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Integration of organic farming practices for production of parthenocarpic cucumber under polyhouse conditions

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Abstract

The present investigation involves integration of organic farming practices for production of parthenocarpic cucumber under polyhouse conditions on yield and related characters of Cucumber. It was observed that due to improper nutrition and non-judicious use of fertilizers cucumber production is lower than expected which further leads to poor fruit size and number of fruits/plant which greatly hampers yield and quality. To overcome this problem, an on farm trial (OFT) was conducted by K.V.K. S.A.S. Nagar (Mohali) in farmer's field during 2022-23 to evaluate the integration of organic farming practices for production of parthenocarpic cucumber under polyhouse conditions. The treatment combinations comprised T₁: Farmer practice (100% RDF), T₂: 75% RDF+ Azotobacter @2Kg/acre, T₃: 75% RDF+PSB@2 Kg/acre, T₄: 75% RDF+Vermicompost@2t/acre, T₅: 75%RDF+Azotobacter (@2Kg/acre+PSB@2 Kg/acre, T₆: 75%RDF+Azotobacter @2Kg/acre+PSB@2 Kg/acre + Vermicompost @ 2t/acre. The results of the study revealed that yield of T₆ was found to be the best along with BC ratio of 4.48 followed by T₅ with BC ratio of 4.42, followed by T₃ with BC ratio of 4.19, followed by T₄ with BC ratio of 3.92, followed by T₂ with BC ratio of 4.12 and T₁ with BC ratio of 3.99.

Keywords: Parthenocarpic cucumber, organic farming, yield, polyhouse, BC ratio

Introduction

One of the most important and well-liked cucurbitaceous vegetable crops is the cucumber (*Cucumis sativus* L.). In nature, cucurbits are very entomophilous, or cross-pollinated. A popular summer vegetable crop in North India, cucumbers are grown throughout Punjab. When there is an adequate supply of water and nutrients, it responds well to high temperatures, humidity, and light intensity (Pal *et al.* 2020) [7]. Parthenocarpic cucumbers are the perfect crop for polyhouse production because of their climbing behaviour, which facilitates trellising and maximises the use of vertical spaces (Guan *et al.*, 2019) [2]. Due to its quick and effective utilisation of solar radiation as well as its simplicity of management and production, greenhouse vegetable production has grown to become one of the most significant vegetable production facilities worldwide. (Cepulienė *et al.* 2022) [1]. High-value vegetable crops can be produced all year round using sheltered cultivation technologies. It is possible to ensure year-round production of parthenocarpic cucumbers by utilising the influence of different inorganic, organic, and biofertilizer sources of nutrients at an optimal amount on cucumber growth, yield, and economic factors under polyhouse settings.

In order to achieve higher crop yields in an environmentally friendly manner, integrated nutrient management is a sustainable approach that focuses on maintaining the plant nutrient supply and soil fertility by incorporating various sources of nutrients, such as organic manures, inorganic fertilisers, and other biological components. The physicochemical and microbiological activity of soil has been negatively damaged by the indiscriminate and excessive application of inorganic fertilisers without the addition of organic manure or biofertilizers (Kumar *et al.*, 2018) [3]. Azotobacter, Rhizobium, and PSB are examples of biofertilizers that help plants fix atmospheric nitrogen in their roots. The efficiency of fertiliser utilisation can be improved by applying nutrients from various sources and using drip watering techniques.

While biofertilizers guarantee the mobilisation of nutrients from the soil complex and provide plants with growth-promoting elements, organic sources guarantee the slow and long-term

release of nutrients. Taking into account all of these factors, a study was conducted to examine the effects of integrating organic farming methods on the growth, yield, and economics of parthenocarpic cucumbers grown in polyhouses (*Cucumis sativus* L.).

