



Effect of Organic and Inorganic Fertilizers on Growth, Yield and Quality of Broccoli (*Brassica oleracea var. italica*)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out with title 'Effect of organic and inorganic fertilizers on growth, yield and quality of broccoli (*Brassica oleracea var. italica*)' at the Horticulture Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj, Uttar Pradesh during *Rabi* in 2022-23 with a view to identify the effects of different doses of organic and inorganic fertilizers and its role in growth, yield and quality of Broccoli variety Pusa KTS-1. The experiment was laid in Randomized block design with 15 treatments including control and 3 replications with different combinations of plant growth regulators. Under this experiment, overall, 15 treatments were taken including RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t . Different Organic and inorganic fertilizers were used comprised of Nitrogen, FYM, Vermicompost and Poultry manure, at different doses. According to the current research, the use of Nitrogen and various organic fertilizers had a significant positive impact on the growth and development of Broccoli. Among the various treatments that were evaluated, T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% PoultryManure) best in terms of plant height (70.73 cm), number of leaves (17.27), Leaf area (33.87 cm²), days to first curd

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initiation (55.63 DAT), days to horticultural maturity (68.63 DAT), curd diameter (17.67 cm), curd weight (341.5g), curd yield per plot (3.07Kg), curd yield per hectare (12.64 t), TSS (11.2^oBrix) and ascorbic acid (105.13mg/100g).

Keywords: Nitrogen, FYM, Vermicompost, Poultry manure, Broccoli.

1. INTRODUCTION

Broccoli (*Brassica oleracea var. italica*) is one of the most nutritious vegetable amongst the cole crops grown for its tender heads. It belongs to the family brassicaceae and originated from the Mediterranean region [1]. United States of America is the largest producer of sprouting broccoli in the world. Broccoli is available in three different colours viz., green, yellow and purple, out of which green colour type is generally preferred.

In India, the cultivation of sprouting broccoli is gaining popularity among the growers for the last few years obviously due to increasing demand in cosmopolitan cities and awareness of its high nutritive values. Sprouting broccoli is occupying an important place as cool season vegetable. In Himachal Pradesh, it is an important vegetable crop and farmers are getting lucrative returns by selling their produce in nearby markets.

Broccoli contains indole-3-carbinol, which helps to fight breast and lung cancer. Besides its anticarcinogenic properties, broccoli is a rich source of vitamins, minerals and proteins. It has about 130 times more vitamins A content than cauliflower and 22 times more than cabbage. It is richest source of sulphoraphane, a compound associated with reducing risk of cancer in human beings [1].

In recent years its cultivation has gained momentum in India. It is grown in an area of 3,776 acre with annual production of 26,612(000 lbs) and productivity of 7.04000 lbs per acre.

Farm Yard Manure (FYM) is a valuable organic fertilizer that plays a significant role in agriculture and gardening. Composed of animal waste and bedding materials, It offers numerous benefits to the soil and plants. In this comprehensive explanation, we will delve deeper into the characteristics, advantages, and u as well as its uses impact on soil fertility and plant growth.

Poultry manure is a specific type of animal waste commonly used as organic fertilizer in agriculture and gardening. It refers to the excrement produced by domesticated birds, primarily

chickens raised for meat or egg production. It is highly regarded for its nutrient-rich composition and beneficial effects on soil fertility and plant growth. Poultry manure contains significant amounts of nitrogen (N), phosphorus (P), potassium (K), and other essential nutrients required for plant development.

Vermicompost is highly regarded for its beneficial properties in soil improvement and plant growth. It is rich in nutrients, including nitrogen, phosphorus, potassium, calcium, magnesium, and trace elements.

