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Effect of inorganic fertilizer and organic manures on growth and yield of broccoli (*Brassica oleracea* var. *italica*) cv. Palam Samridhi at Northern Hill of Chhattisgarh

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Abstract

Broccoli (*Brassica oleracea* var. *italica*) is one of the important temperate vegetable and emerging crop at Northern Hills of Chhattisgarh with benefit economic returns. The experiment was conducted in randomized block design with three replications during *Rabi* season 2020-21 at Potato and Temperate Fruit Research Station, Mainpat, Surguja, I.G.K.V., Chhattisgarh. Ten combinations of inorganic fertilizers and organic manures were taken as treatments with one control. The evaluation of various treatments taken for study revealed that the application of 50% RDF + PM @ 6 t/ha (T₂) responded better with respect to the plant height, number of leaves per plant, head initiation, days to first harvest, head weight, number of secondary head per plant, lateral head weight, head diameter, head yield per plant, head yield per plot, head yield. The stalk length and stalk diameter was observed to be the maximum in treatment in 100% RDF [NPK through chemical Fertilizer] (T₁₀).

Keywords: Inorganic, fertilizer, organic, broccoli, *Brassica oleracea*

Introduction

Broccoli (*Brassica oleracea* L. var. *Italica*), a member of the Cole group that originally comes from the Mediterranean region and It has about 130 times more Vitamin-A contents than cauliflower and 22 times more than cabbage, Broccoli is rich source of vitamins, minerals and essential amino acids, also contains the compound glucoraphanin which have anticarcinogenic properties (Thamburaj and Singh, 2014) [15]. It is either consumed raw as salad or cooked to prepare curries, soup and pickles. In the world market broccoli sold about 60 percent as frozen and remaining 40 percent as fresh. Now days, broccoli emerges as an important crop under protected cultivation during off season around metropolitans and tourist places (Swarup, 2012) [14].

To increase the yield, plenty of chemical fertilizers along with a small quantity of organic once were being used by different workers which ultimately affects the health of soil as well as human (Meena *et al.*, 2017) [6, 7]. Due to excess use of chemical fertilizers a decline pattern is observed in soil fertility therefore integrated nutrient management is an important demand of present era (Attigah *et al.*, 2013) [1]. The main aim of integrated nutrient management is to cultivate a land in such a way that the soil should remain sustainable with maximum quality production of crop (Mishra *et al.*, 2014) [8]. Hence, being a newly introduced crop in Chhattisgarh, there is an urgent need for standardization of integrated nutrient management practices with locally available organic manures integrated with inorganic fertilizers. Keeping this in view, a field experiment was carried out with the objectives to study the effect of integrated application of inorganic fertilizers and organic manures on growth and yield attributes.

Material and Methods

An experimental material of the study includes combinations *viz.* three splits of recommended fertilizers (25%, 50% and 100% NPK fertilizer) and five organic manure (Farm yard manure, vermicompost, mustard oil cake, neem cake, poultry manure) consist 11 different treatments namely; Control [no fertilizer & manure] (T₀), 50% RDF + MOC @ 1.5 t/ha (T₁), 50% RDF + PM @ 6 t/ha (T₂), % RDF + FYM @ 10 t/ha (T₃), 25% RDF + MOC @ 2 t/ha (T₄), 50% RDF + NC @ 2.5 q/ha (T₅), 50% RDF + VC @ 5 t/ha (T₆), 25% RDF + FYM @ 15 t/ha (T₇),

25% RDF + VC @ 5 t/ha + PM @ 2 t/ha (T₈), VC @ 5 t/ha + FYM 10 t/ha + PM @ 2.5 t/ha (T₉), 100% RDF [NPK through chemical Fertilizer] (T₁₀) were used in the investigation. The crop was raised in randomized block design with 3 replications, spacing of 45 cm × 45 cm and plot size of 2 m × 2 m. Nitrogen, phosphorous and potassium were applied in the form of urea, muriate of potash, single superphosphate 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 fourth and sixth week of transplanting. Observations were recorded from randomly selected five tagged plants. Observations parameter were plant height (cm), number of leaves per plant, stalk length (cm), stalk diameter (cm), head initiation (days), days to first harvest, head weight (g), number of secondary head per plant, lateral head weight (g), head yield per plant(g), head yield per plot (kg) and head yield ton per hectare. The experimental data were subjected to statistical analysis suggested by Panse and Sukhatme (1967) [10] and the results were documented, analyzed and presented in tabular form.

