

## Effect of integrated nutrient management on growth and yield of broccoli (*Brassica oleracea* var. *italica*) under Jharkhand conditions

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Sprouting broccoli (*Brassica oleracea* var. *italica*) belonging to the family Brassicaceae is an important cole crop after cabbage and cauliflower. It is one of the most nutritious cole crops and contains vitamin A (130 times and 22 times higher than cauliflower and cabbage, respectively), thiamin, riboflavin, niacin, vitamin C and minerals like Ca, P, K and Fe. The state of Jharkhand provides ample opportunity for successful cultivation of broccoli due to the mild climatic conditions with temperature, relative humidity and rainfall ranging between 10.60-30.5°C, 37.00-87.00 per cent and 1.6-15.6mm, respectively prevailing in Ranchi and adjoining areas.

Being a newly introduced crop of Jharkhand, there is an urgent need for standardization of integrated nutrient management packages having locally available organic sources integrated with chemical fertilizers. Keeping this in view, the research project was carried out with the objectives to study the effect of integrated application of inorganic and organic manures on growth, yield attributes and yields of broccoli.

The investigation was carried out during winter season in the consecutive years 2008-09 and 2009-10 at vegetable section of horticulture garden under the Faculty of Agriculture, Birsa Agricultural University, Kanke, Ranchi (Jharkhand). The physico-chemical characteristics of the soil of experimental plots were determined before the start of experiment and the value of soil pH, organic carbon (%), available N (kg ha<sup>-1</sup>), available P (kg ha<sup>-1</sup>) and available K (kg ha<sup>-1</sup>) were 5.9,

0.34, 340.00, 29.90 and 164.00, respectively. The experiment consisted of 19 treatments *i.e.*, four inorganic, 12 organic and inorganic combinations along with recommended treatment and two controls. In all the combinations treatments, 25% N of inorganic combinations was substituted through FYM, Vermicompost and Karanj cake. The content of nutrients in FYM was 0.5% N, 0.25% P<sub>2</sub>O<sub>5</sub>, 0.50% K<sub>2</sub>O. In Vermicompost the NPK content was 1.5% N, 1.50 P<sub>2</sub>O<sub>5</sub>, 1.50% K<sub>2</sub>O while in the Karanj cake the NPK content was 4% N, 1.00% P<sub>2</sub>O<sub>5</sub>, 1.30% K<sub>2</sub>O.

The experiment was laid out in Randomized Block Design with three replications. Data were recorded on different vegetative growth parameters (plant height, plant spread, number of leaves, leaf length), reproductive characters (Days to Curd Initiation, Days to 50% curd Initiation, Days taken to 50% maturity, Curd weight), yield attributing (curd weight and curd yield) and economics of different treatments.

The treatments were as follows:

- T1 200:100:100 kg NPK ha<sup>-1</sup>
- T2 150:75:75 kg NPK ha<sup>-1</sup>
- T3 100:50:50 kg NPK ha<sup>-1</sup>
- T4 50:25:25 kg NPK ha<sup>-1</sup>
- T5 50 Kg N through FYM+ 150:100:100 kg NPK ha<sup>-1</sup> through inorganic
- T6 37.5Kg N through FYM+112.5:75:75 kg NPK ha<sup>-1</sup> through inorganic
- T7 25 Kg N through FYM+75:50:50 kg NPK ha<sup>-1</sup> through inorganic
- T8 12.5 Kg N through FYM+37.5:25:25 kg NPK ha<sup>-1</sup> through inorganic
- T9 50 Kg N through vermicompost + 150:100:100 kg NPK ha<sup>-1</sup> through inorganic

