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The growth, yield and quality of cucumber (*Cucumis sativus* L.) as influenced by organic sources

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Abstract

Field experiment was carried out at carried out during early summer 2024 in the department of horticulture, Horticulture Research Farm, R.A.K., College of Agriculture, Sehore (M.P.). This experiment was laid out in a Randomized Block Design (RBD) with four replications and five treatments. The experimental crop cucumber was line sown with the spacing of 1m*0.5m. This study evaluated the effects of various treatments on plant growth and development at different growth intervals. The treatments included 100% Nitrogen through Poultry, 100% Nitrogen through City Compost, and RDF (Control). Among the treatments, 100% Nitrogen through Poultry (T_3) consistently exhibited the highest growth parameters. The highest vine length (555.32cm) and number of fruits per vine (8.90) were also found in T_3. The 100% Nitrogen through FYM treatment, T_4, consistently showed the lowest growth parameters, with the lowest leaf area (1301.33 cm²) and number of fruits per vine (5.77) at harvest. These results demonstrate the positive effects of combining 100% Nitrogen through Poultry on plant growth and yield parameters.

Keywords: Cucumber, organic sources, growth, yield, and quality

Introduction

Cucumber (*Cucumis sativus* L.) is widely cultivated as a summer vegetable, valued for its high-water content and various culinary uses, including consumption in salads, cooked dishes, and pickling (Kumar *et al.*, 2018) [13]. The term 'Cucurbit' was coined by Liberty Hyde Bailey to describe cultivated species of the gourd family, which includes over 100 genera and 800 species that thrive in warm climates worldwide (Singh *et al.*, 2017) [22]. The cucumber, which originated in India and Africa (Alhasnawi *et al.*, 2020 [2] and Marliah *et al.*, 2020) [16], requires specific growing conditions, particularly temperatures between 26 to 30 °C with abundant sunlight for optimal growth (Saeed *et al.*, 2015) [20].

In India, cucumber production is substantial, reaching 1,500 thousand tonnes from an area of 90,000 ha, with Rajasthan alone contributing 3,500 tonnes from 1,000 ha (Anonymous, 2024a, b) [3, 4]. Nutritionally, cucumbers are highly beneficial, containing 96.3% moisture, low amounts of carbohydrates, fat, and protein, and providing essential minerals like iron and vitamin C (Bhattacharya *et al.*, 2015) [6]. Beyond their culinary and nutritional value, cucumbers are also used for medicinal purposes due to their hydrating and cooling properties, as well as their ability to aid digestion and detoxify the body.

Cucumber cultivation is primarily limited to open field systems in India, where biotic and abiotic stresses pose challenges to achieving optimal yields and quality. To mitigate these challenges, protected cultivation techniques, such as polyhouse farming, offer a controlled environment that enhances cucumber production by protecting crops from extreme climatic conditions and pests (Mishra *et al.*, 2010 and Duhan, 2016) [7, 17]. Under protected structures, cucumbers are known to yield approximately 3.5 times higher than those grown in open field conditions (Ganesan and Subashini, 1999) [8].

Traditionally, chemical fertilizers have played a major role in boosting crop production; however, over-reliance on these synthetic inputs has led to various environmental concerns, such as soil degradation and nutrient imbalances (Hayat *et al.*, 2010) [11]. The need for sustainable agricultural practices has therefore led to increased interest in organic farming and the use of organic fertilizers like farm yard manure (FYM) and vermicompost. Studies by Akanbi *et al.* (2002) [1] and Ayuso *et al.* (1996) [5] have shown that the application of organic amendments such as FYM and vermicompost improves soil fertility and microbial activity, leading to better root development, enhanced nutrient availability, and ultimately higher yields. Furthermore, vermicompost, as highlighted by Jambhelkar (1994) [12], contains essential nutrients like nitrogen, phosphorus, potassium, and micronutrients that promote plant growth while being environmentally friendly. Thus, the use of organic sources for cucumber cultivation not only improves

soil health but also enhances crop quality and productivity, contributing to sustainable farming practices. This research explores how organic inputs, such as FYM and vermicompost, influence the growth, yield, and quality of cucumber, with an emphasis on their role in mitigating the adverse effects of chemical fertilizers and promoting sustainable agricultural practices.

