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# Response of Broccoli (*Brassica Oleracea* Var. Italica) To Integrated Nutrient Management: A Review

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**Abstract**

Broccoli (*Brassica oleracea var.* italica) is a cruciferous vegetable and it is closely related to cauliflower and cabbage. Broccoli produces large green colored floral bud, containing sulphoraphane compound which reduces various type of cancers such as lung, breast and prostate cancers. Nowadays the demand of vegetables in the market is increasing and the competition has forced the farmerto 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.In adverse, unbalanced or excessiveuses of chemical fertilizers causes detrimental long-term effect on soil fertility and sustainability.Hence, there is need to develop an understanding among the farming community to manage plant nutrition in a judicious manner through integrated nutrient management practices which will further help to improve and sustain the physical, chemical and biological properties of soil and prevents the secondary and micronutrient deficiencies.

**Keywords:** Broccoli,growth, INM, soil fertility and yield

Broccoli (*Brassica oleracea* var. italica) is animportant member of cruciferous crops after cabbage and cauliflower, native of Mediterranean region. Broccoli is also commonly known as “Green sprouting broccoli” or “calabrese”. The flower buds of the broccoli are green or purple which are eaten cooked or raw. In the world, the united statesare the leading producer of the broccoli, while, in India cauliflower and broccoli are grown over an area of 4 lakh ha with annual production 85 lakh metric tonnes. It requires a cool climatic regime and therefore, widely cultivatedin Himachal Pradesh and other hilly areas of Utter Pradesh, Jammu and Kashmir and northern plains.Broccoli is highly nutritious, containing vitamin C, vitamin A, folic acid, dietary fibre and 3.3% protein. It has nutra-ceutical properties due to the presence of a sulphur

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compound‘sulphoraphane’ which reduces the lung, breast and prostate cancers.The nutritional properties being the reason, is becoming more popular among the rich people of India in the recent years **(Sanwal and Yadav, 2006).**Therefore, there is a need for more production of this nutritious vegetable. In the process of producing more yield, the farmers are using high doses of chemical fertilizers having the misconception that, more nutrition will give more remunerative yield, however ignoring the fact that chemical fertilizers will adversely effect the soil health in the long run and do nothing good to sustain the soil fertility. Hence, there is urgency in developing an understanding among the farming community to manage plant nutrition in a judicious manner through integrated nutrient management practices which will further help to improve and sustain the physical, chemical and biological properties of soil and prevents the secondary and micronutrient deficiencies. The major component of the integrated nutrient management is balanced and efficient application of organic and inorganic fertilizers. In integrated nutrient management, the macronutrients like nitrogen, potassium, phosphorus are applied through chemical fertilizers along with organic source of nutrients like, cowdung, FYM, vermin-compost, compost, poultry manures, neem cake, green manures etc.for maintenance of soil fertility and reduce the use of chemical fertilizer.Many researchers have done a significant work in regard to this issue and so, the summarized effect of integrated nutrient management on broccoli is reviewed below:

**Growth of broccoli as influenced by INM:**Significant influence of Integrated nutrient management on various growth parameters of broccoli has been reported by numerous researchers. Integration of Azotobacter with the recommended practice of 20 t/ha cow dung + 100% RDF produce the highest leaf width as recorded by Sharma et al. (2008). During the same year Maurya et al.reported that, poultry manure 2.5 t/ha + 50% RDF and 10t FYM + 50% RDF gave the highest plant height. While, in the subsequent year poultry manure 2.5 t/ha + 50% RDF, 2.5 t/ha Vermicompost + 50% RDF gave the tallest plants. Furthermore, Ouda and mahadeenalso conducted an experiment on broccoli with combination of four organic manure doses (0, 40, 60, 80 t/ha) and three inorganic fertilizer doses (0, 30, 60 kg/ha) out of which, application of 60 t of organic manure + 60kg inorganic fertilizer produces maximum number of leaves/plant.

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Chaudhary et al. (2012) revealed the maximum plant height, number of leaves and leaf area in 5.0t/ha Vermicompost along with 125% RDF (NPK 100:80:60 kg/ha.).Srichandan et al. (2015) recorded maximum plant height (41.58cm) and leaf area (363.32cm$^2$) by application of 75% NP + 100 % k + bio inoculants + Vermicompost (5 t/ha). Similarly,Sharma et al. (2018) revealed the maximum plant height ( 73.25cm), plant spread (66.12cm), leaf length (61.86cm), leaf width (22.53cm), number of leaf (15.7), stalk length (22.51cm) and days of curd initiation (84) in the treatment 100% RDF + biofertilizer +Vermicompost.During the same year Singh et al.observed maximum plant height (51.11cm) and number of leaves per plant (27.87) in 50% RDF +50% V.C. whereas, the maximum plant spread (57.77cm) in 25% RDF + 75% poultry manure.