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- T10 37.5 Kg N through vermicompost + 112.5:75:75kg NPK ha<sup>-1</sup> through inorganic
- T11 25 Kg N through vermicompost + 75:50:50 kg NPK ha<sup>-1</sup> through inorganic
- T12 12.5Kg N through vermicompost + 37.5:25:25 kg NPK ha<sup>-1</sup> through inorganic
- T13 50 Kg N through karanj cake + 150:100:100 kg NPK ha<sup>-1</sup> through inorganic
- T14 37.5 Kg N through karanj cake + 112.5:75:75 kg NPK ha<sup>-1</sup> through inorganic
- T15 25 Kg N through karanj cake + 75:50:50 kg NPK ha<sup>-1</sup> through inorganic
- T16 12.5 Kg N through karanj cake + 37.5:25:25 kg NPK ha<sup>-1</sup> through inorganic
- T17 100:50:50 Kg NPK ha<sup>-1</sup> along with 200 q FYM ha<sup>-1</sup> (Recommended dose)
- T18 N<sub>0</sub>:P<sub>100</sub>:K<sub>100</sub> (control)
- T19 N<sub>0</sub>:P<sub>0</sub>:K<sub>0</sub> (control)

Data on effect of integrated nutrient management on plant growth parameters of broccoli at 75 days after transplanting is given in table-1.

**Plant height:** As evident from the table, at 75 DAT, the maximum plant height was recorded with application of 200% of recommended dose of inorganic nutrients, of which 25% being supplemented with FYM, application of 150% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application of 150% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake and application of 100% recommended dose of nutrients. The minimum plant height was recorded in case of control. In cauliflower, have reported significant increase in plant height with application of 50% NPK applied along with organic manure (vermicompost or FYM).

**Leaf number:** With respect to leaf number, the maximum number of leaves at 75 DAT was recorded with application of 200:100:100 kg NPK ha<sup>-1</sup> through inorganic sources which was at par with application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost. The minimum value was recorded in case of control.

**Leaf length:** The maximum leaf length at 75 DAT was

recorded with application of 200% of recommended dose of inorganic nutrients which was at par with application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application of 150% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake and application of recommended dose of nutrients. The minimum leaf length was recorded in case of control. Jana and Mukhopadhyay (2001) have also reported that increase in nitrogen levels up to 150 kg/ha and phosphorus levels up to 120 kg/ha increased leaf length over its lower levels.

**Plant spread:** The maximum plant spread at 75 DAT was recorded with application of recommended dose of nutrients (100:50:50 kg NPK ha<sup>-1</sup> along with 200qha<sup>-1</sup> of FYM) which was at par with application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM 25% being supplemented with vermicompost. The increase in leaf length under different treatments can be attributed to the increase in plant spread. Similar findings have also been reported by Pandey *et al.* (2008).

Data on effect of integrated nutrient management on reproductive characters and yield of broccoli is given in table 1.

**Curd initiation:** The minimum days (65.50) taken for curd initiation was recorded in case of application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM which was at par with application of 200% of recommended dose of inorganic nutrients, application of 100% of recommended dose of inorganic nutrients, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application of 150% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost and application of recommended dose of nutrients. The maximum days taken to curd initiation was recorded in case of control. With respect to days taken for 50% curd initiation the minimum number of days was recorded with application of application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM and application of recommended dose of nutrients which was at par with application of 200% of recommended dose of inorganic nutrients, application of 150% of recommended dose of inorganic nutrients, application

of 100% of recommended dose of inorganic nutrients, application of 100% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost and application of 150% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost. As observed in case of initiation of curd, maximum number of days taken for 50% curd initiation was recorded in case of control. The minimum number of days taken for 50% of curd maturity was recorded in case of application of 200% of recommended dose of inorganic nutrients which was at par with application of 100% of recommended dose of inorganic nutrients, application 50% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM, application 150% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost, application 200% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake, application 100% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake and application of recommended dose of nutrients. The maximum number of days taken for 50% curd maturity after planting was recorded in case of control.

The results indicated that the treatments receiving high doses of nutrients resulted in hastening of different reproductive growth phases whereas the onset of different reproductive phases were drastically delayed in case of plants receiving low rate of nutrients or no

nutrients. In cabbage, Chaubey *et al.* (2006) observed that higher fertility level favoured the maturity time whereas the process of growth and development was slower at lower fertility level.

