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INTEGRATED NUTRIENT MANAGEMENT (INM) STUDIES ON GROWTH AND YIELD OF BROCCOLI (*BRASSICA OLERACEA VAR. ITALICA*)

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Abstract

The present study entitled "Integrated nutrient management studies on growth and yield of Broccoli (*Brassica oleracea var. italica*)" was conducted during 2018-19 at vegetable research farm of Lovely Professional University, Phagwara, Punjab, India. The experiment was laid out on RBD (Randomized Block Design) with three replications and ten treatments having different combinations of organic manures and inorganic fertilizers. The treatment consisted of T_0: Control, T_1: 100 % RDF *i.e.* N: P: K @120:60:60 kg/ha, T_2: 20 t/ha FYM + 50 % RDF, T_3: 20 t/ha FYM + 25 % RDF, T_4: 10 t/ha FYM + 50% RDF, T_5: 10 t/ha FYM + 25% RDF, T_6: 10 t/ha V.C. + 50% RDF, T_7: 10 t/ha V.C. + 25% RDF, T_8: 5 t/ha V.C. + 50% RDF, T_9: 5 t/ha V.C. + 25% RDF. Application of integrated nutrient management significantly increased the growth and yield of broccoli. The treatment T_6 (10 t/ha Vermicompost + 50% RDF) recorded maximum plant height (39.53 cm and 54.87 cm) and maximum number of leaves/plant (8.20 and 13.60) at 45 and 60 days after transplanting respectively. This treatment also recorded the earliest days to head initiation (57.13 days) and first harvesting (80.07 days), maximum head weight (190 g), head diameter (110.33 mm), yield/plot (4.50 kg) and yield/ha (50.29 q) which was followed by treatment T_2 (20 t/ha FYM + 50% RDF). Thus it was concluded that, among all the treatments under study, the treatment T_6 the best for obtaining better growth and optimum yield.

Key words: Broccoli, farmyard manure, growth, integrated nutrient management, Vermicompost, yield.

Introduction

Broccoli (*Brassica oleracea var. italica*) is an important member of cruciferous crops after cabbage and cauliflower, having chromosome number (2n = 18). In India broccoli is widely grown in Himachal Pradesh and other hilly areas of utter Pradesh, Jammu and Kashmir and northern plains.

In the recent years, it is becoming popular among the rich people of India because of its low fat content, low in calories, high vitamin C and good source of vitamin A, B_2 and calcium (Sanwal and Yadav, 2006).

Nowadays the demand of vegetables in the market is increasing and the competition has forced the farmer to produce more yields. So the farmers are using high doses of chemical fertilizers to increase the growth and yield, ignoring the fact that chemical fertilizers may give abundance of harvest but do nothing to sustain the soil fertility. Indiscriminate uses of chemical fertilizers causes detrimental long term effect on soil fertility. The increasing and continuous use of chemical fertilizers especially nitrogenous to increase the production of food and fiber resulted in declining productivity despite being supplied with sufficient nutrients. So, there a need for the farmers to manage plant nutrition in a judicious manner through integrated nutrient management practices involving organic & inorganic fertilizers which can further help in improvement and maintenance of soil fertility. Integrated nutrient management improves and sustains the physical, chemical and biological properties of soil and prevents the secondary and micronutrient deficiencies. Considering the above facts, the present experiment was planned and undertaken to study the influence of INM on growth and yield of broccoli.

Materials and Methods

The present experiment was carried out during winter season of 2018-19 at the Vegetable Research Farm of Lovely Professional University, Phagwara (Punjab). The experiment was laid out in randomized block design with

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ten treatments and three replications. The treatments included T_0 : Control, T_1 : 100 % RDF *i.e.* N:P:K @120:60:60 kg/ha, T_2 : 20 t/ha FYM + 50 % RDF, T_3 : 20 t/ha FYM + 25 % RDF, T_4 : 10 t/ha FYM + 50 % RDF, T_5 : 10 t/ha FYM + 25 % RDF, T_6 : 10 t/ha V.C. + 50 % RDF, T_7 : 10 t/ha V.C. + 25 % RDF, T_8 : 5 t/ha V.C. + 50 % RDF, T_9 : 5 t/ha V.C. + 25 % RDF.The crop was raised at a spacing of 60 cm × 45 cm and plot size of 6 m × 1.5 m. Required quantities of fertilizers for each plot was calculated and applied by using chemical fertilizers *viz.* Urea, DAP and MOP. Vermicompost and Farmyard manure were used as a source of organic manures which was applied a week before transplanting. Full dose of P, K and half dose of N was applied as basal dose at transplanting. While, the remaining half dose of nitrogen was applied 40 days after transplanting. Observations were recorded for plant height (cm), number of leaves/ plant, number of days to head initiation,number of days to first harvesting, head weight (g), head diameter (mm), yield/plot (kg) and yield/ha (q). The data of the trial obtained were subjected to statistical analysis and the results were documented, analyzed and presented in tabular form.

