabbage is a widely consumed vegetable known for its nutritional benefits. To know what extent organic farming enhance nutritional value, study focused on analyzing its content of β-carotene, vitamin C, Mg, Ca, K, P, Zn and Fe due to their significant health implications.

100 mL of cold metaphosphoric acid (HPO_3) and 10 g of Chinese cabbage were blended for two minutes to measure ascorbic acid concentration. Then collected transparent liquid through filtering in Whatman filter paper No.2 and then evaluated ascorbic acid

Table 1 : Physical and chemical properties of soil at the experimental site, specifically at a depth of 0-15 cm

Characteristics	Analytical result
% Sand (2.0-0.05 mm)	27
% Silt (0.05-0.002 mm)	29
% Clay (<0.002 mm)	44
Textural class	Silty clay
Organic carbon (%)	0.47
Organic matter (%)	0.73
Total N (%)	0.02
Available P (ppm)	21.23
Exchangeable K (mg/100 g soil)	0.11
pH	5.6

concentration using 2, 6-dichlorophenolindophenol titration method (AOAC, 1994). The Beta Carotene concentration was estimated using the procedure developed by Biswas et al. (2011). A mixture of 5 mL acetone and 25 mg of standard Beta-Carotene was stored in a dark location for 10 minutes to create the standard solution. The solution absorbance was measured using a T60-V Spectrophotometer at a wave length of 450 nm.

A mixture of perchloric acid and nitric acid was used to digest the dried tissues, in a weight ratio of 1:1. An acid mixture containing 15 cm^3 and 100 mg of dry tissues were added to a 100 cm^3 conical flask. After the mixture had pre-digested overnight, it was heated to 100ºC for an hour. After that, the temperature was raised to 250ºC and kept there until the solution lost its colour and the volume was reduced to 2-3 cm^3. By adding 50 cm^3 of double distilled water, the digested plant material was diluted before passing it through a filter. Mineral concentrations were ascertained by means of the filtrate. Elemental analysis was conducted utilizing an atomic absorption spectrophotometer (AAS-4141) to quantify the concentrations of minerals.

Statistical analysis

Statistical analysis was performed on the acquired data for different parameters to ascertain the role of cultivars and vermicompost in influencing the yield and attributes that go into Chinese cabbage production. The SPSS software programme was used to conduct the analysis of variance.

RESULTS AND DISCUSSION

Plant height and head diameter of cabbage

Different cultivars and fertilizers level exhibited notable variations in plant height at different growth stages. The current study observed a progressive increase in plant height until harvest, which was strongly influenced by varying doses of vermicompost. The Blues variety exhibited the highest plant height compared to the other two kinds at harvest in both years. Table 2 indicated that the use of 50% NPK + 10 t/ha vermicompost resulted in the highest mean plant height in the Blues variety in both years. This

Table 2 : Effect of variety and reduced inorganic fertilizer with vermicompost on plant height and head diameter of Chinese cabbage

Treatment	Plant height (cm)		Head diameter (cm)	
	1^{st} year	2^{nd} year	1^{st} year	2^{nd} year
C_1VC_0	25.67±0.47^{i}	25.63±0.53^{g}	10.88±0.19^{g}	10.5±0.21^{f}
C_1VC_1	27.64±0.28^{h}	27.65±0.37^{fg}	12.34±0.69^{ef}	12.4±0.75^{de}
C_1VC_2	29.11±0.39^{fg}	28.95±0.47^{ef}	13.85±0.47^{cd}	3.5±0.53^{g}
C_1VC_3	30.73±0.39^{e}	30.5±0.30^{de}	14.48±0.63^{c}	14.3±0.67^{c}
C_2VC_0	27.90±0.26^{gh}	27.55±0.50^{fg}	12.39±0.27^{ef}	12.2±0.28^{de}
C_2VC_1	30.41±0.53^{def}	30.2±0.69^{de}	13.72±0.50^{cd}	13.5±0.50^{cd}
C_2VC_2	36.39±0.39^{b}	36.45±0.62^{b}	16.17±0.16^{b}	16±0.21^{b}
C_2VC_3	39.88±0.84^{a}	39.63±0.82^{a}	18.13±0.27^{a}	18.1±0.35^{a}
C_3VC_0	27.10±0.34^{h}	27±0.61^{h}	11.55±0.39^{fg}	11.4±0.43^{ef}
C_3VC_1	29.69±0.29^{ef}	29.55±0.35^{de}	12.92±0.27^{de}	12.8±0.29^{cde}
C_3VC_2	31.60±0.60^{d}	31.23±0.70^{d}	14.17±0.27^{cd}	14±0.48^{c}
C_3VC_3	34.05±0.26^{c}	33.87±0.34^{c}	16.12±0.36^{b}	15.9±0.60^{b}
	***	***	***	***

