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Impact of various organic manures on yield, yield attributes and economics of cabbage

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Abstract :

The thesis titled "Impact of various organic manures on yield, yield attributes, and economics of cabbage" aims to evaluate the effects of different organic manures on the growth, yield, and economic performance of cabbage. Organic farming has become increasingly popular due to its potential environmental and human health benefits. Therefore, the study assessed the suitability of various organic manures for cabbage production.

The study was conducted in a randomised complete block design with seven treatments, including Farm yard manure, poultry manure, vermicompost, vermicompost + azotobacter, Farm yard manure + azotobacter, poultry manure + azotobacter and a control. The study evaluated cabbage growth and yield parameters, such as plant height, number of leaves, head diameter, weight, and total yield. The economic analysis included the cost of cultivation, net returns, gross return, selling price and benefit-cost ratio.

The study's results indicated that using organic manures significantly influenced cabbage growth, yield, and economic performance. The highest yield was observed in the treatment with poultry manure, followed by farmyard manures and vermicompost. Using organic manures also significantly improved plant height, head diameter, and weight.

Economic analysis revealed that using organic manures significantly increased cabbage production's net returns and benefit-cost ratio. Poultry manure had the highest net returns, followed by cow dung and vermicompost.

In conclusion, the study provides valuable insights into using organic manures for cabbage production. Farmers, policymakers, and decision-makers can use the study's findings in the agriculture sector to promote sustainable and profitable cabbage production.

Keyword : organic manures, fym, vermicompost, poultry manure, plant growth parameters, yield.

1 Introduction :

Brassica Oleracea is known as cabbage. The word *Brassica* mean is closely related to Broccoli and cauliflower. It generally belongs to the family *Cruciferae* and the genus *Brassica*. It has a somatic chromosome number 2n = 18. Since ancient times, people have grown this leafy vegetable. Cabbage comes in various colours, including red, green, savoy, and Chinese cabbage. Dietary fibre and manganese are all in cabbage in reasonable amounts, along with the vitamins C, K, and B6. Numerous phytochemicals that may be beneficial to health are also present. While raw cabbage can be used in salads or slaws, it is most frequently eaten cooked.

It is believed that cabbage originated in the regions that are today Iran, Turkey, and Iraq. Cabbage has been farmed since antiquity. One of the earliest vegetables to be produced, there is documentation of its cultivation from 4000 BC. Cabbage is a hardy vegetable. It is simple to grow and may be grown in various soils. It grows well in cool climates and can be planted in spring or fall (*Saha 2021*). Early spring is often the time for planting cabbage, and late summer or early fall is for harvest. Giving the plant enough water, nutrition, and protection from common pests is critical when growing cabbage.

It is regarded as one of the most well-known vegetables in the world and a nutritional powerhouse. It may be consumed raw and is a fantastic supplement to any diet. Cabbage is a rich source of vitamins and minerals. Vitamins C, K, and B6 and considerable calcium, magnesium, and potassium are present. It is also a good dietary fibre, manganese, and folate source. These vitamins and minerals are essential for promoting health and helping to avoid disease.

According to its low calories and fat content, cabbage is a fantastic option for weight loss. It has a small number of antioxidants that aid in defending the body from the harm that free radicals may do. Consuming cabbage can also lessen inflammation, which may help lower the chance of developing several chronic conditions.

The phytochemicals found in cabbage, which may have health advantages, are abundant. These contain indole-3-carbinol and sulforaphane, which may help prevent cancer and lower the risk of some malignancies. Additionally, cabbage has a lot of dietary fibre, which supports a healthy digestive system. Fibre can aid with blood sugar management and lower cholesterol levels. Diabetes sufferers may benefit from this.

Cabbage is a rich source of antioxidants, which may help protect the body from harm caused by free radicals. Unstable chemicals called free radicals can harm tissues and cells. Consuming cabbage may help lower inflammation and the chance of developing cancer.

It is a very old vegetable that has reportedly been grown in the Mediterranean since the 1600s. Historically, cabbage has been a significant food crop because of its toughness and adaptability. Because it is a great source of fibre, vitamins, and minerals, it is a great choice for a healthy diet (Saha and Dutta, 2021).

Cabbage is a cool-weather crop and can be grown in many climates. It is a hardy vegetable and can tolerate some frost and light freezes. Early varieties of cabbage are generally ready for harvest in about 70-90 days, while later types may take up to 120 days. Most cabbage varieties can be planted either from seeds or transplants. As soon as the soil can be handled in the early spring, cabbage can be planted directly in the garden (*Ansari et al., 2020*). The soil must be moist and lightly fertilised to achieve a decent crop. Transplanting is usually done for early varieties, giving the plants a head start.

It's important to let the cabbage plants grow until the heads are solid and grown before picking them. Before packaging, cutting off the plant heads with scissors or a blade is essential since they may contain dirt and bugs. Cabbage can be kept in a cold, dark location for up to two weeks. When preparing cabbage, it may also be frozen to lengthen its shelf life; it removing any wilted or broken leaves before cooking is important Vitamin C, vitamin K, manganese, and dietary fibre are just a few of the vitamins and minerals that cabbage is a great source of. Furthermore, it includes phytochemicals that might positively affect health, such as reducing inflammation and improving heart health (Singh et al., 2022).

Cabbage may be prepared in a variety of ways. It may be used raw in salads or cole slaw, steamed or stir-fried as a side dish, or cooked in soups and stews. Additionally, it may be used for pickling and fermenting and incorporated into dishes like tacos or egg rolls. Cabbage is a flexible and robust crop that is easy to grow, provides nutrition, and improves the flavour of several dishes. Proper planting, fertilising, and harvesting may be a great addition to any garden.

Cabbage is a widely grown annual crop across India, the country's second-largest vegetable producer after China. Notable states that produce cabbage include West Bengal, Madhya Pradesh, Orissa, Bihar, Gujrat, Assam, Jharkhand, Haryana, Uttar Pradesh, and Chhattisgarh. West Bengal is the highest producer, contributing approximately 2,341.87 tonnes per year, amounting to about 24.38% of India's total production (apeda.gov.in).

Chemical fertiliser is an essential component of cabbage production, as it helps ensure the crop has access to the nutrients it needs for healthy growth. However, despite being a necessary component of cabbage production, overuse of chemical fertilisers can harm the crop. Numerous elements, including nitrogen, phosphorus, and potassium, are found in chemical fertilisers and are crucial for the healthy growth of cabbage. However, when too many of these nutrients are applied, the crop can become over-fertilized, decreasing yield and quality. Excessive nutrient application can also cause a build-up of salts in the soil, leading to reduced water availability, resulting in stunted growth and poor crop quality.

In addition, over-fertilisation of cabbage can increase disease and pest pressure, as the excess nutrients can create an ideal environment for pests and diseases to thrive. Chemical fertilisers also tend to be short-lived, meaning that the nutrients are quickly leached out of the soil and are unavailable for the plant to use. This can lead to nutrient deficiencies in the crop, resulting in poor growth and reduced yields. Furthermore, overuse of chemical fertilisers can cause environmental damage, as the nutrients can leach into nearby water sources, resulting in increased levels of nitrogen and phosphorus in the water. Eutrophication, which occurs when water loses its ability to support aquatic life due to oxygen depletion, can result in the proliferation of algae (*Pandey et al., 2017*).

Cabbage producers should apply the proper amount of fertiliser at the appropriate time to minimise the potential harm from over-fertilisation. Fertiliser should be applied according to soil testing results and over time rather than all at once. Additionally, organic fertilisers, such as compost and manure, should be used in conjunction with chemical fertilisers, as they provide a slow-release source of nutrients that are better able to sustain the crop over the long term. Overall, chemical fertilisers can benefit cabbage production as long as they are applied correctly and at the right time. Excessive chemical fertilisers can lead to decreased yields and quality, increased disease and pest pressure, and environmental damage, so cabbage producers need to be mindful of their fertiliser application. Combining chemical and organic fertilisers and following soil testing results, cabbage producers can ensure that their crop receives the nutrients it needs for healthy growth while avoiding the drawbacks associated with over-fertilisation.