Result and Discussion

All observations were categorized into two parameters *i.e.* Growth and growth attributing characters and Yield and yield attributing characters and described below:

Growth and growth attributing characters

Growth parameters *viz.* plant height, number of leaves per plant, stalk length, stalk diameter, head initiation, days to first harvest were recorded from the selected plant and presented in Table 1.

Data recorded in respect of plant height showed that the effect of organic and inorganic fertilizer *i.e.* reduced doses of fertilizers with organic fertilizer was significant at all stages of plant growth. Table 1 indicated that the maximum plant height 60.11 cm was observed in the treatment T₂ (50 percent RDF + PM @ 6 t/ha), whereas, the least mean plant height values (44.76 cm) noted in the T₀ (control). Similar results due to effect of integrated nutrient management were reported by Mohapatra *et al.* (2013) [9], Shree *et al.* (2014) [12], Meena *et al.* (2017) [6,7] and Singh *et al.* (2018) [13].

Effect of different treatment of organic manure and fertilizer for number of leaves per plant was recorded maximum (22.17) in T₂ (50 percent RDF + PM @ 6 t/ha). Increase in

number of leaves might be due to the application of poultry manure along with inorganic fertilizers, that ultimately helped in increasing the uptake of nitrogen and other nutrients and produced more number of leaves per plant. These findings are in accordance with the results of Mohapatra *et al.* (2013) [9] and Jasim *et al.* (2014) [2].

The stalk length and stalk diameter was recorded maximum 25.45 cm and (6.01 cm) respectively in the treatment T₁₀ (100% RDF NPK through chemical Fertilizer). Mohapatra *et al.* (2013) [9], Shree *et al.* (2014) [12], Meena *et al.* (2017) [6,7] and Singh *et al.* (2018) [13] were also reported the similar findings due to effect of integrated nutrient management.

Earliness is a desirable trait for any crop, thus, the significant early head initiation was recorded in T₂ (50 percent RDF + PM @ 6 t/ha) followed by T₁₀ (100% RDF NPK through chemical Fertilizer). Whereas, control took maximum days for head initiations. Similarly, 70.73 days to harvest was significantly observed in T₂ (50 percent RDF + PM @ 6 ton per hectare) followed by T₉ (VC@ 5 t/ha + FYM @ 10 t/ha + PM @ 2.5 t/ha). These finding are in general accordance with the results of Jasim *et al.* (2014) [2], Shree *et al.* (2014) [12] and Meena *et al.* (2017) [6,7].

Yield and yield attributing characters

Yield parameters *viz.* head weight (g), number of secondary head per plant, lateral head weight (g), head diameter (cm), head yield per plant (g), head yield per plot (kg) and head yield (ton per hectare) were observed and presented in Table 2.

For head diameter, the effect of different treatments organic manure and inorganic fertilizers, were found significantly. Head diameter was ranged from 10.98 cm (T₀) to 16.39 cm (50 percent RDF + PM @ 6 t/ha). It was observed that an increasing application nitrogen through organic manure and inorganic fertilizer increased the head diameter. Similar results were also reported by Kumar *et al.* (2013) [3], Meena *et al.* (2017) [6,7] and Mohanta *et al.* (2018) [5].

The data of Table 2, revealed that head weight of broccoli was influenced significantly through the growth period of plant. T₂ (50 percent RDF + PM @ 6 t/ha) showed significantly superior over all treatments and as well as in the control for number of secondary head per plant (12.23), lateral head weight (199.3), head weight per plant (417.84), head yield per plant (537.11), head yield per plot (8.59) and head yield per hectares (21.48).

Table 1: Effect of inorganic fertilizer and organic manures on Growth and its attributing characters