***Significant at 5% level of significance,

Data showed as a mean of three replication with standard error and similar letter in a column means no significant difference between them at P d" 0.05 according to Duncan multiple range test

C_1: BARI Chinakopi 1; C_2: Blues; C_3: Retasi; VC_0: Recommended NPK (Control); VC_1: 80% NPK + Vermicompost 6 t/ha; VC_2: 70% NPK + Vermicompost 8 t/ha; VC_3: 50% NPK + Vermicompost 10 t/ha

increased 43% greater than the control group at the time of harvest. Jadhav et al. (2024) found that vermicompost has a direct impact on plant growth by providing plant growth regulating substances (PGR), which leads to the absorption of nutrients. Application of reduce rate of inorganic fertilizer with biofertilizer enhanced growth and yield of BARI Chinashak-1 (Haque et al., 2023).

A Chinese cabbage's yield and market value are both affected by its diameter, a quantitative measure of its size. In terms of head diameter, there was a notable variation among the cultivars and fertilizers level (Table 2). The maximum mean head diameter was measured by the C_2VC_3 treatment combination at 18.13 cm, an increase of 46.3% over the control in both years. Variation in fertilization procedures was found to cause diameter and height variation in Chinese cabbage heads. This variation occurs due to enhancement of cell division, elongation which favor by availability of micro and macro nutrient in plant due to application of organic fertilizer (Shi et al., 2021). When the right amount of chemical fertilizers were added to vermicompost, a study by Ali & Kashem (2018) showed that cabbage head diameter and thickness were significantly improved.

Dry matter content (%) and fresh weight (kg) of head

The various levels of vermicompost management strategies had a substantial impact on the percentage of dry matter and fresh weight of head (Table 3). With an increase in vermicompost, the fresh weight of the head per plant increased dramatically. When exposed to 50% NPK+ 10 t/ha of vermicompost, all three varieties' weights nearly doubled in comparison to the control group. The mean of two years data showed that Blues variety exhibited the greatest dry matter content of head was attained with the 50% NPK + vermicompost 10 t/ha treatment which was 70.21% higher than the control. Alam et al. (2017) found that compared to using chemical fertilizers alone, using vermicompost in combination with reduced inorganic fertilizer improved performance growth such as fresh weight of the head and the entire plant. Al-Tawarah et al. (2024) showed that both the fresh and dry weight properties were significantly improved.

Table 3 : Impact of varietal selection and combined vermicompost with reduced inorganic fertilizeron on dry matter content and head fresh weight of Chinese cabbage