Organic farming is essential compared to chemical farming in cabbage for several reasons. Firstly, organic farming eliminates synthetic pesticides, herbicides and fertilisers, which can be toxic to humans and the environment. These chemicals can also contaminate the soil, water and air, leading to health issues like cancer. Additionally, organic farming encourages beneficial insects and natural predators to control pests and diseases, which is better for the environment as it reduces the number of harmful chemicals used. Finally, organic farming also increases the product's nutritional value as it is grown without synthetic fertilisers, which can reduce the nutrient content of the crop. Organic farming also helps to preserve the biodiversity of the environment. As organic agriculture relies on natural methods, it encourages crop rotation and biological pest control, which helps maintain the local ecosystem's natural balance. This is especially beneficial for cabbage, as it promotes the growth of beneficial insects and natural predators, which helps to protect the cabbage from pests and diseases. Additionally, organic farming helps preserve the soil, as it does not use synthetic fertilisers, which can damage the soil structure and lead to nutrient depletion.

Produce grown using organic methods is often healthier. Organic farming avoids using synthetic fertilisers, which can reduce the crop's nutritional content. Crop rotation and organic pest management are also important components of organic farming, which lowers the danger of disease and pest contamination. This ensures that the product is safe and devoid of toxins or dangerous ingredients. Finally, organic farming contributes to environmental protection. The domain's danger of contamination is greatly decreased if synthetic pesticides, herbicides, and fertilisers are abolished. By doing this, pollutants that might harm the environment is less likely to be discharged into the air and water. Additionally, because organic farming promotes the use of natural methods, it also aids in reducing the amount of trash generated. It helps to reduce the amount of garbage produced. In conclusion, organic farming is preferable to chemical farming in cabbage for several reasons. Synthetic pesticides, herbicides, and fertilisers are eliminated in organic farming, which is safer for both the environment and people. Additionally, it enables the development of healthier products and aids in maintaining the biodiversity of the soil and climate. Finally, organic farming contributes to environmental protection by lowering pollution, waste production, and the danger of disease and insect infestation.

The current research on the topic '**Impact of various organic manures on yield, yield attributes, and economics of cabbage'** was undertaken with the following aims and objectives.

- To study the effect of different organic manures on growth, yield attributes and yield of cabbage.
- To work out the economical viability of different treatments in cabbage.

2 Research and Methodology :

During the Rabi season of 2022–2023, the current study, titled **"Impact of various organic manures on yield, yield attributes and economics of cabbage,"** was conducted. This chapter presents specifics of the tools utilised, and procedures used throughout the experiment.

2.1 Location :

At the Amity University Organic Farm in Noida, Uttar Pradesh, which is situated at 28.5440° N and 77.3330E longitudes and the experiment took place during the Rabi season of 2022-2023, at an altitude 200 m above sea level.

2.2 Climate :

Noida, located in Uttar Pradesh, India, has a semi-arid, subtropical climate characterised by hot and dry summers and chilly winters. The region falls under the "Trans Gangetic plains" agro-climatic zone. The months of May and June are the warmest, with maximum temperatures typically ranging from 40°C to 45°C. The coldest month is January, when minimum temperatures typically dip between 4°C and 7°C. From February to June, it progressively increases before declining as the southwest monsoons approach modestly. The mean maximum temperature was 35.21°C, and the lowest was 23.74°C throughout the trial period. Monsoon rainfall totalled 141.26 mm. The average amount of sunlight each day was roughly 4.0 hours. The mean relative humidity (RH) was 60.5% during the experiment. The weather-related data were gathered from the Indian Meteorological Department, Faridabad (UP), during the experimental period.

2.3 Weather During Crop Season (2022-2023) :

The maximum and lowest temperatures were personally recorded, while the regular meteorological daily data for the crop season (01-12-2022 to 30-04-2023) were given from the visual climates' website. Throughout the growing season, the daily maximum air temperature varied from 28.0 to 35.50C, while the daily minimum temperature ranged from 14.0 to 24.50C. The humidity levels ranged from 55 to 67% of the daily average.

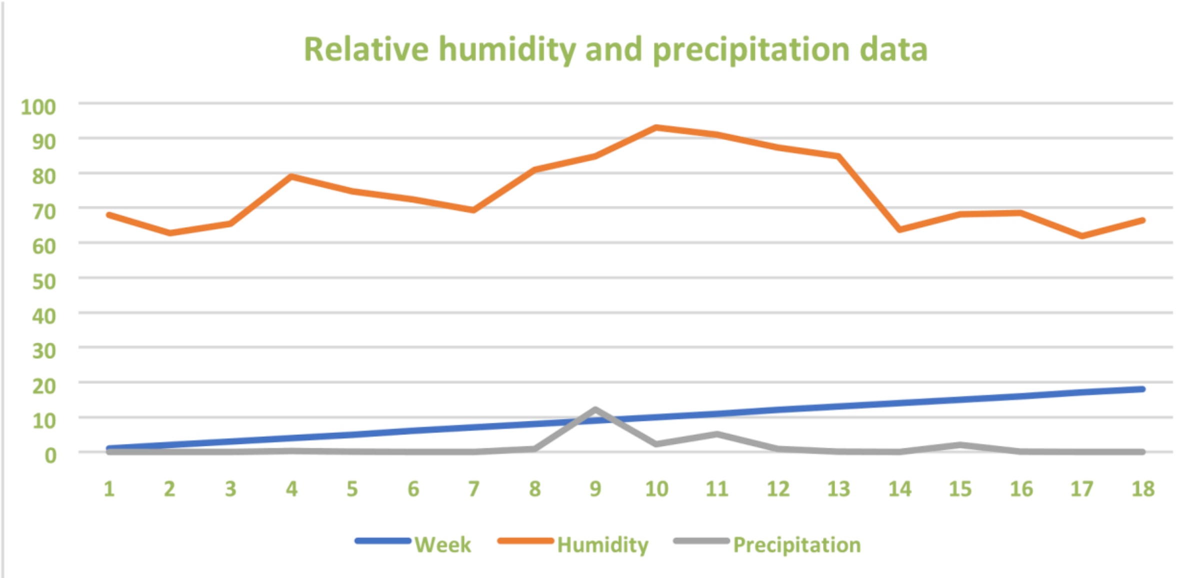


Fig 2.1 Weekly meteorological data during rabi season 2022-23

2.4 Status Of Experimental Soil :

Soil samples were gathered from a depth of 15 to 30 cm and tested to determine the initial physicochemical condition of the soil (Table 3.4). The soil had a sandy loam texture because it included 62.20% sand, 11.00% silt, and 24.20% clay. Both total N (0.045%) and organic carbon (0.60%) were in poor condition. Although the range of the available K was in the centre, the status of the available P was likewise poor. The soil's pH was a little bit alkaline. The field was level, even in topography, and had a respectable drainage system.

Table 2.1 Mechanical and chemical properties of soil

Mechanical properties

S. no	**Particulars**	**Values**
1	Sand%	62.20
2	Silt%	11.00
3	Clay%	24.20

Chemical properties

S. no	**Particulars**	**values**
1	carbon %	0.60
2	N %	0.045
3	Available N (kg/ha)	179.55
4	Available P (kg/ha)	19.70
5	Available K (kg/ha)	263.30

6	pH (1:2.5 soil to water)	8.40
7	Electrical conductivity (ds/m) at 25 ^{0}C	0.98

2.5 CROPPING HISTORY OF THE EXPERIMENTAL FIELD:

Various crops, including maize, brinjal, soybean, tomato, cowpea, and most recently, peas, have been grown in the experimental field in the past. The long list of crops cultivated on the experimental field soil the previous year is shown in the table below.