Materials and Methods

Experimental site, treatments and design

With an average elevation of 316 meters above mean sea level, Mohali district of Punjab is located in a sub-mountainous zone (30.69°N latitude, 76.72°E longitude). In order to assess the effects of integrating organic farming practices for the production of parthenocarpic cucumbers under polyhouse settings on cucumber growth, yield, and related characteristics, the current study was conducted at five farmers' fields in 2022–2023. Each trial covered an area of 800 square meters. The experimental site's soil was sandy loam, deep, and loose. A randomised block design was used for the experiment. Cucumber production was found to be lower than anticipated as a result of careless fertiliser application. This further results in poor fruit size and quantity per plant, which significantly reduces fruit yield and quality.

In order to address this issue, K.V.K. S.A.S. Nagar (Mohali) carried out an on-farm trial (OFT) in a farmer's field in 2022–2023 to assess the impact of integrating organic farming methods on parthenocarpic cucumber production under polyhouse settings on yield and related cucumber characteristics. T₁: Farmer practice (100% RDF), T₂: 75% RDF+Azotobacter (@2 kg/acre), T₃: 75% RDF+PSB@2 kg/acre, T₄: 75% RDF+Vermicompost@2 t/acre, T₅: 75% RDF+Azotobacter (@2 kg/acre+PSB@2 kg/acre) and T₆: 75%RDF+Azotobacter (@2 kg/acre+PSB@2 kg/acre+Vermicompost@2 t/acre Numerous growth, yield, and economic metrics were used to record the observations. The farmers who were chosen to undertake the trial received training on scientific parthenocarpic cucumber farming, including how to raise the crop, intercultural operations, fertiliser management, water management, weed management, and appropriate harvesting. The weather data of the experimental site was presented in Table 1 for the growing period of the crop.

The field was repeatedly ploughed and harrowed until it reached a perfect tillage. The experimental plot was cleared of detritus and the clods were broken. Beds were prepared and the earth was levelled. In September, the nursery plants were moved inside a polyhouse. The recommended package of measures was used to raise the crop. When the cucumber fruits reached a suitable, marketable size, the crop was harvested.

Data collection

From each plot, five plants were chosen at random to record data such as the number of fruits per plant, yield (q/acre), fruit weight (g), fruit length (cm), fruit girth (cm), and days until first harvest. Days from transplanting to first harvest were used to calculate the number of days needed for the first harvest. Fruit yield per hectare was computed and expressed in quintals (q) per acre based on the net plot yield. The formula for calculating the percentage increase was % increase = (Increase/original number) times 100.

Economic analysis

Using the most recent input market prices during the study period, the cost of cultivation and gross returns were calculated. In addition to inputs like seed, manures, fertilisers, and other materials, labour and electricity expenses for various tasks

including ploughing, weeding, irrigation, planting, bed preparation, and harvesting were taken into account based on the going market price. The formula used to calculate net returns was Net Returns (Rs/ha) = Gross Returns (Rs/ha)-Cultivation Cost (Rs/ha). The following formula was used to calculate the benefit-cost ratio (BCR): Benefit: Gross return (Rs/ha) divided by total cultivation costs (Rs/ha) is the cost ratio (BCR).

Statistical analysis was done using standard procedure given by Panse and Sukhatme (1985)^[8].

Table 1: Weather Data of the district in growing season of crop:-

Month	Average Temp °C (Max)	Average Temp °C (Min)	Average Rainfall (mm)
September 2022	36.0	23.0	188.9
October 2022	31.8	19.23	6.4
November 2022	28.3	12.7	0
December 2022	21.2	8.19	0
January 2023	17.32	6.67	8.3
February 2023	26.46	10.96	0

Results and Discussion

Days to first harvest: The results of the present investigation have been presented in Table 2. The number of days needed for harvest was significantly impacted by each treatment. The earliest treatment was T₆ (42 days), which was followed by T₅ (44 days), T₃ (45 days), T₄ and T₂ (46 days), and T₁ (48 days). In contrast to other treatments that required more days to harvest, treatment T₆ required less days. Because organic manure and biofertilizers contain more N₂ fixing, phosphate-solubilizing bacteria, and other beneficial microbes, as well as antibiotics, vitamins, hormones, and enzymes that have a better effect on early flowering and, consequently, early harvest in cucumbers, their application improves soil physico-chemical properties, plant growth, and productivity. The outcomes closely match those of Sahu *et al.* (2020)^[12].