2. MATERIALS AND METHODS

The investigation entitled "Effect of organic and inorganic fertilizers on growth, yield and quality of Broccoli (*Brassica oleracea var. italica*) was done to understand the plant growth, curd yield and quality of Broccoli using different combinations of treatment. The investigation was carried out at Horticultural Research Farm (HRF), Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj during the November to Febuary, The experiment was conducted in Factorial Randomized Block Design (FRBD) with 15 treatments in three replications viz. T₀: RDF (100 Kg N+80 Kg P + 60 Kg K) + FYM @ 25 t, T₁: 60% N + 40% FYM, T₂: 60% N + 40% Vermicompost, T₃: 60% N +40% Poultry Manure, T₄: 60% N + 20% FYM + 20% Vermicompost, T₅: 60% N + 20% Vermicompost + 20% Poultry Manure, T₆: 60% N + 20% FYM + 20% Poultry Manure, T₇: 60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure, T₈: 80% N + 20% FYM, T₉: 80% N + 20% Vermicompost, T₁₀: 80% N + 20% Poultry Manure, T₁₁: 80% N + 10% FYM + 10% Vermicompost, T₁₂: 80% N +10% Vermicompost + 10% Poultry Manure, T₁₃: 80% N + 10% FYM + 10% Poultry Manure and T₁₄: 80% N + 6.6% FYM + 6.6% Vermicompost + 6.6% Poultry Manure. Prayagraj falls in central plain sub-zone of Agro-climatic zone V (*Source: Perspective and Strategic Plan (SPSP) for IWMP of Uttar Pradesh, Department of Land Development and Water Resources, Government of U.P.*). Naini is situated between

the parallels of 20° 33' 40" to 21' .50' N latitude and 73° 27' 58" and 73° 56' 36" E longitude. The climate of this area is tropical characterized by fairly hot summer, moderately cold winter with humid and warm monsoon. The rainfall of this region is heavy and normally received from June to September with tomato hybrid Pusa KTS-1 (IARI). Crop was transplanted with the spacing of 60cm X 45cm with the addition of NPK as a basal dose along with application of organic and inorganic manures which was done at 20 ,40, and 60 days after transplanting. The data was recorded for the following parameters viz. Plant height (cm) [at 20, 40 and 60 DAT] number of leaves, leaf area(cm) ,Days to curd initiation, Days to horticultural maturity, curd diameter(mm), curd weight(g), curd yield per plot(kg), curd yield per hectare (t), Total Soluble Acid (°Brix) and Ascorbic Acid (mg /100g).

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

3.1.1 Plant height (cm) and number of leaves at 20 DAT, 40 DAT and 60 DAT

Analysis of plants showed a significant effect on plant height and number of leaves at 20, 40 and 60 DAT. The maximum plant height (70.73 cm) and number of leaves (17.27) at 60 DAT was observed with treatment T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) and minimum plant height (61.67 cm) was observed in T₀ (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t), while the remaining treatments were moderate in their growth habit. Organic fertilizers positively affect the plant height of broccoli by providing a slow-release supply of nutrients, improving soil fertility, stimulating microbial activity, and containing essential micronutrients. The slow-release nature of organic fertilizers ensures a steady nutrient availability, promoting steady and sustained plant growth, including height development and increases the number of leaves. Similar findings were reported by Magd et al. [2]; Sharma et al. [3] and Kumar et al. [4].

3.2 Earliness Parameters

3.2.1 Days to curd initiation (DAT) and days to horticultural maturity (DAT)

Analysis of the plants shows a significant effect on days to curd initiation and days to horticultural maturity. Minimum days to curd initiation and

days to horticultural maturity was observed in T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 55.63 DAT and 68.63 DAT respectively while the maximum days to curd initiation and days to horticultural maturity was recorded in T₀ (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t) with 60.87 DAT and 75.87 DAT respectively. Organic fertilizers contributed to the earliness parameter of broccoli by providing a steady supply of nutrients, supporting healthy growth, and potentially accelerating the plant's overall development and the production of edible heads. Similar findings were reported by Maurya et al., [5], Wani et al. [6], Sarangthem et al. [7] and Mal et al. [8].

3.3 Yield Parameters

3.3.1 Curd diameter (cm), curd weight (g), curd yield per plot (Kg) and curd yield per hectare (t)

The data pertaining curd diameter varied significantly. Maximum curd diameter was observed in T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 17.67 cm while the minimum curd diameter was recorded in T₀ (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t) with 15.2 cm. Organic fertilizers enhanced soil fertility and root development, facilitating efficient nutrient absorption and curd formation. The micronutrients present in organic fertilizers contribute to optimal nutrient balance for curd growth. Proper timing and application of organic fertilizer are important for maximizing curd diameter. Similar findings were reported by Bahadur et al. Chander et al. [9] and Chatterjee et al. [10]. The maximum curd weight, curd yield per plot and curd yield per hectare were recorded T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 341.5 g, 3.07 Kg and 12.64 tha⁻¹ while the minimum curd diameter was recorded in T₀ (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t) with 250.4 g, 2.25 Kg and 9.27 tha⁻¹. The balanced nutrient availability supports healthy curd development and contributes to increased curd weight. Enhanced soil fertility and root development facilitated by organic fertilizers promote efficient nutrient absorption and curd growth. The presence of micronutrients in organic fertilizers ensures optimal nutrient balance, further enhancing curd weight and maximum yield potential. Similar findings were reported by Khan et al., [11], Dalal et al., [12], Singh et al., [13] and Chaudhary et al., [14].