According toMohanta et al.(2018),the maximum plant height (51.56 cm), plant spread N-S (61.63 cm) and E-W (64.91cm), leaf area (405,45 cm$^2$), number of leaves per plant (22.27), leaf length (23.15 cm), days to 50% head initiation (50.67 days) and days of first harvest (51.00)was observed in the treatment 50% NPK + Vermicompost @ 2.5 t/ha.

**Yield of broccoli as influenced by INM**

Sharma (2000)revealed maximum yield(62.13q/ha.) in the treatment 175:75:60 kg NPK/ha + 12.5t/ha FYM. According to the finding of Sharma et al. (2005), the treatment 150% NPK+ farmyard manure at 20t/ha gavethe highest marketable yield (13.63t/ha.).During the same year Chatterjee et al recorded the highest curd yield (124.07q/ha) from the recommended dose chemical fertilizer (150:60:80) NPK. Among the organic source the treatment mustard oil cake + biofertilizer gave the highest curd yield (103.70q/ha). Integration of biofertilizers with other source of nutrients also influenced the performance of broccoli significantly. Application of mycoplex @ 250 kg/ha + N: P2O5:K2O @60:50:50 kg/ha produced the highest curd weight i.e., 338 g (Raghav and Kamal, 2007).

Maurya et al. (2008)observed maximum yield (155.47q/ ha.) and (191.41q/ha) in the treatment (2.5 t/ha) poultry manure + 50% RDF during 2005-06 and 2006-07 respectively. Application of 50 kg N through Vermicompost + 150:100:100 kg NPK/ ha recorded the maximum yield of curd (Kumar et al. 2008). During the same year Sharma et al.,recorded the highest curd weight, marketable head yield in integration of Azotobacter with the recommended practice of 20t/ha

 

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cow dung manure + 100% recommended dose of NPK. Furthermore, Mohapatra et al. revealedsignificant curd weight and curd diameter in application of 100% NPK + biofertilizer (Azotobacter + Azospirillum +PSB @ 2 kg. each /ha. + FYM @5 t/ha + Vermicompost @ 2.5 t/ha.Srichandan et al. (2015) also reported that the treatment 75% N and P + 100 % k + bio inoculants + Vermicompost (5 t/ha) gave the highest yield (149.43q/ha) and curd diameter (46.71cm).

In the year 2009,Chaurasia et al.reported the maximum curd yield with application of press mud alone or in combination with 50% NPK, planted at 45 x 60 cm spacing.Meena et al. (2017) conducted a trial to study the influence of integrated nutrient management on broccoli cv. KTS-1 and observed maximum curd weight/ plant (438g), curd weight/ plot (3.94kg), curd yield (219.66 q/ha.) in integration of neem cake 1.5 t/ha. + Azotobacter 2kg/ha + Vermicompost 2.5 t /ha + 75% recommended dose of NPK through inorganic fertilizer. While, Lodhi et al. (2017) reported the maximum curd diameter (15.37cm), weight of trimmed curd (413.33gm), curd yield per plot (7.44 kg) and curd yield (14.16 t/ha.) in the treatment 50% recommended dose of nitrogen (RDN) + 16.6% Vermicompost + 16.6 % FYM + 16.6 % poultry manure. Latha et al. (2017)studied the effect of integrated nutrient management on yield and economics of broccoli and revealed the highest average curd weight of 285.17gm with a yield of 104.37q/ha in treatment, poultry manure 2.5t/ha +half RDF through chemical (40:30:30) NPK. During the same year Kumar et alrecorded significant yield i.e., 19.5 t/ha. in the **t**reatment 75% RDF + FYM and Vermicompost 1:1.