Fruit length (cm)

Fruit length was significantly impacted by treatments. T₆ recorded the longest fruit (17.04), followed by T₅ (16.40), T₃ (16.12), T₂ (14.85), T₄ (14.80), and T₁ (13.35). It might be because inorganic fertilisers made nitrogen and other nutrients more readily available, which encouraged plant development by producing more green leaves with better photosynthesis and stronger, longer roots that could take in enough water and nutrients. Mohan *et al.* (2016)^[6], Maragal *et al.* (2018)^[5], Sahu *et al.* (2020)^[12], and Singh *et al.* (2020)^[13] all reported similar results.

Fruit girth (cm)

Fruit girth was significantly impacted by all treatments. T₆ had the largest fruit girth (14.52 cm), followed by T₅ (14.44), T₄ (14.36), T₃ (12.62), T₂ (11.40), and T₁ (10.20 cm). This may be because the combined use of chemical fertilisers, organic manures, and biofertilizers increased the yield attributes. This is because the increased levels of major elements, especially N, through the use of biofertilizers and organic manures may have accelerated the synthesis of amino acids and chlorophyll, resulting in more photosynthates being translocated from leaves to fruits, which increased fruit weight and size. Maragal *et al.* (2018)^[5] and Sahu *et al.* (2020)^[12] reported similar results.

Fruit weight (g)

Fruit weight was significantly impacted by all treatments. Treatment T₆ had the highest fruit weight (149.28 cm), followed

by T₅ (146.14), T₄ (142.66), T₃ (140.44), T₂ (130.32), and T₁ (124.18). Higher metabolic activity brought on by optimal nitrogen supply and phytohormone production, which showed up as improved growth and increased carbohydrate production that led to an increase in fruit weight, could be the cause of the rise in cucumber yield characteristics. Mohan *et al.* (2016)^[6] and Patel *et al.* (2022)^[9] reported similar results.

Number of fruits/plant

The amount of fruits per plant was significantly impacted by all treatments. The highest number of fruits per plant (19.34) was found in treatment T₆, which was followed by T₅ (18.84), T₃ (18.25), T₄ (17.70), T₂ (14.80), and T₁ (14.52). Different organic manures and biofertilizers were found to be successful in fixing nitrogen, synthesising hormones that promote plant growth, and activating enzymes, which led to a rise in the quantity of fruits per plant. Singh *et al.* (2018)^[14] and Patel *et al.* (2022)^[9] reported similar results.

Yield/plant (Kg)

All treatments had significant effect on yield/ha. Among all treatments T₆ was having highest yield (295.9 q/acre) followed

by T₅ (273 q/acre), T₄ (253.6), T₃ (257), T₂ (240.5) and T₁ (226.5 q/acre). More fruit weight, girth, and length were the main causes of T₆'s increased yield. Since the yield per hectare was determined by multiplying the yield per plot by the hectare factor, it was found that the treatment that performed better in a unit area was likely to perform better on a wide scale. The best treatment was found to be applying 75% RDF + Azotobacter (@2 kg/acre + PSB@2 kg/acre + Vermicompost@2 t/acre), which is linked to improved nutrient utilisation in the presence of biofertilizers and organic manures, which improved biological nitrogen fixation, improved root system development, and active synthesis of plant growth hormones. Similar results were published by. Singh *et al.* (2018)^[14], Mohan *et al.* (2016)^[6], Kumar *et al.* (2019)^[4], and Rathore *et al.* (2022)^[11].