Table 2.5.1 Cropping history of the experimental field :

Year	**Kharif Crop rotation**	**Rabi crop rotation**
2019	Maize	Brinjal
2020	Soyabean	Tomato
2021	Cowpea	Spinach
2022	Cauliflower	Peas

2.6 EXPERIMENTAL DETAILS :

The details of the experiment conducted during the year 2022-2023 are as under:

Treatment details :

Table 2.6.1 - The treatment details of the experiment is mentioned in the table below:

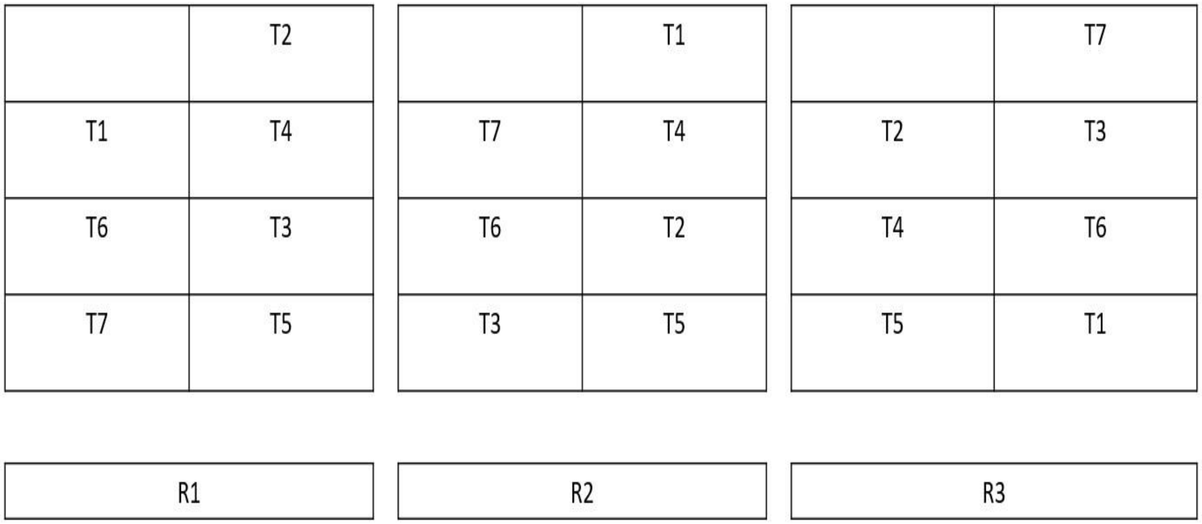
Sr. no	**Treatments**
1	**VERMICOMPOST**
2	**FYM**

3	**POULTRY MANURE**
4	**VERMICOMPOST + AZOTOBACTER**
5	**FYM + AZOTOBACTER**
6	**POULTRY MANURE + AZOTOBACTER**
7	**CONTROL**

2.7 Experiment : "Identification and evaluation of mustard genotypes for agronomic performance"
Experimental layout :

Crop:	Cabbage (*Brassica oleracea*)
Family:	Brassicaceae
Year of Experiment	2022-2023
Season:	Rabi
Design	RBD
Treatment	7
No. of replications	3
Date of nursery sowing	10 December 2022
Date of Transplanting	23 December 2022
Sowing method	Transplanting method
Number of plots	21
Each Plot size:	2.5 cm × 2 cm
Date of Harvesting:	23 March 2023
Location:	Amity Institute of organic agriculture, Noida (UP)

2.8 PLOT LAYOUT :



2.9 Cultural Operations :

All of the prescribed cultural and intercultural practices for oil seed crops were adhered to throughout the trial. During the growth phase of the crops, we frequently performed hand weeding to maintain weed-free beds. Additionally, irrigation was conducted as required. Please refer to the table below for the schedule of cultural practices implemented throughout the experiment.

Table 2.9.1- Scheduling Of The Cultural Operations In The Experiment :

S. NO	Cultural operations	Date of operation	Remarks
1.	Ploughing, planking and harrowing.	21/12/2022	Manually
2.	Layout and preparation of beds.	21/12/2022	Manually
3.	Manures Application	22/12/2022	Manually
4.	Transplanting	23/12/2022	Manually
5.	Weeding	18/01/2023 16/02/2023	Manually
6.	Irrigation	23/12/2022 14/01/2023 18/02/2023	Manually
7.	Date of Harvesting	23/03/2023	Manually

2.10 Cultural practices :

The details of cultural operations performed during crop season are as under.

2.10.1 Seedbed preparation :

The stubble was removed after physically tilling the field to a fine tilth. The field was then divided into several plots according to the necessary ratios.

2.10.2 Time and Method of Sowing :

The seedling was transplanted on 23 December 2022. The method of sowing was the transplanting method.

2.10.3 Application of organic manure :

As needed for the treatment, organic manures were administered in the experiment as a base dose before seed sowing. The organic manures employed as the treatments are vermicompost, FYM, poultry manure, vermicompost + azotobacter, FYM + azotobacter, and poultry manure + azotobacter, and they were weighed separately for each plot and applied as necessary.

2.10.4 Irrigation :

After sowing the seedlings, the first irrigation was administered. To ensure consistent soil hydration, subsequent irrigations were given at regular intervals. This was done as per protocol 3.10.5. After sowing the seedlings, the first irrigation was administered. To ensure consistent soil hydration, subsequent irrigations were given at regular intervals.

2.10.5 Weeding :

Weeds were kept out of the experiment plot throughout the crop growth period. During the cabbage crop's growing phase, seven weeding operations were performed.

2.10.6 Harvesting of the crop :

the harvesting of crops was done on 23/03/2023.

2.11 Observation recorded.

Each plot has seven plants that were chosen at random and labelled. All morphological observations about crop growth and productivity were made using these plants. The entire net plot was taken into account when recording the observation, such as

A) Growth parameters

- Plant height (cm)
- No. outer leaf
- Head diameter (cm)

B) Yield parameters

- Head weight (kg)
- Total yield (kg)

C) Economic studies

- Cost of cultivation
- Gross returns
- Net returns
- Benefit-cost ratio

2.12 Plant Growth Studies :

Observing the developing plant's behaviour under the influence of various treatments was necessary to probe deeper into the mechanisms of plant growth and development. Five sound, healthy plants were randomly selected, and they were each given a tag that was to be used to identify them. At intervals of 15 days, these chosen plants were periodically seen and noted. Indicators such as the number of plants, branches, plant height, and accumulation of dry matter were utilised to assess the impact of various treatments on plant growth.

2.12.1 Plant height :

- Choose the right time: Before taking measurements, wait until the cabbage plant has grown sufficiently tall. This is typically after the plant has developed a few leaves and a recognisable stem.
- Use a measuring tape: A measuring tape is the most accurate tool for measuring plant height. Hold the tape measure vertically next to the cabbage plant, then extend it to the top. Record the measurement in inches or centimetres.
- Measure from the soil surface: Place the measuring tape at the soil surface and measure up to the highest point of the plant. This will give you an accurate measurement of the total height of the cabbage plant.
- Measure multiple plants: Better To represent the overall height of your cabbage crop, measure multiple plants from different areas of the field or garden. Take several measurements per plant and then average the results to get an overall height for each plant.
- Repeat the process: Take regular measurements of your cabbage plants to track their growth and development over time. This will help you identify any issues that may be affecting their growth and make adjustments as needed.

3.12.2 Number of outer leafs :

- We start by selecting the cabbage that we want to measure. Ensure it is a mature cabbage and has not been stripped of its outer leaves.
- Carefully remove the outer leaves of the cabbage one by one, starting from the outside and working your way inwards. Be gentle and avoid damaging the leaves as you remove them.
- Once we removed all the outer leaves, count the number of leaves we have taken off. This number will give you the total number of outer leaves on the cabbage.

3.12.3 Leaf area :

- Select representative cabbage plants for sampling. Ideally, you should choose similar plants in size and growth stage.
- Harvest the entire plant, including the roots, and remove damaged or diseased leaves.

- Cut each leaf from the plant at the base of the petiole (the stalk that attaches the leaf to the stem).
- Place the leaves in a plastic bag and label the bag with the plant identification and the date.
- Take the bagged leaves to a laboratory or a Dry room with controlled temperature and humidity conditions.
- Weigh the entire bag of leaves and record the weight.
- Spread the leaves out on a flat surface and take digital images or photocopies of the leaves.
- To accurately determine the total leaf area of cabbage leaves, one can utilise image analysis software or a leaf area meter.
- Calculate the leaf area per plant by dividing the total leaf area by the weight of the bagged leaves.
- Repeat multiple plants' sampling and measuring process to obtain a representative sample size.

