Original Research Article

Effect of organic and inorganic fertilizers on growth, yield and quality of broccoli (Brassica *oleracea var. italica*).

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 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 and 3 replications with different combination in 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, T_7 (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 cm^2), days to first curd 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 (11.2^0Brix) 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 (**Thamburaj and Singh, 2001**). 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 **(Thamburaj and Singh, 2001).**

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*. T_0: RDF (100 Kg N+80 Kg P + 60 Kg K) + FYM @ 25 t, T_1: 60% N + 40% FYM, T_2: 60% N + 40% Vermicompost, T_3: 60% N +40% Poultry Manure, T_4: 60% N + 20% FYM + 20% Vermicompost, T_5: 60% N + 20% Vermicompost + 20% Poultry Manure, T_6: 60% N + 20% FYM + 20% Poultry Manure, T_7: 60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure, T_8: 80% N + 20% FYM, T_9: 80% N + 20% Vermicompost, T_{10}: 80% N + 20% Poultry Manure, T_{11}: 80% N + 10% FYM + 10% Vermicompost, T_{12}: 80% N +10% Vermicompost + 10% Poultry Manure, T_{13}: 80% N + 10% FYM + 10% Poultry Manure and T_{14}: 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 DISSCUSSIONS

3.1. Growth Parameters

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 T_7 (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) and minimum plant height (61.67 cm) was observed in T_0 (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.* (2006); Sharma *et al.* (2008) and Kumar *et al.* (2010)

3.2. Earliness parameters

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 T_7 (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 T_0 (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.*, (2008), Wani *et al.* (2011), Sarangthem *et al*. (2011) and Mal *et al*. (2015)**.**

3.3. Yield parameters

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 T_7 (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 17.67 cm while the minimum curd diameter was recorded in T_0 (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*. (2004), Chander *et al*. and Chaterjee *et al*. (2005). The maximum curd weight, curd

yield per plot and curd yield per hectare were recorded T_7 (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 T_0 (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*., (2009), Dalal *et al*., (2010), Singh *et al*., (2011) and Chaudhary *et al*., (2012).

3.4. Qualitative parameters

3.4.1. Total Soluble Solid (^{0}Brix) 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 T_7 (60% N + 13.3% FYM + 13.3% Vermicompost + 13.3% Poultry Manure) with 11.2 ^{0}Brix and 105.13 mg/100g respectively while minimum Total Soluble Solid and ascorbic acid was recorded in T_0 (RDF (100 Kg N+80 Kg P+60 Kg K) + FYM @ 25 t) with 6.27 ^{0}Brix 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*., (2012).

REFERENCES

Bahadur A, Singh J and Singh K P. 2004. Response of cabbage to organic manures and biofertilizers. *Indian Journal of Horticulture* 61(3): 178-179.

Chander G, Verma T S and Sharma S. 2010. Nutrient content of cauliflower (Brassica oleracea L. var. botrytis) as influenced by boron and farmyard manure in north west Himalayan alfisols. *Journal of the Indian Society of Soil Science* 58(2): 248-251.

Chaterjee B, Ghanti P, Thapa U and Tripathy P. 2005. Effect of Organic Nutrition In Sprouting Broccoli (Brassica Oleracea L. Var. Italica Plenck). *Vegetable Science* 32(1): 51-54.

Choudhary S, Soni A K and Jat N K. 2012. Effect of organic and inorganic sources of nutrients on growth, yield and quality of sprouting broccoli cv.CBH-1. *Indian Journal of Horticulture* 69(4): 550-554.

Dalal V V, Bharadiya P S and Aghav V D. 2010. Effect of organic and inorganic sources of nitrogen on growth and yield of cabbage (Brassica oleracea L. var. capitata). *Asian Journal of Horticulture* 5(2): 291-293.

Khan N, Dubey A P, Ram P and Mishra A. 2009. Integrated nutrient

management in broccoli (Brassica olaracia L. italica Plenck). *Plant Archives* 9(1): 423-425.

Kumar V, Kumar V, Tyagi A K, Singh B and Kumar N. 2010. Effect of vermicompost and VAM inoculation on growth and yield of cauliflower (Brassica oleracea L.var. botrytis). *Progressive Agriculture* 10: 197-199.

Magd M A, Bassiony A M and Fawzy Z F. 2006. Effect of organic manure with or without chemical fertilizers on growth, yield and quality of some varieties of broccoli plants. *Journal of Applied Sciences Research* 2(10): 791-798.

Mal D, Chatterjee R and Nimbalkar K H. 2015.Effect of Vermi-Compost And Inorganic Fertilizers on Growth, Yield And Quality of Sprouting Broccoli (Brassica Oleracea L. Var. Italica Plenck). *International Journal of Bio-Resource and Stress Management* 5(4):507-512.

Maurya A K, Singh M P, Srivastava B K, Singh Y V, Singh D K, Singh S and Singh P K. 2008. Effect of organic manures and inorganic fertilizers on growth characters, yield and economics of sprouting broccoli cv. Fiesta. *Indian Journal of Horticulture* 65(1): 116-118.

Sarangthem I, Misra A D D and Chakraborty Y. 2011. Cabbage productivity, nutrient uptake and soil fertility as affected by organic and bio-sources. *Agricultural Science Digest* 31(4): 260-264.

Sharma A, Parmar D K, Kumar P, Singh Y and Sharma R P. 2008. Azotobacter soil amendment integrated with cow manure reduces need for NPK fertilizers in sprouting broccoli. *International Journal of Vegetable Science*. 14(3): 273-285.

Singh J P, Singh O V and Solanki V P S. 2011. Effect of potassium and boron on yield and uptake of nutrients by cauliflower. *Annuals of Horticulture* 2(1): 80-82.

Thamburaj S and Singh N. 2001. *Textbook of Vegetables, Tubercrops and Spices. ICAR*. New Dehli. 469.

Wani A B J, Raj Narayan, Ahmed N, Singh A K, Chattoo M A and Sumati N. 2011. Influence of organic and inorganic sources of nutrients on growth, yield and quality of cauliflower (Brassica oleracea L. Var. botrytis). *Environment and Ecology* 29(4A): 1941-1947.

Yadav L P, Kavita A and Maurya I B. 2012. Effect Of Nitrogen And Biofertilizers On Growth Of Cabbage (Brassica Oleracea Var Capitata L.) Var. Pride Of India. *Progressive Horticulture* 44(2): 318-320.

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 (^{0}Brix) 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**