Treatment	Plant height (cm)	No. of leaves per plant	Stalk length (cm)	Stalk diameter (cm)	Head initiation (Days)	Days to harvesting
Control [no fertilizer and manure] (T ₀)	44.76	15.50	18.52	4.57	53.40	74.87
50% RDF + MOC @ 1.5 t/ha (T ₁)	49.67	19.60	23.07	5.17	48.47	72.67
50% RDF + PM @ 6 t/ha (T ₂)	60.11*	22.17*	23.60	5.90	45.40*	70.73*
50% RDF + FYM @ 10 t/ha (T ₃)	53.16	19.97	23.28	5.37	47.00	72.27
25% RDF + MOC @ 2 t/ha (T ₄)	47.61	17.83	21.15	4.60	51.07	73.80
50% RDF + NC @ 2.5 q/ha (T ₅)	48.52	19.10	22.32	5.00	49.57	73.23
50% RDF + VC @ 5 t/ha (T ₆)	53.24	21.07	23.93	5.54	46.30	71.37
25% RDF + FYM @ 15 t/ha (T ₇)	48.39	18.27	22.14	4.66	50.37	73.60
25% RDF + VC @ 5 t/ha + PM @ 2 t/ha (T ₈)	49.72	19.63	23.15	5.22	47.70	72.33
VC @ 5 t/ha + FYM @ 10 t/ha + PM @ 2.5 t/ha (T ₉)	54.34	21.47	24.84	5.65	46.00	70.93
100% RDF [NPK through chemical Fertilizer] (T ₁₀)	53.76	21.40	25.45*	6.01*	45.87	71.30
S.Em±	1.77	0.75	0.52	0.27	0.75	0.72
CD at 5%	5.26	2.23	1.56	0.82	2.25	2.15

* indicates the significant @ 5%

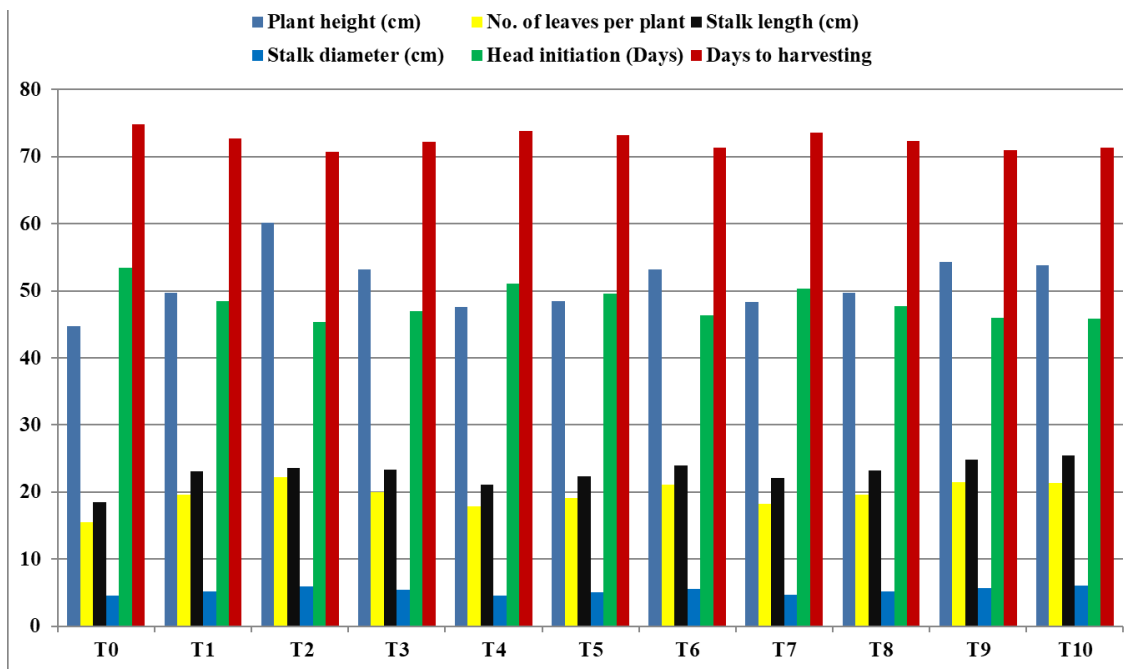


Fig 1: Effect of inorganic fertilizer and organic manures on Growth and its attributing characters

Table 2: Effect of inorganic fertilizer and organic manures on Yield and its attributing characters