2.12.4 Head diameter :

- Choose a cabbage: Select a mature cabbage with a well-formed head.
- Prepare the cabbage: Remove any outer leaves that may be damaged or wilted. Cut the stem off the bottom of the cabbage to sit flat on a cutting board.
- Get a ruler or measuring tape: Use a ruler or measuring tape with millimetre or centimetre markings.
- Measure the diameter: Place the cabbage on a cutting board or other flat surface. Use the ruler or measuring tape to measure the widest part of the cabbage head, which is usually near the bottom of the head. Measure from one side of the head to the other, passing through the centre of the head.
- Record the measurement: Write down the measurement in millimetres or centimetres.

2.12.5 Plant weight :

- Select a cabbage that you want to measure the weight of. Look for a firm cabbage that is heavy and has tightly packed leaves.
- Use a sharp knife to cut off the stem of the cabbage as close to the base as possible. This will allow you to get an accurate weight of just the head.
- Place the cabbage head on the scale and ensure it is centred and balanced. If your scale has a tare function, use it to zero out the weight of the container or plate you are using to hold the cabbage.
- Read the weight displayed on the scale. This is the weight of the cabbage head.
- If you need to record the weight, make sure to note the units of measurement (grams, ounces, etc.) used by the scale.
- Repeat this process for each cabbage head that you want to measure.

2.12.6 Crop yield :

- Harvest the cabbage heads: The first step is to harvest all the cabbage heads from the crop.
- Weigh the cabbage heads: Weigh all the cabbage heads on a scale to get the total weight.
- Calculate the average weight: Divide the total weight by the number of cabbage heads to get the average weight per head.
- To determine the yield per acre, simply multiply the average weight by the number of plants per acre.

2.12.1 Cost of cultivation :

By summing together, the costs associated with each activity and input, the cost of cultivation (INR/ha) was calculated. According to the rates authorised by the University, the amount of manpower and mechanical power needed for various activities, such as harrowing, weeding, irrigation, and harvesting, was determined. Based on real market prices and the appropriate dose, input costs for things like fertiliser and pesticides were determined. The total of all expenses incurred throughout the crop season is included in the cost of cultivation.

2.12.2 Gross returns :

Based on the support price of fenugreek and the prevailing market price for fenugreek, the gross return was calculated by converting the economic yield of fenugreek into monetary terms.

2.12.3 Net return (INR/ha) :

To calculate the net return for each treatment, we deducted the cost of cultivation from the gross return and expressed it as net return (INR/ha).

The formula used was: Net Return (INR/ha) = Gross Return (INR/ha) - Cost of Cultivation (INR/ha).

2.12.4 Benefit-cost ratio :

The net returns were divided by the total cost of all operations involved to determine the benefit-cost ratio for cultivating the Kasuri methi crop.

2.12.5 Statistical analysis :

According to the method outlined by Gomez and Gomez (1984), statistical analysis was performed on the data collected from the field and the lab. Critical difference (CD) was estimated for parameters whose impacts showed significance at a 5% probability level. After applying square root transformation, or (), to the original data, the weed count and dry matter were examined, and the impacts of the various treatments were contrasted using the transformed means.

3 Result :

Below are the results and analysis of a study conducted during the rabi season of 2022-2023 at the Organic Agriculture Farm of Amity University in Noida, Uttar Pradesh. The study, titled "The Impact of Different Organic Manures on Yield, Yield Attributes, and Economics of Cabbage," focuses on the effects of various organic manures on cabbage yield and economic factors.

3.1 Growth parameters

3.2 Yield parameters

3.3 Economic analysis

3.1 Growth parameters :

Throughout the crop's growth process, we recorded data on key growth parameters such as plant height, number of outer leaves, and head diameter. These measurements were taken at various stages of growth, as well as before the crop was harvested.

3.1.1 Plant height (cm) :

The most important growth factor for crops is the parameter plant height. To determine how the various treatments applied to the plants, individually and in combination, affected their growth, the height of the plants was measured at 30 DAS, 60 DAS, and 90 DAS.

The information in Table 3.1.1 and Fig. 3.1.1 shows that there were large variations in plant height. In comparison to other treatments, Treatment T4 (vermicompost + azotobacter) greatly increased the plant height at 30 DAS (14.5 cm), whereas Treatment T7 (control) significantly decreased it (8.2 cm).

The information in Table 3.1.1 and Fig. 3.1.1 shows that there were large variations in plant height. The treatment T4 (vermicompost + azotobacter), which was on par with other treatments, was found to have the greatest plant height at 60 DAS (19.4 cm), whereas the treatment T7 (control) had the lowest (11.3 cm) of all the treatments.

The information in Table 3.1.1 and Fig. 3.1.1 shows that there were large variations in plant height. In comparison to other treatments, Treatment T4 (vermicompost + azotobacter) considerably increased plant height at 90 DAS (22.9 cm), whereas Treatment T7 (control) greatly decreased it (15.1 cm).

Table 3.1.1: Effect of different treatments on plant height (cm)

TREATMENTS	30 DAS	60 DAS	90 DAS
T1 – VERMICOMPOST	11.3	14.3	19.2
T2 – FYM	10.8	13.4	17.4
T3 – POULTRY MANURE	10.6	13.1	18.1
T4 – VERMICOMPOST + AZOTOBACTER	14.5	19.4	22.9
T5 – FYM +AZOTOBACTER	11.8	16.3	21.3
T6 – POULTRY MANURE + AZOTOBACTER	13.4	18	22.4
T7 – CONTROL	8.2	11.3	15.1
C.D. at 5%	0.5	0.4	0.5

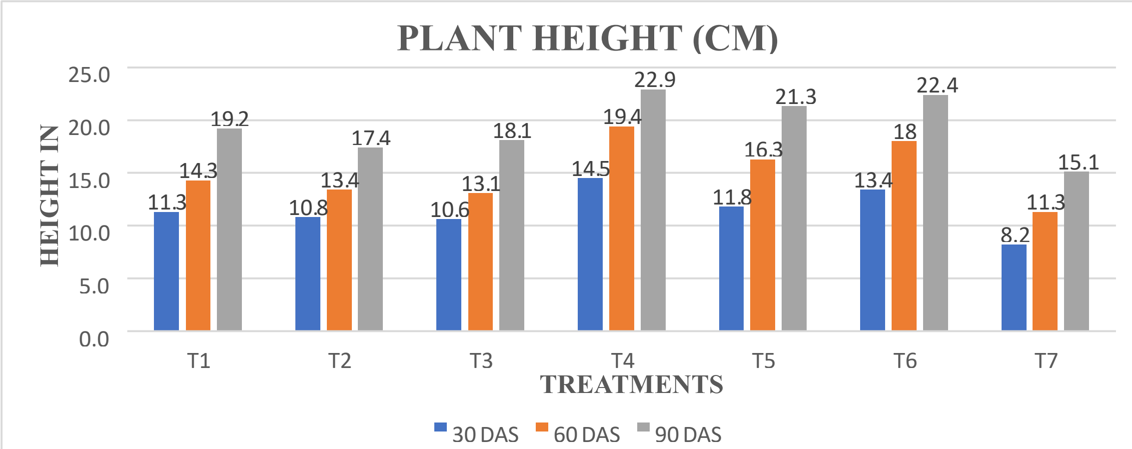


Fig.3.1.1: Effect of different treatments on plant height

3.1.2 Number of outer leaves per plant :

The number of outer leaves per plant was measured at intervals of 30 DAS, 60 DAS, and 90 DAS. It was discovered that organic manures and bio-fertilisers impacted the number of outer leaves per plant, both alone and in combination.

At 30 DAS, all treatments had noticeable variations regarding the number of outer leaves per plant. The highest number of leaves (9.7) among the treatments was found in T4 (vermicompost + azotobacter), while the lowest number of leaves (5.7) was found in T7 (Control).

At 60 DAS, all treatments also demonstrated a substantial difference in the number of leaves per plant. The treatment with the most leaves (14.7) was T4 (vermicompost + azotobacter), whereas the treatment with the fewest leaves (T7) was control.

At 90 DAS, the number of leaves per plant for each treatment also revealed a significant difference. The highest number of leaves (16.7) among the treatments was found in T4 (vermicompost + azotobacter), while the lowest number of leaves (15.7) was found in T7 (Control).