Table 1. Plant height (cm) and number of leaves at 20 DAT, 40 DAT and 90 DAT

Treatment Notation	Treatment Details	Plant height [20 DAT]	Plant height [40 DAT]	Plant height [60 DAT]	Number of leaves [20DAT]	Number of leaves [40DAT]	Number of leaves [60DAT]
T ₀	RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t	28.73	51.67	61.67	2.83	6.27	12.2
T ₁	60% N + 40% FYM	27.77	52.77	62.77	2.73	6.73	12.73
T ₂	60% N + 40% Vermicompost	27.1	53.57	63.57	2.7	7.13	13.13
T ₃	60% N + 40% Poultry Manure	26.77	54.27	64.27	2.87	7.47	13.47
T ₄	60% N + 20% FYM + 20% Vermicompost	27.17	55.03	65.03	2.83	7.87	13.87
T ₅	60% N + 20% Vermicompost + 20% Poultry Manure	26.63	55.73	65.67	2.9	8.2	14.2
T ₆	60% N + 20% FYM + 20% Poultry Manure	27.43	56.37	66.37	2.8	8.4	14.4
T ₇	60% N + 13.3% FYM + 13.3% Vermicompost + 13.3%PoultryManure	26.8	60.73	70.73	2.97	11.2	17.27
T ₈	80% N + 20% FYM	27.33	57.37	67.37	2.77	8.57	14.57
T ₉	80% N + 20% Vermicompost	30.93	57.87	67.87	3.27	8.93	14.87
T ₁₀	80% N + 20% Poultry Manure	32.9	58.5	68.5	2.87	9.33	15.33
T ₁₁	80% N + 10% FYM + 10% Vermicompost	32	58.87	68.87	2.87	9.73	15.73
T ₁₂	80% N +10% Vermicompost + 10% Poultry Manure	29.53	59.43	69.43	2.87	10.13	16.13
T ₁₃	80% N + 10% FYM + 10% Poultry Manure	29.53	59.87	69.87	3.03	10.47	16.47
T ₁₄	80% N + 6.6% FYM + 6.6% Vermicompost + 6.6% Poultry Manure	28.8	60.27	70.27	3.07	10.73	16.73
F- TEST		S	S	S	NS	S	S
S.E. (d) ±		1.39	0.12	0.12	0.17	0.09	0.09
C.D. 0.05		2.87	0.24	0.27	N/A	0.18	0.19
C.V.		5.96	0.26	0.22	7.33	1.23	0.8

Table 2. Days to curd initiation, days to horticulture maturity, curd diameter (cm) and curd weight (g)