Materials and Methods

Field experiment was carried out at carried out during March 2024 at Horticulture Research Farm, R.A.K., College of Agriculture, Sehore (M.P.). Sehore. It is situated in the Vindhya Plateau in western part of M.P at 230.10" N latitude and 760.64" E longitude with an altitude of 501.5 m above mean sea level. Sehore region comes under sub-tropical region, having a temperature ranging from 28-41 °C maximum and 8-24 °C minimum in summer and winter season, respectively. It is hotter during April to May while coolest in December to mid-January. Relative humidity generally fluctuates between 24.8 and 90%. In this area, most of the rainfall is received during June to late September, while winter rains are occasional. The annual rainfall is recorded 1000-1225 mm. The soil of the experimental field was medium black soil with good drainage and uniform texture. This experiment was laid out in a Randomized Block Design (RBD) with three replications with the plot size 4m x 4m. Seeds are line sowed at the rate of 2 kg/ha. Treatment details are T1 - RDF (control), T2 - 100% Nitrogen through vermicompost, T3 - 100% Nitrogen through poultry, T4 - 100% Nitrogen through FYM and T5 - 100% Nitrogen through city compost.

Results

Growth parameters

Vine length, number of primary branches, secondary branches, chlorophyll content, leaf area, and leaf area index showed significant variation across different treatments at 30, 60, and 90 DAS. At 30 DAS, the highest vine length was recorded in T3 (Poultry) with 293.17 cm, followed by T5 (City Compost) with 275.15 cm, and the lowest in T4 (FYM) with 243.34 cm. The number of primary branches was also highest in T_3 (6.11 branches), while T_4 had the fewest (4.48 branches). At 60 DAS, T_3 again showed the highest vine length (418.28 cm), followed by T_5 (388.60 cm), and the lowest in T_4 (377.96 cm). The number of primary branches was also highest in T_3 (10.17 branches), with T_4 having the fewest (8.29 branches). By 90 DAS, T_3 continued to outperform the others with the longest vine length (555.32 cm), the highest number of primary branches (13.19), and the most secondary branches (9.01). T_4 consistently showed the lowest values across most parameters, including vine length (446.11 cm), primary branches (11.43), and secondary branches (7.53). Chlorophyll content was highest in T3 at 30 DAS (40.46 SPAD/mg g^{-1}), 60 DAS (60.26 SPAD/mg g^{-1}), and 90 DAS (80.40 SPAD/mg g^{-1}), with T_4 showing the lowest chlorophyll content across all stages. Similarly, leaf area and leaf area index were greatest in T_3, with the largest leaf area at 30 DAS (382.98 cm^2), 60 DAS (914.90 cm^2), and 90 DAS (1501.28 cm^2). T_3 also had the highest leaf area index at all stages, reaching 0.0255 at 30 DAS, 0.0610 at 60 DAS, and 0.1001 at 90 DAS. T_4 had the smallest leaf area and leaf area index, showing the least growth at each stage.

Yield parameters

The data analyzed on various fruit characteristics significant differences across treatments. T_3 (100% Nitrogen through Poultry) consistently performed the best, recording the highest values for the number of fruits per vine (8.90), fruit length (22.09 cm), fruit diameter (4.29 cm), average fruit weight (221.56 g), fruit yield per vine (7.93), yield per plot (63.89 kg), and yield per hectare (41.23 kg/ha). In contrast, T4 (100% Nitrogen through FYM) showed the lowest values in all parameters, with the lowest number of fruits per vine (5.77), shortest fruit length (14.67 cm), smallest fruit diameter (3.52 cm), lowest average fruit weight (199.37 g), fruit yield per vine (5.73), yield per plot (50.93 kg), and yield per hectare (33.00 kg/ha). T_5 (100% Nitrogen through City Compost) showed moderate results, ranking second in most parameters. However, the Total Soluble Solids (T.S.S.) in °Brix showed no significant differences among treatments.

Table: 1: Effect of different organic sources on growth of cucumber

S.No.	Vine length (cm)			Number of primary branches			Number of secondary branches			Chlorophyll content (SPAD/mgg^{-1})			Leaf area (cm^2)			Leaf area index		
	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
T_1	263.86	382.00	472.05	5.35	9.00	12.33	0.00	4.53	8.43	36.64	56.73	76.25	375.40	863.73	1423.35	0.0250	0.0576	0.0949
T_2	252.99	381.44	456.45	4.78	8.76	12.07	0.00	4.45	8.14	34.28	53.25	74.54	366.78	754.55	1336.48	0.0244	0.0503	0.0891
T_3	293.17	418.28	555.32	6.11	10.17	13.19	0.00	5.00	9.01	40.46	60.26	80.40	382.98	914.90	1501.28	0.0255	0.0610	0.1001
T_4	243.34	377.96	446.11	4.48	8.29	11.43	0.00	4.05	7.53	33.29	50.85	72.03	358.63	701.08	1301.33	0.0239	0.0467	0.0867
T_5	275.15	388.60	500.57	5.71	9.66	12.77	0.00	4.85	8.81	38.74	58.94	78.95	379.01	861.55	1456.95	0.0252	0.0574	0.0971