Table 3.1.2: Effect of different treatments on number of outer leaves

T5 – FYM + AZOTOBACTER	7.7	12.3	14.7
T6 – POULTRY MANURE + AZOTOBACTER	8.7	13.7	15.7
T7 – CONTROL	5.7	10	12
C.D. at 5%	0.8	0.9	0.9

TREATMENTS	**30 DAS**	**60 DAS**	**90 DAS**
T1 – VERMICOMPOST	8.3	12.7	14.7
T2 – FYM	7.3	11	13.7
T3 – POULTRY MANURE	8.7	11.3	13.3
T4 – VERMICOMPOST + AZOTOBACTER	9.7	14.7	16.7

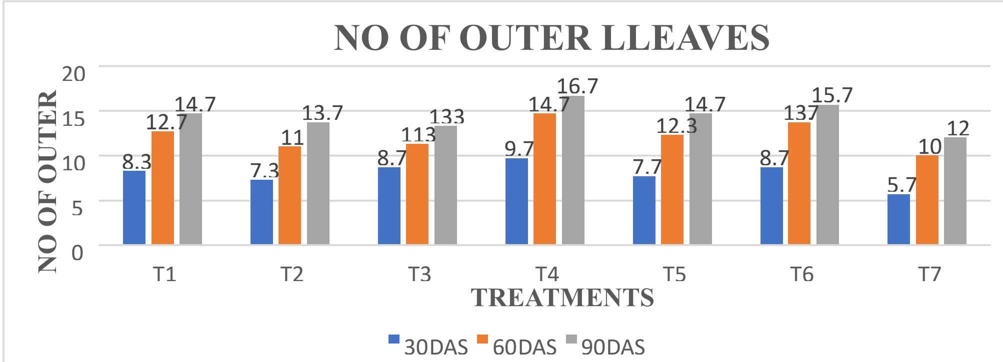


Fig.3.1.2: Effect of different treatments on the number of leaves per plant

3.1.3 Head diameter (cm) :

In this study, the number of branches per plant was observed to be impacted by treating organic manures with biofertiliser when the head diameter per plant was counted at intervals of 60 DAS and 90 DAS, respectively.

At 60 DAS, all treatments revealed substantial variations in the head diameter per plant. Treatment T4 (vermicompost + azotobacter) had the largest head diameter per plant among all the treatments (10.2 cm), whereas T7 (Control) had the smallest head diameter per plant by a substantial margin (6.3 cm).

The head diameter per plant at 90 DAS also revealed significant variations across all treatments. Treatment T4 - (vermicompost + azotobacter) had the largest head diameter per plant (17.7 cm) compared to all other treatments, while T7 - Control recorded a significant minimum head meter per plant (12 cm).

Table 3.1.3: Effect of different treatments on head diameter per plant

TREATMENTS	60 DAS	90 DAS
T1 – VERMICOMPOST	8.1	17.1
T2 – FYM	7.5	16
T3 – POULTRY MANURE	8.3	17.2
T4 – VERMICOMPOST + AZOTOBACTER	10.2	21.5
T5 – FYM + AZOTOBACTER	9.1	17.7
T6 – POULTRY MANURE + AZOTOBACTER	10.1	20.1
T7 – CONTROL	6.3	11.5
C.D. at 5%	**0.4**	**1.0**

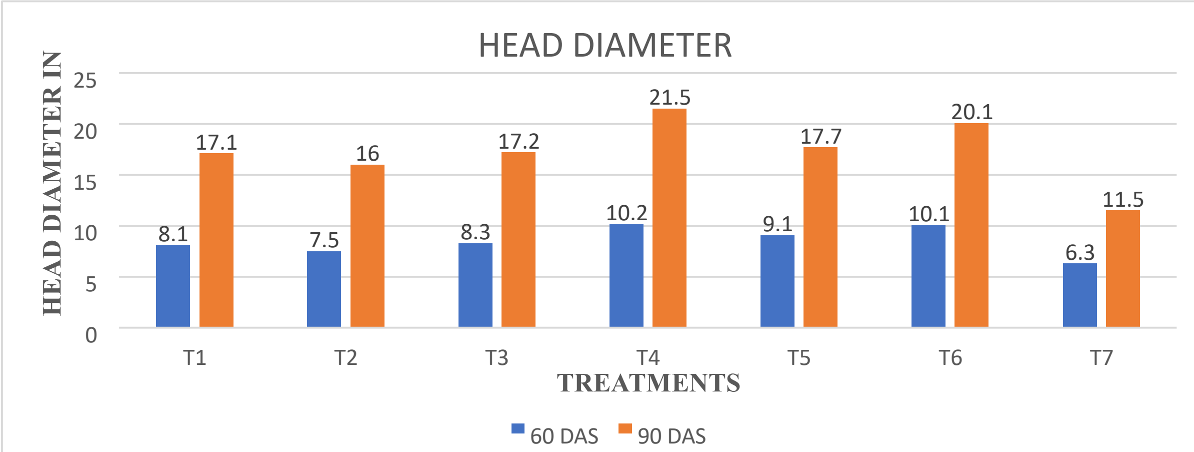


Fig.3.1.3: Effect of different treatments on head diameter per plant

3.2 Yield parameters :

The data of yield parameters, viz. head weight and total yield, were recorded at the time of crop harvest.

3.2.1 Head weight (kg) :

At the time of harvest, the weight of each individual head was measured. It was discovered that individual applications and combinations of organic manures and bio-fertilizers impacted head weight.

All treatments showed a substantial difference regarding the head weight at the harvest stage. At the time of the first harvest, T4 - (vermicompost + azotobacter) recorded the highest head weight (1.09 kg), whereas T7 - Control recorded the lowest head weight (0.48 kg), which was substantially lower.

Table 3.2.1: Effect of different treatments on the head weight

TREATMENTS	HEAD WEIGHT (kg)
T1 – VERMICOMPOST	0.87
T2 – FYM	0.69
T3 – POULTRY MANURE	0.84

T4 – VERMICOMPOST + AZOTOBACTER	1.09
T5 – FYM + AZOTOBACTER	0.96
T6 – POULTRY MANURE + AZOTOBACTER	1.02
T7 – CONTROL	0.48
C.D. at 5%	0.1

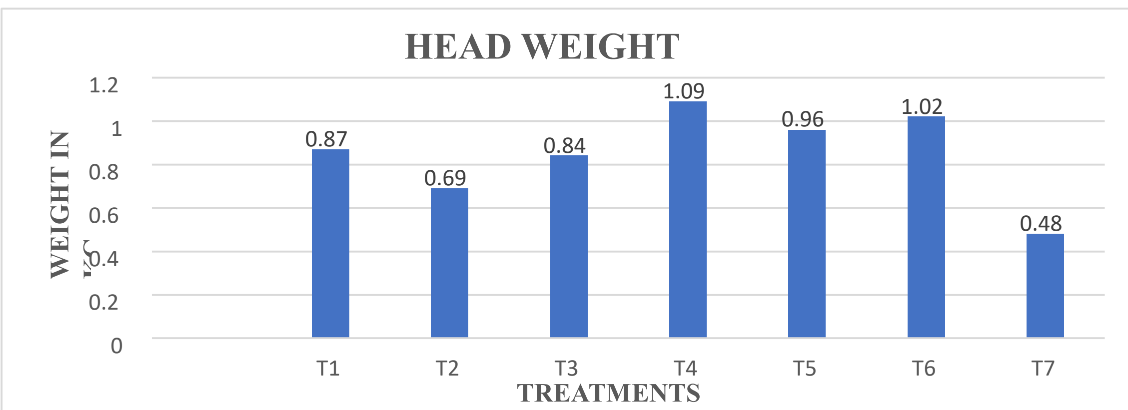


Fig.3.2.1: Effect of different treatments on head weight

3.2.2 Total Yield (t/ha) :

At the time of crop harvest, the total plant yield was measured. It was discovered that both alone and in combination, organic manures and biofertilizers impacted the overall yield.

All treatments showed a substantial difference regarding the crop's overall yield at the harvest stage. At harvest time, T4 (vermicompost + azotobacter) had the highest crop production among the treatments (29.97 t/ha), whereas T7 (Control) had the lowest plant yield (significantly 20.70 t/ha).