Results and Discussion

It was observed that integrated use of organic and inorganic fertilizers had significant influence on growth as well as yield and yield attributing characters of broccoli.

Growth parameters

The data recorded on the effect of integrated nutrient management on various plant growth characters are presented in table 1.

Plant Height (cm)

The maximum plant height was recorded in T_6 (10 t/ ha Vermicompost + 50% RDF) *i.e.* 39.53 cm and 54.87 cm followed by T_2 (20t/ha FYM+50% RDF) *i.e.* 38.47 cm and 53.53 cm at 45 and 60 days after transplanting respectively, whereas, the minimum value was observed in T_0 (control) *i.e.* 30.40 cm and 44.87 cmat 45 and 60 days after transplanting (DAT) respectively. This might be due to the fact that Vermicompost provide various micronutrients like zinc, calcium, copper and iron in optimum range as well as hold the nutrients accumulated in inorganic fertilizer and application of Vermicompost improves soil properties, increased microbial activity and easy availability of micro and macronutrientsso that this combination enhanced the growth of plant.These finding is in confirmity with the result of Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Number of leaves/plant

The maximum number of leaves/plant was recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 8.20 and 13.60 which was at par with T_2 (20t/ha FYM+50% RDF) *i.e.* 8.07 and 13.40 at 45 and 60 days after transplanting (DAT) respectively, whereas, the minimum value was observed in T_0 (control) *i.e.* 6.67 and 11.67 at 45 and 60 days after transplanting (DAT) respectively. The superiority of 10 t/ha Vermicompost + 50 % RDF for more number of leaves/plant might be due to increase soil microbial activities, high absorption of nutrients from the soil which ultimately lead to more photosynthetic activities. These finding is in confirmity with the result of Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Table 1: Growth of broccoli as influenced by integrated nutrient management (INM).

Treatment	Plant height (cm)		Number of leaves/plant		Days to head initiation	Days to first harvesting
	45 DAT	60 DAT	45 DAT	60 DAT		
T_0 (Control)	30.40	44.87	6.67	11.67	63.40	85.07
T_1 (100% RDF)	37.43	51.47	8.07	13.20	58.20	80.93
T_2 (20 t/ha FYM + 50% RDF)	38.47	53.53	8.07	13.40	57.67	80.53
T_3 (20 t/ha FYM + 25% RDF)	35.50	48.07	7.53	13.13	59.73	83.13
T_4 (10 t/ha FYM + 50% RDF)	36.43	49.13	7.47	13.27	58.67	82.60
T_5 (10 t/ha FYM + 25% RDF)	35.47	47.87	7.40	13.00	60.33	83.47
T_6 (10 t/ha VC + 50% RDF)	39.53	54.87	8.20	13.60	57.13	80.07
T_7 (10 t/ha VC + 25% RDF)	36.40	48.73	7.33	13.13	59.40	82.73
T_8 (5 t/ha VC + 50% RDF)	36.77	50.13	7.40	13.13	58.53	81.60
T_9 (5 t/ha VC + 25% RDF)	35.80	48.27	7.53	12.73	59.50	83.07
C.D. at 5 %	0.48	1.06	0.23	0.22	0.40	0.23
SE(m)	0.16	0.36	0.08	0.07	0.13	0.08
C.V.	0.76	1.24	1.78	0.98	0.39	0.16

*DAT = Days after transplanting, FYM= Farm yard manures, VC = Vermicompost.

Number of days to head initiation

The earliest days to head initiation was recorded in T_6 (10 t/ha Vermicompost + 50%) *i.e.* 57.13 days, followed by T_2 (20t/ ha FYM + 50% RDF) *i.e.* 57.67 days after transplanting. Whereas, the maximum number of days to head initiation was recorded in T_0 (control) *i.e.* 63.40 days after transplanting. Minimum days to head initiation in (10 t/ha Vermicompost + 50% RDF) treatment might be due to the release of nitrogen and phosphorus in the soil enabling plants to use them which leads to increase plant hormonal activities resulting to produce earlier head initiation of broccoli. Similar

result was also obtained by Mohanta *et al.,* (2018).

Number of days to first harvesting

Minimum number of days to first harvesting were recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 80.07 days, followed by T_2 (20t/ha FYM + 50%) *i.e.* 80.53 days after transplanting. Maximum 85.07 days were recorded in T_0 (control). Application of 10 t/ha Vermicompost + 50% RDF which produce the early crop of broccoli because organic resources improve soil texture and productivity, by improving soil tilth and aeration it also increase the water holding capacity and activity of microorganisms and reduce the mining of soil nutrients.. Similar result was also obtained by Mohanta *et al.,* (2018).

