



Effect of Organic Manure and Bio Fertilizer on Growth, Yield and Quality in Cabbage

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The Department of Horticulture at the Naini Agricultural Institute Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP) conducted an experiment in 2022 to investigate the "Effect of organic manures and biofertilizers on growth, yield, and quality in cabbage (*Brassica oleraceae* L. Var. capitata)". There were ten treatments totaling various amounts of organic manure and bio-fertilizer, with water serving as the control. At 20, 40, and 60 days after transplantation, the treatment is sprayed. The plot size was kept at 2 m × 1.5 m, and each treatment was reproduced three times in a randomized block design. The best results were achieved with treatment T6 (Farm Yard Manure @20t/ha + Bio-Fertilizer (Azotobacter + PSB) each @5kg/ha). The maximum plant height (24.33 cm), the plant's spread (68.59), the number of leaves

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per plant (13.67), the average head weight (1.93 kg), the head's compactness (5.56 Kg/inch), the yield per plot (6.93 kg), the yield per hectare (71.60 t/ha), the TSS (5.9 Brix), and the amount of ascorbic acid per 100g. Under T6, the gross return (Rs 221430/ha), net profit (Rs 172530/ha), and B:C ratio (4.52) were all much greater. Overall results revealed that the application of FYM @20t/ha + Biofertilizer @5kg/ha proved to be better for different growth, yield and quality traits in cabbage.

Keywords: PSB; azotobactor; FYM; growth; yield; cabbage.

1. INTRODUCTION

Cabbage (*Brassica oleraceae* L. Var *Capitata*) is a Cole crop and belongs to the family Cruciferae or Brassicaceae having chromosome number $2n=2x=18$. It is believed to have originated from Western Europe and Mediterranean region. Cabbage is a popular vegetable in temperate, sub-tropical and tropical regions and now grown almost throughout the year. In India, Orissa, West Bengal, Karnataka, Maharashtra, Gujarat and Punjab are the major cabbage growing states.

Cabbage is a cool season crop but adapted to a wide range of climates and soils but best results are obtained in a cool environment with a monthly temperature of 13°C to 16°C and where soil is well supplied with nutrients and irrigation water.

Improved Soil Health: Organic manure and biofertilizers help improve soil structure and fertility over time. They enhance soil microbial activity, increase nutrient availability, and promote beneficial soil organisms, leading to healthier and more productive soil.

Sustainable Nutrient Management: Organic manure and biofertilizers provide a balanced mix of essential nutrients to plants. They release nutrients slowly over time, reducing the risk of nutrient imbalances and leaching. This leads to a more sustained and efficient nutrient uptake by cabbage plants.

Reduced Environmental Impact: Organic manure and biofertilizers are generally derived from natural sources and are less likely to cause pollution or harm to the environment compared to synthetic fertilizers. They promote sustainable agricultural practices and reduce the risk of nutrient runoff into water bodies.

Enhanced Plant Growth: The nutrients provided by organic manure and biofertilizers contribute to healthier plant growth. Cabbage plants grown with these inputs tend to have

larger leaves, stronger stems, and better overall vigor.

Improved Nutrient Retention: Organic matter in the soil helps retain moisture and nutrients, reducing the need for frequent irrigation and fertilization. This can lead to water conservation and a more efficient use of resources.

Disease Resistance: Some biofertilizers contain beneficial microorganisms that can suppress harmful pathogens in the soil. This can lead to reduced incidence of diseases in cabbage crops, potentially lowering the need for chemical pesticides.

Enhanced Crop Quality: Cabbage grown with organic inputs often exhibits better taste, texture, and nutritional content. This can lead to higher market value and consumer preference.

Cost Savings: While the initial cost of organic manure and biofertilizers might be higher compared to synthetic fertilizers, their long-term benefits include reduced need for additional inputs, resulting in potential cost savings for the farmer.

Long-Term Soil Improvement: Continuous use of organic manure and biofertilizers can contribute to long-term soil health and fertility. This is in contrast to synthetic fertilizers, which may degrade soil quality over time if not managed properly.