Treatment Notation	Treatment Details	Days to curd initiation	Days to horticulture maturity	Curd diameter	Curd weight	Curd yield per plot	Curd yield per hectare
T ₀	RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t	60.87	75.87	15.2	250.4	2.25	9.27
T ₁	60% N + 40% FYM	60.57	75.57	15.33	274.13	2.47	10.15
T ₂	60% N + 40% Vermicompost	60.07	75.07	15.53	280.27	2.52	10.38
T ₃	60% N + 40% Poultry Manure	59.8	74.8	15.67	276.57	2.49	10.25
T ₄	60% N + 20% FYM + 20% Vermicompost	59.53	74.53	15.7	286.33	2.58	10.61
T ₅	60% N + 20% Vermicompost + 20% Poultry Manure	59.07	74.07	15.9	293.2	2.64	10.86
T ₆	60% N + 20% FYM + 20% Poultry Manure	58.8	73.5	16.2	299.07	2.69	11.08
T ₇	60% N + 13.3% FYM + 13.3% Vermicompost + 13.3%PoultryManure	55.63	68.63	17.67	341.5	3.07	12.64
T ₈	80% N + 20% FYM	58.5	71.8	16.33	304.9	2.75	11.31
T ₉	80% N + 20% Vermicompost	58.13	71.13	16.53	309.07	2.78	11.45
T ₁₀	80% N + 20% Poultry Manure	57.67	70.67	16.67	315.23	2.84	11.68
T ₁₁	80% N + 10% FYM + 10% Vermicompost	57.47	70.47	16.73	319.63	2.88	11.84
T ₁₂	80% N +10% Vermicompost + 10% Poultry Manure	57.03	70.03	16.92	325.13	2.93	12.05
T ₁₃	80% N + 10% FYM + 10% Poultry Manure	56.57	69.57	17.27	328.77	2.96	12.18
T ₁₄	80% N + 6.6% FYM + 6.6% Vermicompost + 6.6% Poultry Manure	56.13	69.13	17.33	330.37	2.97	12.22
F- TEST		S	S	S	S	S	S
S.E. (d) ±		0.07	0.07	0.09	0.52	0.02	0.02
C.D. 0.05		0.15	0.14	0.19	1.07	0.08	0.08
C.V.		0.13	0.12	0.8	0.22	0.19	0.19

Table 3. Total soluble solid (⁰Brix) and ascorbic acid (mg/100g)

Treatment Notation	Treatment Details	Total Soluble Solid	Ascorbic acid
T ₀	RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t	90.4	75.87
T ₁	60% N + 40% FYM	92.37	75.57
T ₂	60% N + 40% Vermicompost	93.2	75.07
T ₃	60% N + 40% Poultry Manure	94.13	74.8
T ₄	60% N + 20% FYM + 20% Vermicompost	95.2	74.53
T ₅	60% N + 20% Vermicompost + 20% Poultry Manure	96.23	74.07
T ₆	60% N + 20% FYM + 20% Poultry Manure	98.07	73.5
T ₇	60% N + 13.3% FYM + 13.3% Vermicompost + 13.3%PoultryManure	105.13	68.63
T ₈	80% N + 20% FYM	98.6	71.8
T ₉	80% N + 20% Vermicompost	99.37	71.13
T ₁₀	80% N + 20% Poultry Manure	99.87	70.67
T ₁₁	80% N + 10% FYM + 10% Vermicompost	100.47	70.47
T ₁₂	80% N +10% Vermicompost + 10% Poultry Manure	101.33	70.03
T ₁₃	80% N + 10% FYM + 10% Poultry Manure	102.57	69.57
T ₁₄	80% N + 6.6% FYM + 6.6% Vermicompost + 6.6% Poultry Manure	103.47	69.13
F- TEST		S	S
S.E. (d) ±		0.07	0.14
C.D. _{0.05}		0.15	0.29
C.V.		0.13	0.18

3.4 Qualitative Parameters

3.4.1 Total soluble solid (⁰Brix) and ascorbic acid (mg/100g)

The data pertaining Total Soluble Solid and ascorbic acid varied significantly. The Maximum Total Soluble Solid and ascorbic acid was observed in T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 11.2 ⁰Brix and 105.13 mg/100g respectively while minimum Total Soluble Solid and ascorbic acid was recorded in T₀ (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t) with 6.27 ⁰Brix and 90.4 mg/100g respectively. The impact of organic fertilizers on the Total Soluble Solids (TSS) content of broccoli, representing sweetness or sugar content and ascorbic acid i.e. Vitamin – C influenced by factors such as nutrient balance, soil health, environmental conditions, and cultivar selection. Organic fertilizers provide a balanced nutrient supply, which affected the carbohydrate synthesis and mineral accumulation in broccoli, potentially influencing higher TSS levels and ascorbic acid. Similar research confirming the findings were reported by Sawan et al., (2010) and Yadav et al., [15].

4. CONCLUSION

Based on the findings of experiment entitled “Effect of Organic and Inorganic Fertilizers on growth, yield and quality of Broccoli (*Brassica oleracea var. italica*)”, it is concluded that T₇ (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% PoultryManure) is best in terms of plant height, number of leaves, leaf area, days to curd initiation, days to curd maturity, curd diameter, curd weight, curd yield per plot, curd yield per hectare, TSS and ascorbic acid T₁₃(80% N + 10% FYM + 10% PM) is best.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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