Treatment	Day matter content (%)		Fresh weitht (kg)	
	1st year	2nd year	1st year	2nd year
C_1VC_0	8.36±0.06^{g}	8.4±0.75^{f}	0.45±0.01^{g}	0.46±0.02^{c}
C_1VC_1	10.35±0.08^{e}	10±0.10^{e}	0.63±0.02^{f}	0.6±0.03^{bc}
C_1VC_2	11.69±0.26^{d}	11.55±0.43^{d}	0.73±0.37^{e}	0.68±0.21^{abc}
C_1VC_3	13.44±0.03^{c}	13.2±0.96^{c}	0.80±0.25^{d}	0.78±0.35^{abc}
C_2VC_0	9.77±0.08^{f}	9.8±0.11^{e}	0.69±0.00^{ef}	0.7±0.02^{abc}
C_2VC_1	12.01±0.12^{d}	12±0.16^{d}	0.85±0.01^{d}	0.82±0.10^{abc}
C_2VC_2	15.05±0.08^{b}	15±0.11^{b}	1.18±0.01^{b}	1.15±0.05^{ab}
C_2VC_3	16.63±0.41^{a}	16.5±0.43^{a}	1.25±0.02^{a}	1.2±0.04^{a}
C_3VC_0	8.51±0.10^{g}	8.43±0.21^{f}	0.48±0.01^{g}	0.5±0.01^{c}
C_3VC_1	11.50±0.19^{d}	11.23±0.32^{d}	0.67±0.01^{ef}	0.65±0.03^{abc}
C_3VC_2	13.53±0.23^{c}	13.45±0.37^{c}	0.96±0.02^{c}	0.95±0.21^{abc}
C_3VC_3	14.52±0.28^{b}	14.33±0.48^{bc}	1.15±0.02^{b}	1.14±0.37^{ab}
	***	***	***	***

***Significant at 5% level of significance,

Data showed as a mean of three replication with standard error and similar letter in a column means no significant difference between them at P d" 0.05 according to Duncan multiple range test

C_1: BARI Chinakopi 1; C_2: Blues; C_3: Retasi; VC_0: Recommended NPK (Control); VC_1: 80% NPK + Vermicompost 6 t/ha; VC_2: 70% NPK + Vermicompost 8 t/ha; VC_3: 50% NPK + Vermicompost 10 t/ha

Marketable yield and gross yield

The combined effect of different cultivars and the use of vermicompost with reduced fertilizer level had a considerable impact on the amount of marketable yield as well as gross yield of Chinese cabbage (Table 4). The Blues variety demonstrated a greater capacity to produce a higher marketable yield per hectare as a result of the application of 50% NPK + 10 t/ha vermicompost in two consecutive years. This mean yield of two years was 56.7% and 8.7% higher than that of the BARI Chinakopi 1 and Retasi varieties, respectively. Nurhidayati et al. (2016) found that using vermicompost resulted in a substantial increase in the marketable weight and overall production of cabbage compared to using inorganic treatment. A similar discovery was reported by Farjana et al. (2019).

The combined effect of different cultivars and the use of vermicompost had a substantial impact on the overall output of Chinese cabbage in both years. The mean of two years data reported that when using 50% NPK + 10 t/ha of vermicompost, the Blues variety demonstrated a gross yield that was 48.1% higher than BARI Chinakopi 1 and 9.9% higher than the Retasi variety. The growth and yield of BARI Chinashak-1 primarily rely on the nitrogen fertilizer rate, in addition to the application of vermicompost. The Blues variety showed better adaptability than the other variety grown different part of the Bangladesh producing higher amount of yield and nutrient content which align with the finding Hasan et al., 2024. According to Adhikari et al. (2023), vermicompost has been found to enhance cabbage yield, enhance soil fertility, and decrease the need for chemical fertilizers. The use of vermicompost enhances the uptake of macronutrients (N, P, K) and micronutrients (Zn, Cu, Mn, B) in Chinese cabbage, leading to improved leaf biomass and overall plant health. Better nutrients availability enhance cell division, plant growth as a result better yield (Gong et al., 2019).

Amount of *β*-carotene, Vitamin-C, Mg and Ca

A notable variation was seen in the levels of Vit-C, β-carotene, Ca, and Mg in Chinese cabbage among different cultivars, due to different vermicompost levels with reduce fertilizer rates (Table 5). The Blues variety had the highest mean levels of Vitamin C, β-carotene, Calcium, and Magnesium. This was attributed to the

Table 4 : Impact of varietal selection and combined vermicompost with reduced inorganic fertilizeron on marketable yield and gross yield of Chinese cabbage