Yield and yield parameters

The application of integrated nutrient management had significant influenced the yield and yield parameters. Data recorded on the effect of integrated nutrient management on yield and yield parameters presented in table 2.

Head weight (g)

The maximum head weight was recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 190 g, followed by T_2 (20t/ha FYM + 50% RDF) *i.e.* 179.33 g. Minimum (94.80 g) average head weight was reported in T_0 (control). The increase in head weight might be due to the more photosynthesis from a larger area of the leaves and the translocation of photosynthates to the sink which is ultimately the head. The increase in the head weight at this level might also be due to the increase in the plant spread and head diameter. The combination of Vermicompost improved the soil physical conditions and biological activity which lead to continuous supply of nutrients along with micronutrients resulting in good uptake of nutrients and crop vegetative growth. The improved in root growth and hormones production by micro-organisms in Vermicompost application, increased the production of carbohydrates and organic structures and transfer them to head and increased their weight. These findings are in close conformity with the findings of Ola *et al.,* (2019), Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Table 2: Yield and yield parameters of broccoli as influenced by integrated nutrient management (INM).

Treatment	Head weight (g)	Head diameter (mm)	Yield /plot (kg)	Yield /ha (q)
T_0 (Control)	94.80	76.67	2.27	25.27
T_1 (100% RDF)	163.47	97.67	3.92	43.59
T_2 (20 t/ha FYM + 50% RDF)	179.33	99.67	4.30	47.81
T_3 (20 t/ha FYM + 25% RDF)	110.53	78.33	2.65	29.47
T_4 (10 t/ha FYM + 50% RDF)	140.93	90.33	3.37	37.57
T_5 (10 t/ha FYM + 25% RDF)	123.00	82.67	2.95	32.79
T_6 (10 t/ha VC + 50% RDF)	190.00	110.33	4.50	50.29
T_7 (10 t/ha VC + 25% RDF)	129.73	85.33	3.11	34.59
T_8 (5 t/ha VC + 50% RDF)	149.57	93.33	3.53	39.11
T_9 (5 t/ha VC + 25% RDF)	119.27	80.67	2.86	31.80
C.D. at 5 %	1.24	0.94	0.03	0.40
SE(m)	0.41	0.31	0.01	0.13
C.V.	0.51	0.60	0.53	0.62

Head diameter (mm)

The maximum head diameter was recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 110.33 mm, followed by T_2 (20t/ha FYM + 50% RDF) *i.e.* 99.66 mm whereas, minimum 76.66 mm head diameter was reported in T_0 (control). Increased head diameter might be due to the soil microbial activities, high absorption of nutrients from the soil which also affected the photosynthesis process. Application of Vermicompost + 50% RDF influences the plant metabolism by increasing the availability of applied nutrients and moisture retention capacity. Positive response of organic source of nutrient and inorganic fertilizers on head diameter may be due to the better availability of micro and macro nutrient in the soil that produced healthy plants with large vegetative growth, which reflected head diameter. Similar result has been reported of Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Yield/plot (kg)

The maximum yield/plot was recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 4.50 kg, followed by T_2 (20t/ha FYM + 50% RDF) *i.e.* 4.30 kg. While, the minimum value pertaining to yield/plot was observed in T_0 (control) 2.27 kg. The enhanced yield of broccoli might be due to the application of Vermicompost and 50 % RDF increase the micro and macro nutrient in the soil, microbial and enzyme activities and also have increased the rate of photosynthesis with further increase in vegetative growth providing more sites for translocation of photosynthesizes with an ultimate increase in yield. Similar result was also obtained by Ola *et al.,* (2019), Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Yield/ha (q)

The maximum yield/ha was recorded in T_6 (10 t/ha Vermicompost + 50% RDF) *i.e.* 50.29 q followed by T_2 (20t/ha FYM + 50% RDF) *i.e.* 47.81 q. While, the minimum value pertaining to yield/plot was observed in T_0 (control) *i.e.* 25.27 q. The significant improvement in yield and yield attributing parameters on account of integrated form using inorganic and Vermicompost might

have attributed to the translocation of nutrients from soil, particularly when sink was able to synthesize the enhanced amount of carbohydrates assimilated by the enhanced rate of photosynthesis. Further, increased vegetative growth might have provided more sites for translocations of photosynthesis. This ultimately resulted in increased yield.Similar result was also obtained by Ola *et al.,* (2019), Mohanta *et al.,* (2018) and Singh *et al.,* (2018).

Conclusion

On the basis of the above findings of present investigation it can be concluded that treatment T_6 (10 t/ha Vermicompost + 50% RDF) was the best treatment for more growth and high yield. Besides this, other profitable treatment which could also be recommended to farmers are T_2 (20 t/ha FYM + 50% RDF).

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