Table 3.2.2: Effect of different treatments on the total yield (t/ha)

TREATMENTS	TOTAL YIELD(t/ha)
T1 – VERMICOMPOST	24.43
T2 – FYM	22.33
T3 – POULTRY MANURE	23.43
T4 – VERMICOMPOST + AZOTOBACTER	29.97
T5 – FYM + AZOTOBACTER	25.30
T6 – POULTRY MANURE + AZOTOBACTER	27.00
T7 – CONTROL	20.70
C.D. at 5%	4.7

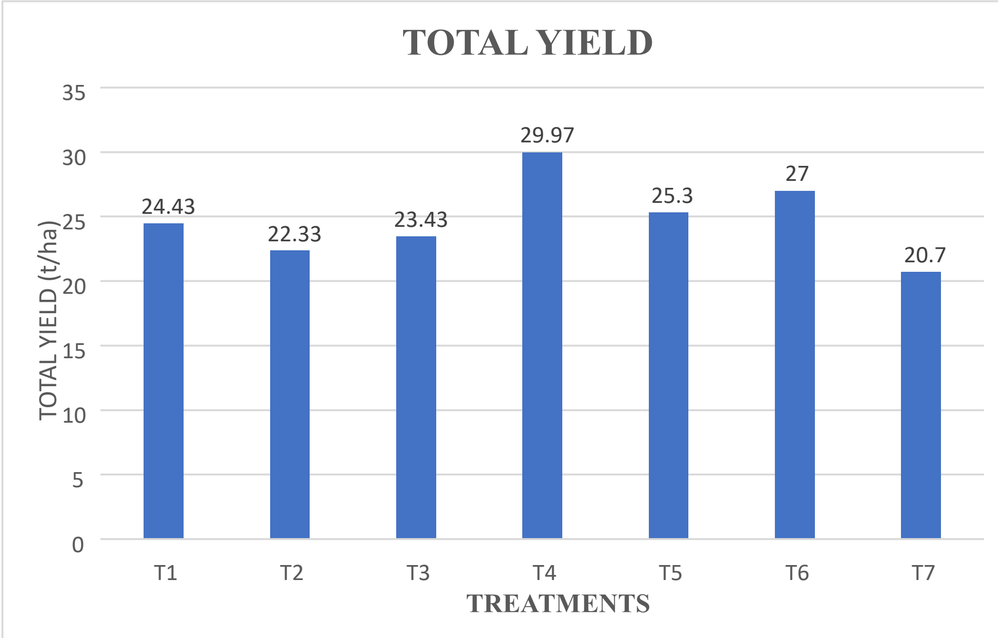


Fig. 3.2.2: Effect of different treatments on total yield (t/ha)

3.3 ECONOMIC ANALYSIS :

The net profit from various treatments is determined in economic analysis. This study trial used different organic manures and bio fertilisers in various treatment combinations. The cost of cultivation and the gross return fluctuate due to varied yields. This study computed a benefit-cost ratio (BC ratio) and maximum net returns. Cabbage production requires a B/C ratio greater than 1. If it is less than 1, Cabbage will not function well. If it is less than 0, the grower or farmer has experienced a loss.

3.3.1 Cost of cultivation (Rs/ha) :

The table below shows how organic manures and bio fertilisers affect the cost of cultivation. The cost of cultivation is how the different fixed expenses and variable costs are invested in crop production. T4 (vermicompost + azotobacter) had the highest culture cost. In T7 (control), the lowest cultivation cost was noted).

3.3.2 Gross return (Rs/ha) :

The table below shows the impact of treatments on the gross return. Vermicompost with Azotobacter was used in T4 to provide the highest gross return, whereas control was used in T7 to produce the lowest gross return.

3.3.3 Net return (Rs/ha) :

The table shows how treatments have an impact on net return. T4 (Vermicompost + Azotobacter) showed the highest net return, whereas T7 (Control) showed the lowest net return.

3.3.4 BC ratio :

The effect of treatments on the BC ratio is presented in the table below. The maximum B: C ratio was observed in T4 (vermicompost + azotobacter) and the minimum B C ratio was observed in T7(control)

Cost of Cultivation

Sr. No.	Particulars of operation	Inputs	Rate/Unit (D)	Cost (D/ha)
A. Land preparation				
1	Ploughing by disc plough (one)	Tractor-drawn disc plough	2500/ha	2500
2	Layout and bed preparation	8 labours	500/man day	4000
3	Manures application (Vermicompost, FYM, Poultry manure)	8 labours	300/man days	2400
B. Transplanted				
1	Cost of seedlings	30,000 seedlings/ha	Rs.4/seedling	120,000
2	Seedling transplanting	10 labours	400/man-days	4000
C. After Care				
1.	Organic fertiliser application (FYM)	8 labours	300/man days	2400
2.	Weeding and hoeing	10 labours	300/person-days	3000
3	Irrigation (3 times)	Three labours	300/person-days	900
D. Harvesting		Ten labours	400/person-days	4000
E. Miscellaneous		-	-	1000
TOTAL COST				1,44,200

Cost of treatments

Benefit cost ratio (BC ratio)

Sr. No.	Particulars	Input	Rate/unit (`)	Cost (`/ha)
1	Vermicompost	4 ton	6500/ton	26000
2	FYM	18 ton	600/ton	12000
3	Poultry manure	2 ton	3250/ton	6500
4	azotobacter	2 kg	200/kg	400

Sr. No	Treatments	Yield (t/ha)	Returns	Gross returns (D)	Cost of cultivation /ha	Net returns/ ha	BC ratio
		Green yield	Green yield				
1	T1	24.43	732,900	732,900	170,200	562,700	4.3
2	T2	22.33	699,900	699,900	156,200	543,700	4.48
3	T3	23.43	7,02,900	7,02,900	150,700	552,200	4.66
4	T4	29.97	899,100	899,100	170,600	728,500	5.27
5	T5	25.30	759,000	759,000	156,600	602,400	4.84
6	T6	27.00	810,000	810,000	152,100	657,900	5.32
7	T7	20.70	621,000	621,000	144,200	476,800	4.3

4 Discussion :

The significant findings of the present investigation have been interpreted and discussed in this chapter in light of the research work already done by scientists in our country and abroad.

The discussion comprises the relevant topics viz. Growth and yield attributing characters in the case of Cabbage ***Brassica oleracea var. capital*** Cabbage ***(Brassica oleracea var. capital)*** is a versatile and popular vegetable crop cultivated worldwide. It belongs to the Brassicaceae family and is known for its tight, leafy heads. Cabbage is a nutritious addition to our diets and a crop with its own cultivation techniques, benefits, and challenges. This discussion will explore various aspects of cabbage cultivation, its benefits, and the challenges farmers face.

A natural source of nutrients and soil microorganisms, organic manure can increase the fertility of the soil, the growth of plants, and crop yield. Contrarily, biofertilizers are microbial inoculants that give beneficial microorganisms to the soil and plant roots, improving soil health, plant growth, and nutrient uptake. Biofertilizers and organic manure have both been demonstrated to benefit a variety of crops, including cabbage.

The study evaluates the effects of various organic manures and biofertilizers on cabbage growth, yield, and financial performance. Field tests employing various applications of organic manure and biofertilizers will be carried out as part of the study. Growth and yield metrics such as plant height, the number of outer leaves, head diameter, head weight, and yield per hectare will be examined.

Using organic manure and biofertilizers should increase the development and productivity of cabbage crops. The elements included in organic waste, such as nitrogen, phosphorus, and potassium, are essential for cabbage growth. Organic waste also improves the soil's structure, water-holding ability, and nutrient availability, which leads to better plant development and productivity.

On the other hand, biofertilizers can improve nutrient absorption by plants by fixing atmospheric nitrogen, solubilising phosphorus, and generating compounds that help in plant development, like hormones and enzymes. This leads to greater disease and insect resistance, improved nutrient uptake, and improved root formation, all of which eventually boost plant growth and output in cabbage harvests.

Organic manure, a naturally occurring source of nutrients and soil microbes, may boost soil fertility, plant development, and crop output. Contrarily, biofertilizers are microbial inoculants that introduce advantageous microorganisms to plant roots and the soil, enhancing plant development and nutrient absorption. Several crops, including cabbage, have been shown to benefit from biofertilizers and organic manure.

