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Effect of organic manures and inorganic fertilizers on growth, yield and quality of broccoli (*Brassica oleracea* var. *italic*) C.V - green comet

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Abstract
The present study entitled "Effect of Organic Manures and Inorganic Fertilizers on Growth, Yield and Quality of Broccoli (*Brassica oleracea* var. *italic*) c.v.- Green comet" was carried out during the Rabi season 2018-2019. The experiment was carried out in a Randomized block design consisting of 12 treatments with three replications using vermicompost, farmyard manure, poultry manure for organic manures and Urea, DAP, MOP for inorganic fertilizers to find out the best combination treatment. The seedlings are sown in a row to row at a distance of 50cm and plant to plant at a distance of 60cm. Among the treatments T_5 (75% RDF + 2.5t/ha Vermicompost) had the best overall growth, yield and quality and the lowest was reported on T_0 (Control).

Keywords: Broccoli, FYM, VC, PM, inorganic, yield

Introduction
Horticulture is that branch of Agriculture concern with garden crops. Horticulture has contributed to the well-being of mankind in many ways. Vegetables are important part of our diet because they provide vitamins and minerals. They also contribute to the economic value of the country. In India, the total area of production is estimated to be 10290 ha with a production of 175008 MT [4].

Broccoli is an edible green plant within the cabbage family whose large flowering head is eaten as a vegetable [7]. Broccoli is a member of *Cruciferae* its botanical name is *Brassica oleracea cv.italica*. The word broccoli comes from the latin word of brachium, which means an arm or branch [7]. Broccoli has large flower heads, usually green in colour, arranged in a tree-like structure branching out from a thick, edible stalk. The mass of flower heads is surrounded by leaves. It is a rich source of vitamins, minerals, proteins etc. It has about 130 times more Vitamin A contents than cauliflower and 22 times more than cabbage [8].

The nutritive value of broccoli per 100g is moisture 89.3g, energy 141kj, carbohydrates 5.5g, sugar 1.7g, dietary fiber 2.6g, fat 0.2g, protein 3.3g, vit A 9000IU, calcium 1.29mg, iron 205mg, phosphorous 0.79mg, thiamine 0.071mg, riboflavin 0.117mg, niacin 0.639mg, vitamin C 137mg [8].

In present era, due to the use of excess chemical fertilizer it has been observed that the soil fertility is declining. So the main aim is to cultivate the crop in such a way that the soil remains sustainable for maximum quality production. Hence, the present experiment was undertaken to determine the best organic and inorganic fertilizer combination for maximum growth, yield and quality in broccoli.

Materials and Methods
The present investigation was carried out during the Rabi season 2018-19 at the Department of Horticulture, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The experiment was carried out in randomized block design with 11 treatments in three replications. The treatments include different doses and combinations of Organic manures and Inorganic fertilizers. Broccoli cultivar Green comet was taken as test crop. The treatment combinations T0 : Control, T1 : Recommended dose of NPK (120:80:80 kg /ha), T2 (VC@10tha^{-1}), T3 (FYM@20tha^{-1}), T4 (PM@10tha^{-1}), T5(75% RDF + 2.5t/ha Vermicompost), T6 (75% RDF + 5t/ha FYM), T7 (50% RDF+ 2.5 t/ha poultry manure), T8 (50% RDF + 5t/ha Vermicompost), T9 (50% RDF + 10t/ha FYM), T10 (50%

RDF + 5t/ha Poultry manure), T11(50% RDF +10t/ha FYM +5t/ha VC + 5t/ha PM) were used in the investigation. The crop was raised with a spacing of 60 cm × 50 cm and plot size of 1.5m × 1.5m. The organic manures (Vermicompost, poultry Manure and FYM) were applied in plots one month before the transplanting of seedlings. Nitrogen, phosphorous and potassium were applied in the form of Urea, DAP and MOP. Before transplanting, half of nitrogen and full doses of phosphorous and potassium were applied in the plots and the crop was top dressed with remaining half dose of nitrogen in two splits after 3th and 5th week of transplanting.