In the year 2018, Sharma et al.,observed the maximum curd diameter (32.91cm), average curd weight (427.73gm) and curd yield (35.97 t/ha) in the treatment (100 %RDF + biofertilizer + Vermicompost). The same year Singh et al., recorded the maximum diameter of curd (19.91cm), maximum weight of trimmed curd (465.33gm), maximum curd yield per plot (3.72kg), curd yield per hectare (20.68 t/ha) in the treatment, 50% RDF + 50% Vermi-compost.Similarly, 50% NPK + Vermicompost @ 2.5 t/ha recorded the highest head girth (42.76 cm), head diameter (14.16 cm), terminal head weight (327.57gm), head volume (595.67 cc), gross yield (233.56q/ha) and marketable yield (Mohanta et al. 2018).

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**Quality of broccoli as influenced by INM:** Raghav and Kamal (2007) evaluated the influence of VAM and inorganic fertilizers on broccoli and recorded highestchlorophyll (39.7 mg/100g), reducing sugar (2.40%) and Vitamin A (375.1IU) content in the treatmentmycoplex at 250 kg/ha + N: $P_2O_5$:$K_2O$ @60:50:50 kg/ha.

The findings ofMeena et al. (2017)revealedthe highest value of TSS (10.15 $^0$B), vitamin C content (82.91 mg/100gm), acidity (0.49) and total sugar content (3.16g) with application of neem cake 1.5 t/ha. +Azotobacter 2kg/ha +Vermicompost 2.5 t/ha + 75% recommended dose of fertilizer through inorganic fertilizer. Similarly, Sharma et al. (2018)reported maximum ascorbic acid (84.17mg /100gm) and TSS (14.77 $^0$Brix) in thetreatment75% RDF + biofertilizer + Vermicompost. While, dry matter content (9.88%) was found in 100% RDF + biofertilizer + Vermicompost. During the same year Singh et al.also reported maximum TSS in the treatment 50% RDF + 50% V.C. while, maximum vitamin C, 103.97mg/100gm was found in 25% RDF + 75% V.C.According to the finding of Mohanta et al. 2018the treatment 50% NPK + Vermicompost @ 2.5 t/ha revealed thehighest vitamin C (80.24mg/gm) and dry matter content (11.77%).

**Economics of broccoliasInfluenced by INM:** In the year 2005 Sharma et al.,reported the highest returns of Rs. 1, 32,220 /ha with benefit cost ratio of 3.27 from treatment 150% NPK + FYM 20 t/ha. While, Mohapatra et al. (2008) revealed that, Vermicompost @5 t/ha +100 %RDF (150:45:80 kg/ha) + biofertilizer (Azotobacter + Azospirillum) +PSB@ 2kg each/ha recorded the highest cost of cultivation Rs. 43508.00/ha, however the maximum gross income of Rs. 209235.00/ha and cost benefit ratio of 5.1 were also recorded in the treatment, 150:45:80 kg/ha N: P: K + biofertilizer (Azotobacter + Azospirillum +PSB @ 2 kg each/ha) + FYM@5t/ha + Vermicompost@ 2.5 t/ha by spending Rs. 41188.00.

The maximum net return and benefit cost ratio (4.09) was observed in 5.0t/ha Vermicompost along with 125% RDF (Chaudhary et al., 2012). Srichandan et al. (2015) revealed that, the treatment, 75% NP + 100 % k + bio inoculants + Vermicompost (5 t/ha) gave the highest net return Rs. 95,455 with B.C. ratio of 3.45.On the other hand, according to Lodhi et al. (2017) the treatment 50% RDN + 16.6% Vermicompost + 16.6% FYM + 16.6% poultry manure gave the highestgross return Rs 3, 66,500/ ha, net return 2,70,208/ha and benefit cost ratio

 

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(3.81:1).Highest net return of Rs. 2, 22,820 with benefit cost ratio 2.9 and production cost of Rs. 76,700 were recorded in treatment poultry manure 2.5t/ha + half RDF through chemical (Latha et al., 2017).

The treatment, 100 % RDF + biofertilizer + Vermicompost) gave the highest net return of Rs. 2, 29,029, 00) along with benefit cost ratio 3.26:1 (Sharma et al., 2018). During the same year Mohanta et al. concluded thatthe treatment 50% NPK + Vermicompost @ 2.5 t/ha recorded the maximum gross returns (Rs. 700680.00/ha), net return (Rs. 525510.00/ha.) and B.C. ratio (4.0).

**Conclusion**

The above findings clearly indicated that, INM had a significant influence on the growth, yield, andquality of broccoli as compared with application of nutrients only through chemical fertilizers or pure organic sources.

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