**Curd weight:** The maximum curd weight was recorded with application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake which was at par with application of 200% of recommended dose of inorganic nutrients, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with FYM, 25% being supplemented with vermicompost and recommended dose of nutrients. This indicated that the maximum curd weight was recorded in case of plants receiving at least a total of 200 :100 :100 kg/ha N, P and K. Sharma (2000) have reported that integration of organic and inorganic fertilizers application significantly increased the head yield over inorganic fertilizers alone and also over control. The treatment N175 P75 K60 + FYM 12.5 t/ha recorded the maximum yield (63.12 q/ha). Pandey *et al.* (2008) recorded highest values for growth of broccoli curd in terms of head depth, girth and apical head weight with application of vermicompost @ 2.5 t/ha + ½ dose of recommended NPK + Azotobacter.

As observed in case of curd weight, the maximum yield of curd/ha was recorded in case of application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with vermicompost which was at par with application of 200% of recommended dose

**Table 1.** Effect of integrated nutrient management on plant growth, reproductive and yield parameters of broccoli (pooled data)

Treatments	Plant height (cm)	Number of leaves	Leaf length (cm)	Plant spread (cm)	Days to curd initiation	Days to 50 % curd initiation	Days taken to 50 % curd maturity	Curd weight (g)	Yield (g/ha)
T1	55.17	21.27	48.83	55.70	67.67	74.67	86.83	280.0	80.79
T2	54.80	19.77	46.87	48.23	68.33	74.67	88.83	236.3	82.10
T3	50.30	18.83	41.63	41.07	68.00	74.83	88.17	160.0	67.21
T4	47.93	16.67	39.37	36.47	72.00	81.50	89.67	81.3	52.01
T5	54.70	19.83	46.00	55.05	65.50	73.50	88.67	286.0	84.88
T6	52.40	19.23	44.67	47.28	70.33	76.50	90.00	216.0	83.33
T7	50.17	18.57	42.80	38.02	69.67	75.17	90.00	154.0	70.99
T8	47.07	17.77	36.47	32.07	71.50	79.67	88.00	84.8	42.75
T9	54.43	20.60	46.47	53.25	68.00	75.50	89.00	291.6	96.67
T10	54.80	19.57	48.20	45.98	67.50	74.17	88.33	259.3	84.57
T11	48.67	17.40	38.47	39.88	72.17	76.67	91.50	135.8	74.54
T12	39.93	18.97	34.80	34.32	70.33	78.00	88.67	74.0	50.23
T13	52.33	18.30	45.87	50.97	68.50	75.33	87.67	305.5	85.65
T14	49.63	19.57	44.23	45.17	69.83	76.17	88.83	241.6	83.72
T15	45.37	17.13	40.17	39.47	69.17	77.50	88.00	171.6	72.07
T16	43.67	15.67	37.37	34.92	72.83	80.67	91.50	119.6	51.08
T17	54.77	19.47	46.60	51.08	66.50	73.50	87.83	286.8	85.96
T18	34.00	13.67	30.03	33.33	75.33	83.17	96.83	50.0	38.43
T19	31.33	12.67	27.70	30.35	80.17	87.50	97.83	40.1	28.01
SE (m) ±	1.14	0.37	1.17	1.48	0.89	0.76	0.59	13.3	4.18
CD at 5 %	3.27	1.06	3.35	4.26	2.56	2.17	1.68	38.3	12.0

of inorganic nutrients of which 25% being supplemented with FYM, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented with karanj cake and application of recommended dose of nutrients. The minimum yield was recorded in case of control.

The maximum total cost of cultivation (Rs. 72533 ha<sup>-1</sup>), the maximum gross return (Rs 1,45,000 ha<sup>-1</sup>) and maximum net profit (Rs. 72467 ha<sup>-1</sup>) was recorded with application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented through vermicompost. Application of 150% of recommended dose of inorganic nutrients resulted in maximum benefit cost ratio (2.25). Similar value of benefit cost ratio has also been reported by Sharma *et al.* (2002) who have obtained maximum yield of broccoli with application of 90 kg N and 60 kg P<sub>2</sub>O<sub>5</sub>/ha. Hence, for farmers with high investment capacity, application of 200% of recommended dose of inorganic nutrients of which 25% being supplemented through vermicompost can be recommended for obtaining maximum profit.

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