Results and Discussion

The result presented in table 1 shows the significant influence concerning with the growth, yield and quality attributes of broccoli as affected by different combinations of organic manures and inorganic fertilizers either alone or in combinations. The maximum Plant height (56.93cm), number of leaves (23.13), leaf area (429.38cm), leaf area index (20.69), leaf width (18.13cm), days taken to head initiation (48.57), head weight (409.27g), yield per plot (2.46 kg), yield per hectare (8.19 t/ha), head diameter(15.87 cm), TSS (8.43) was obtained in treatment T5 (75% RDF + 2.5t/ha Vermicompost) whereas the minimum Plant height (29.95cm), number of leaves (13.20), leaf area (203.37cm), leaf area index (12.18), leaf width (11.15cm), days taken to head initiation (57.33), head weight (222g), yield per plot (1.33 kg), yield per hectare (4.44 t/ha), head diameter(11.83 cm), TSS (5.20) was obtained in treatment T0(Control). The overall improvement in growth yield and quality in the treatment combination T5 (75% RDF + 2.5t/ha Vermicompost) maybe due to combined application of vermicompost that significantly helped in maintaining the soil fertility and plant nutrient supply at an optimal level which supports the findings of Singh *et al*. (2010), Sarma *et al*, Makinde *et al* (2012), G Yau *et al* (2018) [6, 5, 3, 2]. This finding has close conformity with Basel *et al*. [1], Wani *et al*. [9], which reported that the excessive amount of organic and inorganic fertilizer is used to achieve a higher yield and growth.

The economics of different treatments viz., yield (t/ha), cost of cultivation, gross return and benefit cost ratio are as follows, yield per hectare (8.19 t/ha), Maximum gross return (ha) was Rs 265285 ha, maximum net return Rs. 149223 ha with T5 (75% RDF + 2.5t/ha Vermicompost), the cost benefit ratio of treatment T5 (75% RDF + 2.5t/ha Vermicompost) i.e. (1:2.29) was also found to be the best treatment combinations in terms of economics returns.

Table 1: Effect of organic manures and inorganic fertilizers on growth, yield and quality of broccoli

Treatment No.	Treatment combination	Plant height (cm)	No. of leaves	Leaf area (cm)	Leaf area index (cm^2)	Leaf width (cm)	Days to Head initiation	Head weight (g)	Yield per plot (kg)	Yield per hectare (t/ha)	Head diameter (cm)	TSS (^{0}BRIX)
T_0	Control	29.95	13.20	203.37	12.18	11.15	57.33	222	1.33	4.44	11.83	5.20
T_1	RDF (120:80:80)	45.13	20.80	348.23	15.03	13.65	51.67	291.53	1.75	5.83	14.13	6.33
T_2	VC @ 10t/ha	49.49	20.60	338.05	15.39	13.38	51.00	293.73	1.76	5.87	14.33	6.40
T_3	FYM @ 20t/ha	48.20	20.80	332.82	15.92	13.04	50.33	303.93	1.82	6.08	14.80	6.37
T_4	PM @ 10 t/ha	52.62	21.07	350.97	16.02	14.35	52.00	326.47	1.96	6.53	14.50	7.13
T_5	75% RDF + 2.5t/ha VC	59.25	23.13	429.38	20.69	18.13	48.57	409.27	2.46	8.19	15.87	8.43
T_6	75% RDF + 5t/ha FYM	49.61	21.47	345.28	14.95	14.41	51.33	337.80	2.03	6.76	14.17	6.77
T_7	50% RDF+ 2.5 t/ha PM	49.57	20.60	396.34	17.52	13.84	52.00	342.60	2.06	6.85	14.37	7.43
T_8	50% RDF + 5t/ha VC	50.53	20.87	352.88	16.21	13.93	52.00	339.73	2.04	6.79	15.37	6.87
T_9	50% RDF + 10t/ha FYM	51.73	21.40	361.38	15.98	14.03	51.67	376.80	2.26	7.54	14.50	6.80
T_{10}	50% RDF + 5t/ha PM	51.39	21.40	361.82	15.87	13.99	52.33	343.53	2.06	6.87	14.37	7.03
T_{11}	50% RDF +10t/ha FYM +5t/ha VC + 5t/ha PM	56.93	22.40	404.09	19.35	16.43	49.67	379.87	2.28	7.60	15.00	8.13
F-test		S	S	S	S	S	S	S	S	S	S	S
SE(m)		1.19	0.17	3.16	0.68	0.31	1.26	12.15	0.03	0.11	0.34	0.20
C.D. at 5%		2.47	0.35	6.56	1.41	0.65	2.60	25.20	0.07	0.22	0.70	0.40

Conclusion

The above study revealed that the application of organic manures and inorganic fertilizers had shown an adverse effect in enhancing growth, yield and quality with maximum net returns. In view, of the results, it is concluded that application of T5 (75% RDF + 2.5t/ha Vermicompost) gave the highest yield on broccoli.

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