SE(m)	7.24	3.90	3.63	0.26	0.29	0.35	-	0.19	0.29	1.13	1.82	0.88	5.24	9.49	6.08	0.01	0.01	0.01
C.D. @ 5%	21.44	11.54	10.74	0.78	0.87	1.05	-	0.57	0.87	3.34	5.38	2.59	15.51	28.09	17.99	0.01	0.01	0.01

Table: 2: Effect of different organic sources on yield and quality of cucumber

S. No.	Number of fruits per vine	Fruit length (cm)	Fruit diameter (cm)	Average fruit weight (g)	Fruit yield per vine	Yield per plot (kg)	Yield per hectare	T.S.S. (^{0}Brix)	B:C Ratio
T_1	6.99	17.05	3.97	204.28	7.38	57.73	37.40	3.81	3.93
T_2	6.23	16.13	3.81	203.88	6.95	53.38	35.73	3.72	3.72
T_3	8.90	22.09	4.29	221.56	7.93	63.89	41.23	4.06	4.43
T_4	5.77	14.67	3.52	199.37	5.73	50.93	33.00	3.65	3.69
T_5	7.71	18.56	4.03	208.62	7.45	61.45	39.00	3.94	4.28
SE(m)	0.24	0.55	0.15	3.46	0.28	0.28	0.59	0.16	-
C.D. @ 5%	0.70	1.62	0.46	10.24	0.84	0.81	1.75	NS	-

Discussion

Growth parameters

The application of poultry manure as a 100% nitrogen source has shown significant positive effects on various growth parameters of cucumber. Treatment T_3, which involves providing nitrogen through poultry manure, has been particularly effective in enhancing vine length, with Jadhav *et al.* (2018) and Siddiqui *et al.* (2020) confirming its role in promoting plant growth by improving nutrient availability. The gradual release of nitrogen from poultry manure also contributes to better root development, leading to increased primary and secondary branch formation, as observed by Sharma *et al.* (2016) and Singh *et al.* (2017) [22]. Additionally, the balanced nutrient composition of poultry manure has been shown to enhance chlorophyll content, with Singh and Yadav (2014) and Khan *et al.* (2015) noting significant improvements in SPAD values, indicating better photosynthetic efficiency. The steady nitrogen release also promotes larger leaf areas, as demonstrated by Zhang *et al.* (2021) and Sharma *et al.* (2022) [21], while improving the leaf area index (LAI), which correlates with higher photosynthetic capacity and overall plant productivity (Zhang *et al.*, 2010 and Khan *et al.*, 2015) [24]. The slow-release nitrogen in poultry manure ensures sustained growth, supporting better leaf development, vine elongation, and overall plant vigor, making it a highly effective organic fertilizer for cucumber cultivation.

Yield and Quality parameters

The application of poultry manure as a 100% nitrogen source has been shown to significantly enhance various yield parameters in cucumber improving both the quantity and quality of the produce. The number of fruits per vine is notably increased due to the nutrient-rich composition of poultry manure, which enhances soil microbial activity, improves flowering, and ensures better fruit set, as evidenced by Sharma *et al.* (2022) [21] and Zhang *et al.* (2010) [24]. Similarly, fruit length and diameter are significantly improved, as poultry manure promotes sustained plant growth and provides balanced nutrient release. Studies by Patel *et al.* (2021) [19] and Gupta *et al.* (2019) [9] demonstrated that cucumbers treated with poultry manure had longer and larger fruits compared to those treated with synthetic fertilizers, due to the steady availability of nitrogen and improved soil conditions. Furthermore, the application of poultry manure results in heavier fruits, as shown by Patel *et al.* (2020) [18] and Kumar *et al.* (2018) [13], who attributed the increased fruit weight to improved nutrient uptake and soil health. These improvements also extend to overall fruit yield per vine, with multiple studies, including those by Gupta *et al.* (2020) [10] and Kumar *et al.* (2022) [15], highlighting the superior yield performance of cucumbers treated with poultry manure. Similarly, poultry manure boosts the yield per plot and hectare, enhancing productivity through better nutrient cycling, soil structure, and water retention, as observed by Kumar *et al.* (2022) [15] and Singh *et al.* (2021) [23]. Overall, poultry manure, with its organic nutrient profile and slow-release properties, has proven to be an effective and sustainable fertilizer for increasing cucumber yield, surpassing the effects of synthetic fertilizers in both quantity and quality.

Conclusions

This study demonstrates the benefits of using organic fertilizers, particularly poultry manure, in cucumber cultivation. Poultry manure, as a 100% nitrogen source, significantly improved growth, and yield parameters, leading to higher fruit production and better quality. Economically, poultry manure offered a favorable benefit-cost ratio (BCR), providing long-term gains through increased yield, improved soil health, and reduced fertilization costs, making it a sustainable and cost-effective option for organic farming. In contrast, farmyard manure showed the least effectiveness.

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