The study evaluates the effects of various organic manures and biofertilizers on cabbage growth, yield, and financial performance. Field tests employing various applications of organic manure and biofertilizers will be carried out as part of the study. Growth and yield metrics such as plant height, the number of outer leaves, head diameter, head weight, and yield per hectare will be examined.

To sum up, it is critical to study how different organic manures affect cabbage output, yield characteristics, and economics since this information might encourage using ecologically friendly vegetable cultivating techniques. Enhancing soil health, plant development, and production through the use of organic manure and biofertilizers can lead to higher crop quality and improved farmer profitability. This study might provide useful knowledge on employing these organic inputs in cabbage production and promote sustainable agriculture practices.

The objective of the current study was to ascertain "the impact of various organic manures on yield, yield attributes, and economics of cabbage" in light of the relevance and utility of these organic manures. The investigation's results are mentioned below.

4.1. Effect of organic manures and biofertilisers :

4.1.1. Plant growth parameters :

However, changes in plant height, the number of outer leaves, and head diameter were noted in the current study due to manures, biofertilizers, or a combination of both. At 30, 60, and 90DAS, the application of T4 (Vermicompost + Azotobacter) produced the highest plant height (14, 19, 4, and 22.9 cm per plant), the fewest outer leaves (9, 14, and 16.7 cm per plant), and the largest head diameter (10, and 21.5 cm per plant), respectively.

Along with having considerably fewer outer leaves (5, 7, and 12 per plant), head diameter, and plant height at 30, 60, and 90DAS, the T7 control treatment also had significantly fewer outer leaves (8, 11, 15, and 15.1 cm per plant) and head diameter (6, 11, and 11.5 cm per plant).

4.1.2. Yield and yield attributes :

Over the control, vermicompost + azotobacter produced the highest fresh weight of the entire cabbage plant. By promoting protein and carbohydrate absorption, organic manure boosted cell division and the development of new tissues, leading to luxuriant vegetative growth and more photosynthetic area, resulting in more vegetative growth and a higher fresh weight of the plant. This could be because plants make more photosynthates because their leaf area is larger.

The head weight and yield per hectare were all significantly influenced by organic nutrient management. The best way to increase crop yield and yield attributes is to use an organic nutrient management system that uses organics like vermicompost, FYM, poultry manure, and biofertilizers.

Combining organic manures with the biofertilizer T4 (vermicompost + azotobacter), significant increases in head weight (1.09 kg) and total yield per ha (29.97 t/ha) were discovered. The T7 control plot had the significantly lowest head weight (0.48 kg) and the lowest total yield (20.70 t/ha).

At harvest, however, there was a modest decline in plant spread. From 30 DAT to 60 DAT, the plant spread was steadily enhanced. During head development at harvest, photosynthetic transfer from older to younger leaves occurred, which was followed by drying and leaf drop for older leaves. In a cabbage crop, similar results were observed by Naher et al. (2014).

4.2 Economics :

Applying organic manures in conjunction with biofertilizers like vermicompost + azotobacter, FYM + azotobacter, and chicken manure + azotobacter has boosted net return compared to applying them alone to cabbage crops.

As with using vermicompost and chicken manure as manures and seed treatment with azotobacter, doing so with cabbage plants boosts net returns above FYM-treated plants. Both treatments clearly saw a large increase in yield, and as a result, their net returns over input costs were higher than those of other treatments.

4.3 Net return and Benefit-cost ratio :

T6 (poultry manure + azotobacter) had the highest benefit-cost ratio (5.32), which was followed by T1 (vermicompost) (4.3) and T7 (4.3) control. In general, it was discovered that the benefit-cost ratio was higher than unity in all treatments, indicating higher returns on every rupee invested. However, the net return is highest (728,500) in T4 (vermicompost + azotobacter), followed by (657,900) in T6 (poultry manure + azotobacter), and the lowest net return was obtained in T7 (control) (476,800).

5 Conclusion :

It can be inferred from the findings of the present study and the agroclimatic characteristics of Noida, Uttar Pradesh, that growing this cultivar of Brassica oleracea cabbage with vermicompost + azotobacter will result in greater plant growth and crop yield per hectare than growing it with other organic manures and biofertilizers.

Additionally, the cultivar grown with chicken manure + azotobacter treatment has shown virtually equal growth and production characteristics with a much higher cost-benefit ratio (5.40) when compared to vermicompost + azotobacter (4.3) and all other treatments.

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7 References :

1. Abdel-Mawgoud, M. M., El-Khawas, S. A., and Shaaban, M. M. (2020). Effect of different organic manures on growth, yield and chemical composition of cabbage. Middle East Journal of Agriculture Research, 9(1), 175-186.
2. Aghakhani, M., and Koocheki, A. (2019). Effect of different organic manures on growth, yield and quality of cabbage (Brassica oleracea L. var. capitata). Journal of Plant Nutrition, 42(8), 1001-1011.
3. Ahmed, M. A., and Ali, A. H. (2021). Effect of organic manures on growth, yield, and quality of cabbage (Brassica oleracea L. var. capitata). Annals of Agricultural Sciences, 66(1), 1-9.
4. Akram, M., Bilal, M., Ali, M. A., Yaseen, M., and Hussain, S. (2021). Comparative efficacy of organic manures on yield and economics of cabbage (Brassica oleracea L.). Scientifica, 2021, 1-7.
5. Alshaal, T., Fathy, S. A., and Haggag, H. E. (2021). Effect of sewage sludge on growth, yield and heavy metals of cabbage (Brassica oleracea L. var. capitata). Environmental Science and Pollution Research, 28(12), 1493814949.
6. Ansari, S.A., Patil, S.R., Jadhav, P.R. (2020). Influence of different organic manures on cabbage's growth, yield, and quality (Brassica oleracea var. Capitata L.). Journal of Applied and Natural Science.

7. Barman, D., Sarkar, S., and Sarkar, B. (2019). Impact of organic and inorganic manures on yield, yield attributes and economics of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 7(1), 246-250.
8. Bhattacharjee, R., Datta, S. C., and Datta, S. K. (2020). Effect of fish waste compost on growth, yield and economics of cabbage. Journal of Pharmacognosy and Phytochemistry, 9(3), 1789-1793.
9. Bhattacharya, S., and Mandal, A. K. (2018). Effect of different organic manures on yield and economics of cabbage (Brassica oleracea L. var. capitata) in terai region of West Bengal. Journal of Applied and Natural Science, 10(3), 761-765.
10. Choudhary, R. K., Yadav, R. L., Kumar, V., and Kumar, A. (2019). Impact of vermicompost and inorganic fertilizers on yield and yield attributes of cabbage (Brassica oleracea L. var. capitata). International Journal of Current Microbiology and Applied Sciences, 8(12), 2296-2303.
11. Dang, Y. P., Dalal, R. C., Routley, R., Schwenke, G. D., Mayer, R. J., and McDonald, M. (2010). Effects of residue retention and organic manure application on soil nitrogen dynamics and crop productivity under irrigated subtropical cropping systems. Soil Research, 48(2), 137-149.
12. Das, S., Roy, S., Saha, A., and Dey, P. K. (2020). Impact of vermicompost and poultry manure on growth, yield and quality of cabbage (Brassica oleracea var. capitata) under eastern sub-Himalayan region of India. Journal of Plant Nutrition, 43(12), 1719-1734.
13. Dhaduk, B. K., Patel, K. D., Patel, D. B., and Patel, R. J. (2017). Effect of organic manures and bio-fertilizers on yield, quality and economics of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 5(6), 1406-1410.
14. Fong, L. K., Azmi, M. H., & Lau, K. S. (2018). Effects of compost on cabbage growth and profitability. International Journal of Agriculture, Forestry and Plantation, 2, 27-34.
15. Gao, Y., Wang, L., Zhang, Y., Han, X., and Liu, X. (2020). Biochar-based organic manure improves cabbage growth and yield, and economic benefits in greenhouse production. Science of The Total Environment, 744, 140752.
16. Goswami, R. K., Pathak, M., Sarma, P. K., and Kalita, H. K. (2019). Effect of different organic manures on growth and yield attributes of cabbage (Brassica oleracea var. capitata). International Journal of Chemical Studies, 7(4), 28-32.
17. Goyal, A., and Prasad, R. (2019). Impact of organic and inorganic fertilizers on yield, quality and economics of cabbage (Brassica oleracea L. var. capitata) in mid hill region of Uttarakhand. International Journal of Chemical Studies, 7(1), 1433-1437.
18. Hussain, S., Hameed, S., and Saleem, M. (2018). Effect of different organic manures on growth, yield and quality of cabbage (Brassica oleracea var. capitata). Pakistan Journal of Agricultural Sciences, 55(2), 303-309.