Per cent increase over check

The percentage increase over check of treatment T₆ was found to be 30.64 per cent followed by T₅ (20.53 per cent), T₃ (13.46 per cent), T₄ (11.96 per cent) and T₂ (6.18 per cent). This might also due to higher fruit length, fruit girth, fruit weight, early harvest higher fruit yield.

Table 2: Growth, Yield and Yield contributing characters as influenced by different treatments in Cucumber

Treatments	Days to first harvest	Fruit length (cm)	Fruit girth (cm)	Fruit weight (g)	No. of fruits/plant	Yield /plant (kg)	Yield/ acre (q)	Per cent increase over check
T ₁	48	13.35	10.20	124.18	14.52	1.62	226.5	--
T ₂	46	14.85	11.40	130.32	14.80	1.74	240.5	6.18
T ₃	45	16.12	12.62	140.44	18.25	2.38	257.0	13.46
T ₄	46	14.80	14.36	142.66	17.70	2.40	253.6	11.96
T ₅	44	16.40	14.44	146.14	18.84	2.62	273.0	20.53
T ₆	42	17.04	14.52	149.28	19.34	3.20	295.9	30.64
SE(m)	0.730	0.161	0.138	0.481	0.064	0.082	0.413	--
CD	2.33	0.515	0.441	1.54	0.206	0.262	1.32	--

Economics

Economic analysis explains how economic behaviour is analysed and how the findings are applied to address economic issues. The input and output prices of commodities prevailed during the year of demonstration were taken for calculating cost of cultivation, net returns and benefit cost ratio. The availability of workers and a viable market for the disposal of produce also affect net profit per hectare.

Among the varieties, T₆ produced a net return of Rs. 4,59,800 per acre with a B: C ratio of 4.48, while T₅ produced a net return of Rs. 4,22,500 per acre with a B: C ratio of 4.42, T₄ produced a net return of Rs. 3,77,700 with a B: C ratio of 3.92, T₃ produced

a net return of Rs. 3,91,500 with a BC ratio of 4.12, and T₁ produced a net return of Rs. 3,39,500 with a BC ratio of 3.99. T₆ had the highest total cost of manufacturing (Rs. 132,500/-), followed by T₄ (Rs. 1,29,500/-), T₅ (Rs. 1,23,500/-), T₃ (Rs. 1,22,500/-), T₂ (1,16,500/-), and T₁ (1,13,500/-).

Any crop's cost-benefit ratio is a crucial component that influences a farmer's decision to cultivate a certain crop. Any horticultural practice that a farmer adopts must have a favourable impact on the cost-benefit ratio. Generally speaking, farmers adopt strategies that guarantee lower cultivation costs, which boosts profitability. The findings are consistent with those of Rathore *et al.* (2022)^[11] and Prabhu *et al.* (2006)^[10].

Table 3: Economic returns from different treatments in cucumber

Treatments	Gross return (Rs./acre)	Gross cost (Rs./acre)	Net return (Rs./acre)	BC Ratio
T ₁	4,53,000	1,13,500	3,39,500	3.99
T ₂	4,81,000	1,16,500	3,64,500	4.12
T ₃	5,14,000	1,22,500	3,91,500	4.19
T ₄	5,07,200	1,29,500	3,77,700	3.92
T ₅	5,46,000	1,23,500	4,22,500	4.42
T ₆	5,91,800	1,32,000	4,59,800	4.48

Conclusion

Vegetable protected farming can be used to produce high-value vegetable harvests all year long. Under polyhouse conditions, the growth and yield parameters of parthenocarpic cucumbers are greatly affected by the integration of several organic and biofertilizer sources of nutrients with optimal inorganic fertiliser treatment. The experiment's findings showed that T₆

(75%RDF+Azotobacter @2Kg/acre+PSB@2Kg/acre + Vermicompost @2t/acre) had the best yield, with a BC ratio of 4.48. T₅ and T₃ had BC ratios of 4.42 and 4.19, respectively.

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