Compliance with Organic Standards: For farmers aiming to cultivate organically certified cabbage, the use of organic manure and biofertilizers is essential to meet organic farming standards and regulations.

Cabbage is rich in minerals and vitamins. It contains, vitamin-A (2000 IU), thiamine (0.06 mg) riboflavin (0.03 mg) and vitamin-C (124 mg) per 100 g edible part. It also contains minerals like potassium (114 mg), phosphorus (44 mg), calcium (39 mg), sodium (14.1 mg) and iron (0.8 mg) per 100 g of edible part. Deshpande (2004).

Organic manures are derived from decayed plant/ animal matters and are free from harmful chemicals. Bio fertilizers like Rhizobium, Azotobacter, Azospirillum and blue green algae (BGA) are extremely cost effective than the chemical fertilizers and increases crop yield by 20- 30%, replaces chemical nitrogen and phosphorus by 25% and stimulate plant growth, provide protection against drought and soil-borne diseases. Azotobacter (Nitrogenous biofertilizer) converts atmospheric nitrogen into ammonical form which is made available to plants and Phosphotica (Phosphatic biofertilizer) solubilize fixed phosphorus already in the soil and make it available to the plants. Organic manures feed the soil and maintain sustainability in the agro ecosystem. Modern agriculture based on the use of organic manures, plays major role for producing good quality and higher yielding cabbage per unit area. There is a need to seek alternative nutrient sources which could be cheap and eco-friendly so that farmers may be able to reduce the Growing of crops by the combined package of organic manures and Bio fertilizers brings forth the Organic farming which is in vogue today. Organic farming relies on ecological process, biodiversity and cycles adapted to the local conditions, rather than the use of inputs with adverse effects. It combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved.

2. MATERIALS AND METHODS

At the Horticultural Research Field, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj (25.4358° N latitude, 81.8463° E longitude), India. This experiment was conducted during the rabi season of 2022. The Prayagraj district is part of the subtropical zone in southeast Uttar Pradesh, which has very hot summers and moderately mild winters. The location's maximum temperature can reach 46°C to 48°C and hardly ever drops below 4°C or 5°C. The relative humidity varies from 20% to 94%. In this region, there are roughly 1013.4 mm of yearly rainfall.

The field experiment was conducted using randomized block design with three replications with and laboratory experiment was conducted using complete randomized design with four replications and nine treatments. The experimental field was divided into three blocks

of equal size. That is of 1.5m x 1.5m and ten plots were there and having a spacing of 60cm x 45cm.

Chart 1. treatments were as follows

Notation	Treatment
T1	Farm Yard Manure (FYM) @ 20t/ha
T2	Vermicompost @ 5t/ha
T3	Neem cake @ 2t/ha
T4	Poultry Manure @ 5t/ha
T5	Bio-Fertilizers (Azotobacter + PSB) each @ 5kg/ha
T6	Farm Yard Manure + Bio-Fertilizer
T7	Vermicompost + Bio-Fertilizer
T8	Neem cake + Bio-Fertilizer
T9	Poultry Manure + Bio Fertilizer
T10	Control

Data on growth, flowering behaviour and yield contributing attributes were collected from randomly selected 5 plants for each treatment in each replication on the parameters Plant Height, Plant Spread, Number of leaves, Head Polar Diameter, Head equatorial diameter Average head weight, Marketable head yield/plot(kg), Marketable head yield/ha(kg)TSS, Ascorbic acid, Head compactness. Collected data from each experiment were statistically analyzed as per design of experiment.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height

The plant height at 60 DAT per plant ranged from 16.33 to 24.33 cm. The maximum number of primary branches per plant was recorded under treatment T6–FYM @20 t/ha + Biofertilizer (Azotobacter + PSB) each 5kg/ha is 24.33 cm. the impact of organic manure and biofertilizers on the growth of cabbage. The researchers found that organic manure, when combined with biofertilizers containing beneficial microorganisms, significantly increased plant height compared to control groups. The improved nutrient availability and root development provided by the biofertilizers likely contributed to enhanced plant height. Similar findings were reported by Chatterjee R., Bandhopadhyay S. and Jana J.C. [1].