19. Jena, S., Sarangi, A., and Mishra, S. K. (2018). Economic viability of cabbage cultivation under different organic manure treatments in Odisha. International Journal of Current Microbiology and Applied Sciences, 7(11), 1366-1372.
20. Kariuki, S. M., Mucheru-Muna, M. W., Mugendi, D. N., & Mugwe, J. N. (2019). Effect of organic and inorganic fertilizer application on soil properties, cabbage (Brassica oleracea var. capitata) yield and economic profitability in Kiambu County, Kenya. Journal of Agricultural Science, 11, 51-63.
21. Khademalrasoul, A., Sadeghi, M., and Oveisi, M. (2020). Economic evaluation of different organic and chemical fertilizer treatments on cabbage (Brassica oleracea var. capitata) yield and quality. Journal of Cleaner Production, 279, 123758.
22. Kour, A., Azad, M. A., Raina, A. K., and Bhat, M. Y. (2021). Effect of organic manures on yield and economics of cabbage (Brassica oleracea var. capitata L.). International Journal of Chemical Studies, 9(2), 2098-2102.
23. Kumar, A., Kumar, V., and Kumar, V. (2021). Effect of vermicompost, farmyard manure and poultry manure on growth, yield and quality of cabbage (Brassica oleracea var. capitata L.). Indian Journal of Agricultural Sciences, 91(2), 102-107.
24. Kumar, P., Singh, P., and Singh, M. (2018). Effect of different organic manures on growth, yield and quality of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 6(1), 32-36.
25. Kumar, R., Kumar, P., and Sharma, S. (2020). Effect of organic manures on yield, yield attributes and economics of cabbage (Brassica oleracea var. capitata). Journal of Pharmacognosy and Phytochemistry, 9(2), 2482-2486.
26. Makanjuola, S. A., and Adewumi, T. A. (2020). Influence of organic manures on the growth, yield and economics of cabbage (Brassica oleracea L. var. capitata). Journal of Agricultural Extension, 24(1), 1-13.
27. Mohanty, D., Rout, R., and Meher, M. (2020). Influence of organic manures on yield, yield attributes and economics of cabbage (Brassica oleracea var. capitata) in organic farming. International Journal of Chemical Studies, 8(2), 5146-5150.
28. Mondal, S., Hazra, P., Sarkar, D., and Maity, T. K. (2019). Impact of different organic manures on growth, yield and economics of cabbage (Brassica oleracea var. capitata) in coastal saline soil. Journal of Applied and Natural Science, 11(2), 340-346.
29. Naher MNA, Alam MN, Jahan N, Effect of nutrient management on the growth and yield of cabbage (Brassica oleraceae var. capitata.) in calcareous soils of Bangladesh, The Agriculturists. 2014; 12(2):24-33
30. Nouri, L., Hadian, J., and Farzaneh, M. (2013). Effects of different organic fertilizers on yield and yield components of cabbage (Brassica oleracea var. capitata). Archives of Agronomy and Soil Science, 59(6), 817-828.
31. Pandey, V., Patel, M., Kaur, H. (2017). Comparison of the effect of different organic manures on the growth and yield of cabbage (Brassica oleracea var. Capitata). Journal of Agricultural and Biological Science.

32. Pathak, R. K., Singh, R. K., and Yadav, A. (2019). Impact of different organic manures on growth, yield and yield attributes of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 7(1), 1317-1321.
33. Saha, S.K., Datta, S., Dutta, D. (2021). Effect of different organic manures on growth, yield and quality of cabbage (Brassica oleracea var. Capitata). Journal of Soil Science and Plant Nutrition.
34. Salam, M. A., Sultana, S., and Hussain, M. S. (2018). Effect of organic manures on growth, yield and economics of cabbage (Brassica oleracea var. capitata). International Journal of Agricultural Research, Innovation and Technology, 8(1), 9-14.
35. Saranraj, P., and Kumaresan, G. (2019). Effect of organic manures on growth, yield and economics of cabbage (Brassica oleracea var. capitata). International Journal of Current Microbiology and Applied Sciences, 8(10), 2070-2076.
36. Sharma, S., Kumar, S., Kumar, S., and Sharma, V. (2020). Effect of organic manures on yield and quality of cabbage (Brassica oleracea var. capitata L.) in Western Himalaya. International Journal of Chemical Studies, 8(3), 30733076.
37. Singh, D., Singh, N., Singh, R., and Sharma, R. K. (2017). Effect of organic manures on growth, yield and quality of cabbage (Brassica oleracea L. var. capitata). International Journal of Current Microbiology and Applied Sciences, 6(6), 3726-3735.
38. Singh, J., Singh, V., and Singh, B. (2019). Effect of different organic manures on growth, yield, and quality of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 7(1), 2247-2251.
39. Singh, M., Singh, M., Kumar, S., and Kumar, S. (2020). Effect of different organic manures on growth, yield and quality of cabbage (Brassica oleracea var. capitata). Journal of Pharmacognosy and Phytochemistry, 9(5), 15251530.
40. Singh, M., Singh, R., Singh, V. P., and Kumar, A. (2019). Effect of different organic manures on yield and quality of cabbage (Brassica oleracea var. capitata). Journal of Pharmacognosy and Phytochemistry, 8(4), 4064-4067.
41. Singh, R., Kumar, S., Singh, R., and Singh, B. (2021). Impact of organic manures on yield, quality, and economics of cabbage (Brassica oleracea var. capitata) in subtropical region of India. Journal of Plant Nutrition, 44(2), 304316.
42. Singh, S. P., and Singh, M. K. (2018). Effect of organic manures on growth, yield and economics of cabbage (Brassica oleracea var. capitata). Journal of Pharmacognosy and Phytochemistry, 7(1), 2534-2539.
43. Singh, S., Patel, R.K., Kumar, A. (2022). Impact of organic manures on growth, yield, and economics of cabbage (Brassica oleracea var. Capitata) in India. Journal of Agricultural Economics and Development.
44. Singh, S., Singh, M., and Kumar, R. (2016). Effect of different organic manures on yield, yield attributes and economics of cabbage (Brassica oleracea L. var. capitata). International Journal of Chemical Studies, 4(4), 146-150.

45. Tadesse, T., Assefa, A., & Tadele, T. (2018). Effect of compost and inorganic fertilizer application on growth and yield of cabbage (Brassica oleracea L.) in Lemo district, southern Ethiopia. Journal of Soil Science and Environmental Management, 9, 33-38.

46. Voon, C. H., Abdullah, A. M., Ismail, B. S., & Abidin, M. H. Z. (2017). Effect of organic manure on yield and soil properties of cabbage (Brassica oleracea var. capitata) grown on organic soil in Cameron Highlands, Malaysia.
Malaysian Journal of Soil Science, 21, 43-53.

47. Voon, C. H., Abdullah, A. M., Ismail, B. S., Abidin, M. H. Z., & Chee, W. W. (2018). Influence of organic manure on cabbage yield, soil biological and chemical properties in Cameron Highlands, Malaysia. Communications in Soil Science and Plant Analysis, 49, 933-

48. Yadav, R. P., and Shukla, R. (2020). Effect of organic manures on yield, quality and economics of cabbage (Brassica oleracea var. capitata). International Journal of Chemical Studies, 8(2), 843-846.

49. Yasin, M., Mahmood, T., Javed, M. A., and Ahmad, R. (2018). Effect of organic manures on growth, yield and quality of cabbage (Brassica oleracea var. capitata). Sarhad Journal of Agriculture, 34(4), 1064-1071.