Original Research Article

EFFECT OF ORGANIC MANURE AND BIO FERTILIZER ON GROWTH, YEILD AND QUALITY IN CABBAGE

Abstract

An experiment was conducted during 2022 to study the **"Effect of organic manures and biofertilizers on growth and yield in cabbage"** at

Vegetable farm, Department of Horticulture, Naini Agricultural Institute Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj (UP). There were 10 treatments consisting of different attributes of organic manure and bio-fertilizer and water was used as control. The treatment is spayed at 20, 40 and 60 days after transplanting. All the treatments were replicated three times in a randomized block design keeping the plot size 2m x1.5m. The treatment T_6 (Farm Yard Manure @20t/ha + Bio-Fertilizer (Azotobacter + PSB) each @5kg/ha) found the best performances. The maximum Plant height (24.33 cm), plant spread (68.59) Number of leaves per plant (13.67), head polar dimeter (20.93), head equatorial diameter (21.25), average head weight (1.93 kg), head compactness (5.56 Kg/inch), yield per plot (6.93 kg), yield per hectare(71.60 t/ha), TSS(5.9 Brix), Ascorbic acid per (38 mg/100g).The significantly higher gross return (Rs 221430/ha), net profit (Rs 172530/ha) and B:C ratio (4.52) was recorded under T_6. 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*

Introduction

Cabbage (*Brassica oleraceae* L. Var C*apitata*) is a Cole crop and belongs to the family Cruciferae or Brassicaceae having chromosome number2n=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 13^0C to 16^0C 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 gedible 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 andeco-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.

Material 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 : Ten treatments were as follows.

Notation	Treatment
T_1	Farm Yard Manure (FYM) @ 20t/ha
T_2	Vermicompost @ 5t/ha
T_3	Neem cake @ 2t/ha
T_4	Poultry Manure @ 5t/ha
T_5	Bio-Fertilizers (Azotobacter + PSB) each @ 5kg/ha
T_6	Farm Yard Manure + Bio-Fertilizer
T_7	Vermicompost + Bio-Fertilizer
T_8	Neem cake + Bio-Fertilizer
T_9	Poultry Manure + Bio Fertilizer
T_{10}	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.

Result and Discussion

Growth Parameters

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 T_6–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. (2014).**

Plant Spread

At 60 DAT the significantly highest plant spread was observed in T_6 (68.59 cm) and the lowest was obtained in T_{10} (58.89 cm). Several studies have shown that the application of organic 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. (2018).**

No. of Leaves

At 20 DAT the significantly maximum number of leaves was observed in T_6 (7.66) and the lowest was obtained in T_{10} (4). At 40 DAT the significantly maximum number of leaves was observed in T_6 (11.33) and the lowest was obtained in T_{10} (7.66).At 60 DAT the significantly maximum number of leaves was observed in T_6 (13.66) and the lowest was obtained in T_{10} (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. (2017)**

Yield Parameters

Head Polar Diameter

The number of fruits per plant with maximum is recorded (20.93) at T_6-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum control at T_{10} (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. (2011)**

Head Equatorial Diameter

The maximum head equatorial diameter (21.25) was found in T_6-FYM @20t/ha + Biofertilizer @5kg/ha and the minimum average head equatorial diameter (16.3) was observed in control plants (T_{10}). 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. (2017)**

Average Head Weight (kg)

The average head weight with maximum is recorded (1.93 kg) at T_6-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum control at T_{10} (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. (2012)**

Marketable head yield/plot

The yield per hectare (t/ha) with maximum is recorded (6.93) at T6. While the minimum control at T_{10} (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. (2016)**

Marketable head yield/ha

The yield per hectare (t/ha) with maximum is recorded (22.14) at T_6-FYM @20t/ha + Biofertilizer @5kg/ha.While the minimum control at T_{10} (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. (2012)**

Total soluble solid (^{0}brix)

The maximum TSS (5.9 Brix) was recorded on T_6, T_6-FYM @20t/ha + Biofertilizer @5kg/ha. While the minimum TSS (5.1 Brix) recorded in T_{10} 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. (2017).**

Ascorbic acid (mg/ 100g)

The data revealed that, ascorbic acid (38 mg/100g) was significantly increased by application of treatment T_6 at par with the treatments. The lowest ascorbic acid (33.33 mg/100g) was recorded in treatment T_{10} control. **Raghav, M. and Shashi Kamal (2007)**

Head compactness(kg/ha)

The head compactness was recorded significantly higher (5.56) from T_6-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. The treatment T_{10} (T_{10}-Control) recorded the significantly less compact of head (4.6). **Upadhyay, A.K.; Anant Bahadur; Jagdish Singh. (2012**

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 Compactness	Plant Height 60DAT	Plant Spread 60DAT	No. of Leaves 60DAT
T_1	18.61	19.18	1.1	6.1	15.99	5.56	34.6	4.93	22.33	60.13	12
T_2	17.88	18.50	1.2	6.2	14.95	5.33	34.46	5.16	23	62.63	12.66
T_3	17.66	18.25	1.33	6.33	16.14	5.2	35.36	4.86	21.33	63.09	12.66
T_4	17.26	18.06	1.53	6.53	16.81	5.16	34.53	5.16	20	64.20	11.66
T_5	19.23	20.02	1.56	6.56	16.66	5.5	34.33	4.96	22	62.61	11.33
T_6	20.93	21.25	1.93	6.93	22.14	5.9	38	5.56	24.33	68.59	13.66
T_7	18.75	19.63	1.3	6.3	19.62	5.7	37	5.26	21	65.03	11.33
T_8	18.32	19.25	1.067	6.06	18.43	5.36	36.03	5.2	19.33	59.91	12.66
T_9	17.92	18.73	1.167	6.16	17.99	5.3	35.16	4.93	19	60.25	12.33
T_{10}	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**

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 T_6(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, T_6 is best. In terms of benefit-cost ratio T_6 is found to be the best amongst all the treatments.

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