Treatment	Marketable yield (t/ha)		Gross yield (t/ha)	
	1st year	2nd year	1st year	2nd year
C_1VC_0	30±0.76^g	29.78±0.88^g	38.66±0.77^g	38.5±0.80^g
C_1VC_1	42.22±1.55^f	42.15±1.44^f	52.00±1.54^f	51.88±1.54^f
C_1VC_2	48.66±2.52^e	48.52±2.72^e	59.33±2.52^e	58.9±2.80^e
C_1VC_3	53.33±1.67^d	53.17±1.66^d	65.11±1.55^d	65±1.58^d
C_2VC_0	46.44±0.58^{ef}	46.25±0.59^{ef}	56.00±0.66^{ef}	55.85±0.80^{ef}
C_2VC_1	56.89±0.97^d	56.75±1.12^d	68.22±0.97^d	68.1±1.17^d
C_2VC_2	78.66±1.01^b	78.53±1.01^b	91.33±1.02^b	91.12±1.28^b
C_2VC_3	83.55±1.60a	83.45±1.82^a	96.44±1.70^a	96.2±1.76^a
C_3VC_0	32.00±0.38^g	31.88±0.48^g	41.11±0.44^g	40.77±0.93^g
C_3VC_1	45.11±0.97^{ef}	45±1.02^{ef}	56.00±1.15^{ef}	55.86±1.33^{ef}
C_3VC_2	64.22±1.55^c	64.1±1.57^c	75.33±1.76^c	75.12±1.97^c
C_3VC_3	76.88±1.93^b	76.5±2.06^b	87.77±2.98^b	87.52±2.84^b
	***	***	***	***

***Significant at 5% level of significance,

Data showed as a mean of three replication with standard error and similar letter in a column means no significant difference between them at P d" 0.05 according to Duncan Multiple Range Test

C_1: BARI Chinakopi 1; C_2: Blues; C_3: Retasi; VC_0: Recommended NPK (Control); VC_1: 80% NPK + Vermicompost 6 t/ha; VC_2: 70% NPK + Vermicompost 8 t/ha; VC_3: 50% NPK + Vermicompost 10 t/ha

Table 5 : The influence of reduced rate of inorganic fertilizer with vermicompost and cultivars on amount of *β*-carotene, Vitamin-C, Mg and Ca in Chinese cabbage

Treatment	*β*-carotene (mg/100g)	Vitamin-C (mg/100g)	Mg (mg/100g)	Ca (mg/100g)
C_1VC_0	91±0.57^{i}	17.66±0.33^{f}	9±0.57^{d}	64.66±0.88^{f}
C_1VC_1	141±0.57^{f}	23.66±0.33^{cd}	9.73±0.41^{cd}	66.33±0.66^{f}
C_1VC_2	171±0.57^{d}	23.66±0.33^{cd}	10.55±0.29^{bc}	70±0.57^{cde}
C_1VC_3	186±0.56^{b}	32.33±0.88^{a}	11.60±0.55^{ab}	71.33±0.66^{bcd}
C_2VC_0	99.33±0.66^{g}	25.00±0.57^{bc}	10.34±0.43^{bc}	69.66±0.66^{de}
C_2VC_1	146±0.57^{e}	26.33±0.33^{b}	10.93±0.52^{bc}	71.66±0.88^{bcd}
C_2VC_2	187±0.57^{b}	26.66±0.88^{b}	11.40±0.34^{ab}	72.66±0.33^{b}
C_2VC_3	195±1.15^{a}	32.00±0.57^{a}	12.24±0.26^{a}	74.66±0.33^{a}
C_3VC_0	96±0.57^{h}	15.66±0.88^{f}	7.74±0.37^{e}	66.33±0.88^{g}
C_3VC_1	144±0.57^{e}	16.00±0.15^{f}	8.99±0.11^{d}	69±0.57^{e}
C_3VC_2	180.66±0.88^{c}	21±0.57^{e}	11.08±0.22^{ab}	70.66±0.33^{c}
C_3VC_3	187±1.15^{b}	22.33±0.33^{de}	11.52±0.28^{ab}	72±0.57^{bc}
	***	***	***	***

***Significant at 5% level of significance,

Data showed as a mean of two years with standard error and similar letter in a column means no significant difference between them at P d" 0.05 according to Duncan Multiple Range Test