3.1.2 Plant spread

At 60 DAT the significantly highest plant spread was observed in T6 (68.59 cm) and the lowest was obtained in T10 (58.89 cm). Several studies have shown that the application of organic

Table 1. Effect of organic manure and bio fertilizers on growth, yield and quality parameters in cabbage

Treatment	Head Polar Diameter	Head Equatorial Diameter	Avg. Head Weight	Marketable Head Yield Plot/kg	Yield/ha	TSS	Ascorbic Acid	Head Comp actness	Plant Height 60DAT	Plant Spread 60DAT	No. of Leaves 60DAT
T1	18.61	19.18	1.1	6.1	15.99	5.56	34.6	4.93	22.33	60.13	12
T2	17.88	18.50	1.2	6.2	14.95	5.33	34.46	5.16	23	62.63	12.66
T3	17.66	18.25	1.33	6.33	16.14	5.2	35.36	4.86	21.33	63.09	12.66
T4	17.26	18.06	1.53	6.53	16.81	5.16	34.53	5.16	20	64.20	11.66
T5	19.23	20.02	1.56	6.56	16.66	5.5	34.33	4.96	22	62.61	11.33
T6	20.93	21.25	1.93	6.93	22.14	5.9	38	5.56	24.33	68.59	13.66
T7	18.75	19.63	1.3	6.3	19.62	5.7	37	5.26	21	65.03	11.33
T8	18.32	19.25	1.067	6.06	18.43	5.36	36.03	5.2	19.33	59.91	12.66
T9	17.92	18.73	1.167	6.16	17.99	5.3	35.16	4.93	19	60.25	12.33
T10	15.88	16.3	0.9	5.9	12.73	5.1	33.33	4.6	16.33	58.89	9
F-test	S	S	S	S	S	S	S	S	S	S	S
SE(d)	0.069	0.06	0.13	0.13	0.83	0.10	0.58	0.09	0.8	0.15	0.8
C.D	0.14	0.13	0.28	0.28	1.75	0.22	1.23	0.19	1.69	0.33	1.69
C.V	0.46	0.41	12.64	2.62	5.92	2.39	2.03	2.25	4.69	0.11	8.20

manure and biofertilizers improves nutrient availability in the soil. Nutrients such as nitrogen, phosphorus, and potassium play crucial roles in promoting lateral shoot development and branching, leading to increased plant spread. Similar findings were reported by Chaudhary, S. K. Yadav S. K. Mahto D. K Sharma R. P. and Kumar Mahesh. [2].

3.1.3 No. of leaves

At 20 DAT the significantly maximum number of leaves was observed in T₆ (7.66) and the lowest was obtained in T₁₀ (4). At 40 DAT the significantly maximum number of leaves was observed in T₆ (11.33) and the lowest was obtained in T₁₀ (7.66). At 60 DAT the significantly maximum number of leaves was observed in T₆ (13.66) and the lowest was obtained in T₁₀ (9). The marked increase in growth characters might be due to the possible stimulation of meristematic tissues by auxin accelerating greater cell division and cell enlargement in growing portions. Findings are in accordance with the findings of Pawar Rohit and Barkule Santosh. [3].

3.2 Yield Parameters

3.2.1 Head polar diameter

The number of fruits per plant with maximum is recorded (20.93) at T₆-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum control at T₁₀ (15.88). Combining organic manure and biofertilizers can have synergistic effects, maximizing nutrient availability and fostering healthy plant growth. Keep in mind that factors like proper irrigation, pest management, and suitable cabbage varieties also influence head diameter. Consulting local experts and conducting trials tailored to your conditions can provide specific insights. Similar findings were seen by Mhaske M.G., Ziauddin S., Kalalbandi B.M. and Saitwal Y.S. [4].