Treatment	Head diameter (cm)	No. of secondary head/plant	Lateral head weight (g)	Head Weight (g) per plant	Head Yield/plant (g)	Head Yield/plot (Kg)	Head Yield (ton per hectare)
Control [no fertilizer and manure] (T ₀)	10.98	4.93	33.48	140.10	173.58	2.78	6.94
50% RDF + MOC @1.5 t/ha (T ₁)	13.88	10.57	106.77	284.40	391.17	6.26	15.64
50% RDF + PM @ 6t/ha (T ₂)	16.39*	12.23*	119.30*	417.84*	537.11*	8.59*	21.48*
50% RDF + FYM @ 10 t/ha (T ₃)	14.40	12.10	115.10	324.53	439.63	7.03	17.58
25% RDF + MOC @ 2t/ha (T ₄)	13.37	9.17	81.13	236.37	317.50	5.08	12.69
50% RDF + NC @ 2.5 q/ha (T ₅)	13.57	9.57	100.73	256.50	357.23	5.71	14.29
50% RDF + VC @ 5t/ha (T ₆)	14.79	11.50	108.47	340.60	449.03	7.18	17.96
25% RDF + FYM @ 15t/ha (T ₇)	13.41	9.03	100.50	248.67	349.17	5.59	13.96
25% RDF + VC @ 5t/ha + PM @ 2t/ha (T ₈)	14.30	10.33	113.50	310.93	424.43	6.79	16.97
VC @ 5t/ha + FYM @ 10t/ha + PM @ 2.5 t/ha (T ₉)	16.12	8.23	93.63	347.90	441.52	7.06	17.65
100% RDF [NPK through chemical Fertilizer] (T ₁₀)	15.64	7.97	102.37	359.50	451.87	7.23	18.07
S.Em±	0.24	1.24	8.33	17.93	20.83	0.33	0.83
CD at 5%	0.72	3.71	24.77	53.27	61.91	0.99	2.47

* indicates the significant @ 5%

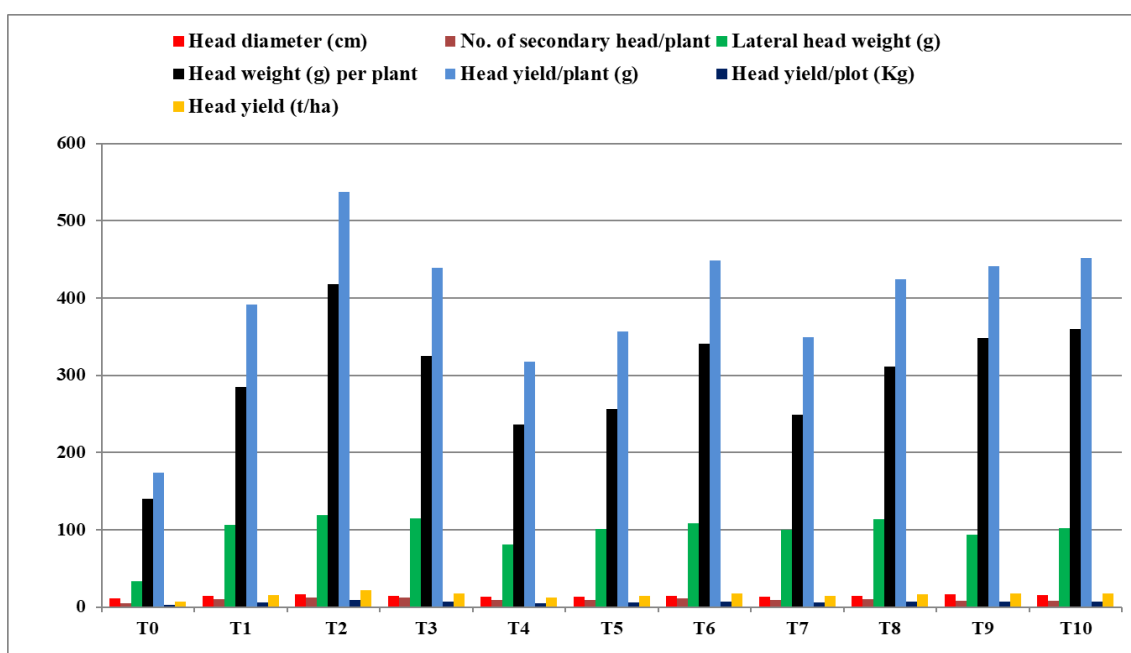


Fig 2: Effect of inorganic fertilizer and organic manures on Yield and its attributing characters

Conclusion

Among the all treatments, T₂ observed the maximum head yield (21.48 ton per hectares). The influence of organic manure and inorganic fertilizer on head weight of broccoli sought to be increased in the treatment receiving nitrogen fixation through poultry manure leads to increase the head weight of broccoli per plot or per hectare yield. These results conformity with finding of Kumar *et al.* (2013) ^[3], Meena *et al.* (2017) ^[6, 7], Lodhi *et al.* (2017) ^[4], Mohanta *et al.* (2018) ^[5] and Sharma *et al.* (2018) ^[11]. Hence, soil application of 50% RDF + PM @ 6 t/ha was found to be the best for obtaining the highest yield (214 q/ha) in the condition of Northern Hills of Chhattisgarh.

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