C_1: BARI Chinakopi 1; C_2: Blues; C_3: Retasi; VC_0: Recommended NPK (Control); VC_1: 80% NPK + Vermicompost 6 t/ha; VC_2: 70% NPK + Vermicompost 8 t/ha; VC_3: 50% NPK + Vermicompost 10 t/ha

use of 50% NPK + 10 t/ha vermicompost, which resulted in increases of 28%, 96.3%, 7.1%, and 18.4% correspondingly compared to the control group (Table 5). Vermicompost significantly increased the vitamin C content and other beneficial nutrients in Chinese cabbage leaves (Wang et al., 2010). According to Hasan et al. (2024), the amount of chlorophyll and vitamin C in the leaves was greatly improved when the amount of vermicompost was increased. Ca and Mg levels in cabbage were found to rise after being amended with vermicompost, as reported by Reza et al. (2016).

The application of vermicompost enhance soil urease and invertase activities which are linked to better nutrient availability that can increase vitamin C, β-carotene and others nutrients content (Nurhidayati et al., 2016).

Amount of K, P, Zn and Fe

Significant differences were found among cultivars in terms of the levels of potassium (K), phosphorus (P), zinc (Zn) and iron (Fe) content. The amount of zinc did not change significantly when the vermicompost level was varied. However, the amount of P, K, and Fe exhibited statistically significant fluctuation. The Blues variety exhibited the highest mean level of potassium, phosphorus, zinc and iron when treated with 50% NPK + 10 t/ha vermicompost in both years. These treatments resulted in a respective increase of 10.5%, 5%, 21% and 13.1% compared to the control group (Table 6). The Blues variety had the highest concentration of K, P, Zn and Fe compared to the BARI Chinakopi 1 and Retasi varieties, all of which received the same treatment.

Applying vermicompost to cabbage seedlings has nutritional, hormonal, and biochemical effects, specifically affecting the levels of zinc and auxin (Pour et al., 2013). Organic fertilizer like vermicompost boosted the phosphorus and potassium content of cabbage by enhancing solubility of these compound in soil (Najafi-Ghiri, 2014). Reza et al. (2016) found that vermicompost could be an organic source that helps cabbage grow faster and absorb more nutrients. The levels of potassium, phosphorus, zinc and iron and other vital nutrients were substantially increased after using vermicompost. The inclusion of plant growth-

Table 6 : The influence of reduced rate of inorganic fertilizer with vermicompost and cultivars on amount of K, P, Zn and Fe in Chinese cabbage

Treatment	K (mg/100 g)	P (mg/100 g)	Zn (mg/100 g)	Fe (mg/100 g)
C_1VC_0	201±0.57^{k}	21.33±0.33^{fg}	0.19±0.006^{fg}	0.43±0.00^{f}
C_1VC_1	213±0.57^{i}	23.33±0.33^{cd}	0.20±0.003^{cdef}	0.50±0.00^{e}
C_1VC_2	217.33±0.33^{g}	24.33±0.66^{c}	0.21±0.000^{ab}	0.51±0.00^{e}
C_1VC_3	220.33±0.33^{f}	26.33±0.33^{b}	0.21±0.003^{abc}	0.64±0.00^{d}
C_2VC_0	226±0.57^{d}	26.66±0.33^{b}	0.19±0.003^{fg}	0.84±0.00^{c}
C_2VC_1	229.33±0.33^{c}	26.33±0.33^{b}	0.20±0.003^{cde}	0.85±0.00^{bc}
C_2VC_2	243.66±0.66^{b}	27±0.00^{ab}	0.22±0.006^{ab}	0.86±0.00^{b}
C_2VC_3	249.66±0.88a	28±0.00^{a}	0.23±0.005^{a}	0.95±0.00^{a}
C_3VC_0	211±0.57^{j}	20.33±0.33^{g}	0.15±0.005^{h}	0.26±0.00^{i}
C_3VC_1	215±0.57^{h}	21.66±0.33^{ef}	0.16±0.005^{h}	0.27±0.00^{hi}
C_3VC_2	220±0.57^{f}	22.66±0.33^{de}	0.18±0.005^{g}	0.28±0.00^{h}
C_3VC_3	222.66±0.33^{e}	23.66±0.33^{cd}	0.19±0.005^{def}	0.30±0.00^{g}
	***	***	***	***