3.2.2 Head equatorial diameter

The maximum head equatorial diameter (21.25) was found in T₆-FYM @20t/ha + Biofertilizer @5kg/ha and the minimum average head equatorial diameter (16.3) was observed in control plants (T₁₀). Synergistic effects from combining organic manure and biofertilizers can increase nutrient availability and promote wholesome plant growth. Remember that factors like effective pest control, proper irrigation, and the right cabbage cultivars all affect head diameter. Specific insights can be gained by

consulting regional authorities and performing experiments catered to your circumstances. Similar findings were seen by Meena Kusum, Ram R.B., Meena M. L., Meena J.K. and Meena D. C. [5].

3.2.3 Average head weight (kg)

The average head weight with maximum is recorded (1.93 kg) at T₆-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum control at T₁₀ (0.9 kg). The right application rates, timing, and interaction with other agronomic methods are necessary to get the best outcomes. Cabbage head weight is also greatly influenced by elements including irrigation, insect control, and choice of cabbage variety. Similar findings were seen by Choudhary, Santosh, Soni, A.K. and Jat, N.K. [6].

3.2.4 Marketable head yield/plot

The yield per hectare (t/ha) with maximum is recorded (6.93) at T₆. While the minimum control at T₁₀ (5.9). The possible reason for increased fruit yield might be associated to better inorganic nitrogen utilization in the presence of bio fertilizers, which enhanced biological nitrogen fixation, better development of root system and possible higher synthesis of plant growth hormones. Similar trend of work has been noted by Reza Md. Selim, Islam A. K. M. Sajjadul, Rahman Md. Asif, Md. Yunus Miah, Akhter Sohela and Rahman [7].

3.2.5 Marketable head yield/ha

The yield per hectare (t/ha) with maximum is recorded (22.14) at T₆-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum control at T₁₀ (12.73). The possible reason for increased fruit yield might be associated to better inorganic nitrogen utilization in the presence of bio fertilizers, which enhanced biological nitrogen fixation, better development of root system and possible higher synthesis of plant growth hormones. Similar trend of work has been noted by Devi K. Babyshila and Singh N. Irabanta [8].

3.2.6 Total soluble solid (⁰brix)

The maximum TSS (5.9 Brix) was recorded on T₆, T₆-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum TSS (5.1 Brix) recorded in T₁₀ Control.

Total soluble solids (T.S.S.), quality of solids, dissolved in the liquid part of cabbage were observed to be increased after treatment with bio fertilizers. These findings are in close conformity with the increased in quality due to application of bio-fertilizer and nitrogen, phosphorus and potassium could be attributed to the enhanced photosynthetic and metabolic activities, which resulted in the synthesis of higher amount of acids, metabolites, and glucose. These reserves ultimately contributed synthesis of TSS in cabbage Negi Ekta, Punetha Shailaja, Pant S.C., Kumar Sandeep, Bahuguna Pankaj, Mekap Bengia and Nautiyal B.P. [9].

3.2.7 Ascorbic acid (mg/ 100g)

The data revealed that, ascorbic acid (38 mg/100g) was significantly increased by application of treatment T₆ at par with the treatments. The lowest ascorbic acid (33.33 mg/100g) was recorded in treatment T₁₀ control. Raghav, M. and Shashi Kamal [10].

3.2.8 Head compactness(kg/ha)

The head compactness was recorded significantly higher (5.56) from T₆-FYM @20t/ha + Biofertilizer @5kg/ha at higher rates as compared to all the remaining treatments. The compactness of head was decreased significantly under the lower rates of organic manures and bio-fertilizers combination [11]. The treatment T₁₀ (T₁₀-Control) recorded the significantly less compact of head (4.6). Upadhyay, A.K.; Anant Bahadur; Jagdish Singh. [12].

4. CONCLUSION

From the above experiment finding it may be concluded that the effect of organic manure and bio-fertilizer in growth, yield and quality in cabbage treatment of Farm yard manure+ Bio-fertilizer that is T₆(FYM@20t/ha+ Bio-fertilizer (Azotobacter+PSB) each @5kg/ha was found to be best in the terms of growth viz, plant height, plant spread and no. of leaves and in terms of yield viz, average head weight, Yield per plot, Yield per Hectare and in terms of quality viz, TSS and ascorbic acid, T₆ is best. In terms of benefit-cost ratio T₆ is found to be the best amongst all the treatments.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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