***Significant at 5% level of significance

Data showed as a mean of two years data with standard error and similar letter in a column means no significant difference between them at P d" 0.05 according to Duncan Multiple Range Test

C_1: BARI Chinakopi 1; C_2: Blues; C_3: Retasi; VC_0: Recommended NPK (Control); VC_1: 80% NPK + Vermicompost 6 t/ha; VC_2: 70% NPK + Vermicompost 8 t/ha; VC_3: 50% NPK + Vermicompost 10 t/ha

promoting compounds in vermicompost improves root characteristics which in terms increased nutrient absorption, according to Vennila et al. (2012). The application of bio-organic fertilizers significantly enhances soil properties, including pH, nitrate nitrogen, and organic matter content, which in turn accumulated more mineral content in plant and Blues variety showed highest amount of nutritional content accumulation than others variety due to higher nutrient absorption and physiological behavior (Kalisz et. al., 2012)

CONCLUSION

The findings of this study indicated that the treatment combination using Blues and 50% NPK + 10 t/ha vermicompost showed the greatest and beneficial effect on the growth characteristics that contribute to yield, as well as the yield and quality parameters of Chinese cabbage. Undoubtedly, additional investigation is required in order to assess the efficacy of various vermicompost combination and reduced levels of inorganic fertilizer in region specific level and extensive field trial is required to understand appropriate level of vermicompost in the context of Bangladesh.

ACKNOWLEDGEMENT

Authors are grateful to Sher-e-Bangla Agricultural University for providing necessary assistance and Ministry of Science & Technology, Bangladesh for their research grant.

REFERENCES

Adhikari, R., Katel, S., Chhetri, P. K., Simkhada, P., Chaudhari, P., & Yadav, S. P. S. (2023). Effect of different sources of organic fertilizers on crop growth and yield of cabbage. *Journal of Agriculture and Applied Biology*, *4*(1), 83-94.

Alam, M. A. U., Hoque, M. E., Laily, U. K., Khatun, M. U. S., Islam, M. K., & Mollah, S. H. (2017). Growth and yield performance of cabbage under different combinations of vermicompost and fertilizers. *International Journal of Advanced Research in Biological Sciences*, *4*(6), 79-86.

Ali, S., & Kashem, M. A. (2018). Effect of vermicompost on the growth and yield of cabbage. *Journal of Agricultural Engineering and Food Technology*, *5*(1), 45-49.

Al-Tawarah, B., Alasasfa, M. A., & Mahadeen, A. Y. (2024). Efficacy of compost and vermicompost on growth, yield and nutrient content of common beans crop (*Phaseolus vulgaris* L.). *Journal of Ecological Engineering*, *25*(2), 215-226.

AOAC. (1994). Association of official analytical chemists. *Official Methods of Analysis*. Washington, D.C.

Biswas, A. K., Sahoo, J., & Chatli, M. K. (2011). A simple UV-Vis spectrophotometric method for determination of β-carotene content in raw carrot, sweet potato and supplemented chicken meat nuggets. *LWT-Food Science and Technology*, *44*(8), 1809-1813.

Farjana, S., Islam, M. A., & Haque, T. (2019). Effects of organic and inorganic fertilizers, and mulching on growth and yield of cabbage (*Brassica oleracea* var. *capitata* L.). *Journal of Horticulture and Postharvest Research*, *2*(2), 95-104.

Francioli, D., Schulz, E., Lentendu, G., Wubet, T., Buscot, F., & Reitz, T. (2016). Mineral vs. organic amendments: microbial community structure, activity and abundance of agriculturally relevant microbes are driven by long-term fertilization strategies. *Frontiers in Microbiology*, *7*. https://doi.org/10.3389/fmicb.2016.01446.

Gong, X., Li, S., Carson, M., Chang, S., Wu, Q., Wang, L., An, Z., & Sun, X. (2019). Spent mushroom substrate and cattle manure amendments enhance the transformation of garden waste into vermicomposts using the earthworm *Eisenia fetida*. *Journal of environmental management*, *248*, 109263.

Haque, T. (2023). Effects of application of nitrogen and vermicompost on growth performance and yield of Bari Chinashak-1 (*Brassica chinensis* L.). *Journal of Agriculture, Food and Environment (JAFE)| ISSN (online version)*: 2708-5694, *4*(3), 21-26.

Hasan, M. J., Khatun, K., Mostarin, T., Karishma, K. C., Nadim, M. K. A., & Chowdhury, S. M. A. (2024). Influence of vermicompost and biofertilizer on growth, head yield and quality of broccoli (*Brassica oleracea* L. var. *italica*). *Agricultural Science & Technology* (*1313-8820*), *16*(1).

Jadhav, A. B., Gosavi, A. B., Jadhav, S. A., & Patil, A. V. (2024). Influence of different substrates on nutrient composition of vermicompost and vermiwash. *International Journal of Plant & Soil Science*, *36*(6), 340-352.

Kalisz, A., Kostrzewa, J., Sekara, A., Grabowska, A., & Cebula, S. (2012). Yield and nutritional quality of several non-heading Chinese cabbage (*Brassica rapa* var. *chinensis*) cultivars with different growing period and its modelling. *Horticultural Science & Technology*, *30*(6), 650-656.

Najafi-Ghiri, M. (2014). Effects of zeolite and vermicompost applications on potassium release from calcareous soils. *Soil and Water Research*, *9*(1), 31-37

Nurhidayati, N., Ali, U., & Murwani, I. (2016). Yield and quality of cabbage (*Brassica oleracea* L. var. *capitata*) under organic growing media using vermicompost and earthworm *Pontoscolex corethrurus* inoculation. *Agriculture and Agricultural Science Procedia*, *11*, 5-13.

Pour, A. A., Moghadam, A. R. L. and Ardebili, Z. O. (2013). The effects of different levels of vermicompost on the growth and physiology of cabbage seedlings. *International Research Journal of Applied and Basic Sciences*, *4*(9), 2726-2729.

Reza, M. S., Islam, A. K. M. S., Rahman, M. A., Miah, M. Y., Akhter, S., & Rahman, M. M. (2016). Impact of organic fertilizers on yield and nutrient uptake of cabbage (*Brassica oleracea* var. *capitata*). *Journal of Science, Technology and Environment Informatics*, *3*(2), 231-244.

Seong, G. U., Hwang, I. W., & Chung, S. K. (2016). Antioxidant capacities and polyphenolics of Chinese cabbage (*Brassica rapa* L. ssp. Pekinensis) leaves. *Food Chemistry*, *199*, 612-618.

Shi, L., Zheng, W., Lei, T., Liu, X., & Hui, M. (2021). The effect of different soil amendments on soil properties and on the morphological and physiological characteristics of Chinese cabbage. *Journal of Soil Science and Plant Nutrition*, *21*, 1500-1510. https://doi.org/10.1007/s42729-021-00456-6.

Šimon, T., & Czakó, A. (2018). Influence of long-term application of organic and inorganic fertilizers on soil properties. *Plant Soil and Environment*, *60*, 314-319. https://doi.org/10.17221/264/2014-PSE.

Song, C., Ye, X., Liu, G., Zhang, S., Li, G., Zhang, H.,Li F., Sun R., Wang, C., Xu, D., & Zhang, S. (2023). Comprehensive evaluation of nutritional qualities of Chinese cabbage (*Brassica rapa* ssp. pekinensis) varieties based on multivariate statistical analysis. *Horticulturae*, *9*(12), 1264.

Vennila, C., Jayanthi, C., & Sankaran, V. M. (2012). Vermicompost on crop production-A review. *Agricultural Reviews*, *33*(3), 265-270.

Wang, D., Shi, Q., Wang, X., Wei, M., Hu, J., Liu, J., & Yang, F. (2010). Influence of cow manure vermicompost on the growth, metabolite contents, and antioxidant activities of Chinese cabbage (*Brassica campestris* ssp. *chinensis*). *Biology and fertility of Soils*, *46*, 689-696.

(***Received : 12.07.2024; Revised : 07.11.2024; Accepted : 12.11.2024)***