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# INTEGRATED NUTRIENT MANAGEMENT APPROACH FOR BRINJAL – A REVIEW

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## ABSTRACT

**Integrated nutrient management is one of the most important component of modern production technology to sustain the vegetable production and soil fertility in the future. Integrated use of chemical and organic fertilizer on yield and yield components of brinjal is very crucial for assurance of food security. Integrated nutrient supply/management (INS) aims at maintenance or adjustment of soil fertility and plant nutrient supply to an optimum level for sustaining the desired crop productivity through optimization of benefit from all possible sources of plant nutrients in an integrated manner which includes; Maintain or enhance soil productivity through a balanced use of fertilizers combined with organic and biological sources of plant nutrients. Brinjal is the most popular and commercially important vegetable crops of India. It is highly productive and usually finds a place as "poor man's crop". The growth, yield and fruit quality of brinjal are largely dependent on number of interacting factors. On the other hand brinjal is a long duration crop with high yield which removes large quantities of nutrients from the soil. The integrated nutrient management is very useful in this context. Research works on INM system for brinjal is scanty. This paper has reviewed the research work carried out by various scientists in India and abroad. The review deals with the effect of different INM components on growth, yield, fruit quality, nutrient content and uptake, as well as economics of brinjal.**

***Key words :*** ***Brinjal, biofertilizers, integrated nutrient management, micronutrients, fertilizers.***

In India, brinjal (*Solanum melongena* L.) belonging to the order Polemoniales and family Solanaceae, is cultivated as one of the leading and the second major vegetable crops next to tomato, covering an area of 4.96 lakh ha with a total production of 78.81 lakh tonne, having productivity of 15.90 tonne/ha (Chadha, 2002). Major states growing brinjal are West Bengal, Orissa, Bihar and Gujarat. India is bestowed with vast diversity of flora, fauna, soil and agro climatic conditions. The growth, yield and fruit quality of brinjal are largely dependent on number of interacting factors. Amongst them, INM system is the most crucial as well as basic factor and is found to exert a great influence not only on growth, yield and fruit quality of brinjal but also for obtaining sustained productivity. Plant requires essential 17 mineral elements for proper growth and completion of life cycle. Nickel (Ni) is the latest addition to the list of essential nutrients done in 1987 (Rattan and Goswami, 2002).The continuous use of high level of chemical fertilizers leads to decrease the nutrient uptake efficiency of plants, resulting in either stagnation or decrease in yield and also causing environmental pollution (Singh and Kalloo, 2000).In recent times the concept of Integrated Nutrient Management system has been receiving increasing attention worldwide obviously for reasons of economization of fertilizer usage, safeguarding and ensuring scientific management of soil health for optimum growth, yield and quality of crops in an integrated manner in a specific agro-ecological situations, through balanced use of organic and inorganic plant nutrients; so that one can harvest good yield without deteriorating soil health. Hence, judicious application of these combinations can sustain the soil fertility and productivity.

**Effect of integrated nutrient management on growth of brinjal :** Significant improvement in vegetative characters such as plant height and number of leaves per plant in brinjal over the recommended rate of N fertilizer due to inoculation with mixture of Azotobacter + Azospirillum and followed by application of 75 kg N $ha^{-1}$ (Paithankar *et al*., 2004). FYM + PM (press mud) at 12.5 t $ha^{-1}$ each along with 100% NPK (100:50:50) + biofertilizers recorded the highest values for plant height (108.90 cm), number of primary branches (11.66) and number of leaves (94.05), whereas FYM at 25 t $ha^{-1}$ along with 100% NPK + biofertilizers recorded the highest values for stem girth (3.71 cm), number of secondary branches (15.58) and leaf area (68.62 c.m2) (Chauhan *et al.,* 2007).

Subba Rao and Sankar (1997) conducted an

experiment and recorded that brinjal crop responded well to application of organic manures either alone or in combination besides improving the soil status. They further recorded that the effect of manures on dry matter production and other growth characters were significantly better than those of inorganic fertilizers. Additionally, manure treatments were equally effective compared to NPK treatments in the induction of early flowering in brinjal. An investigation was conducted by Nanthakumar and Veeraragavathatham (1999) and the results clearly indicated that a combined nutrition of organic manure through 12.5 t $ha^{-1}$ of FYM and 75 per cent of the recommended dose of inorganic N, P and K (75 kg N, 37.5 kg P and 30 kg K $ha^{-1}$) favourably increased the growth parameters. Combining organic fertilizers, namely 12.5 t $ha^{-1}$ of farmyard manure, and 2 kg each of Azospirillum and phosphobacteria, with inorganic fertilizers at 75% of the recommended dose of N and P, and 100% of K (namely 75 kg N, 37.5 kg P and 22 .5 kg K $ha^{-1}$) favourably influenced the growth parameters with a maximum yield of 36.48 t $ha^{-1}$ (Nanthakumar and Veeraragavathatham, 2003)

Application of 25 t FYM $ha^{-1}$ + 100 : 50 : 50 kg NPK $ha^{-1}$ + bio fertilizers resulted in the maximum number of fruits (26.64 per plant), fruit length (10.77 cm), fruit girth (10.03 cm), fruit weight (54.11 g) and fruit yield of brinjal (1.43 kg per plant in brinjal cv. Annamalai (Anburani *et al*., 2003). FYM at 25 t $ha^{-1}$along with 100% NPK (100:50:50) + biofertilizers recorded the highest fruit set percentage (65%), number of fruits (26.64), fruit yield per plot (62.92 kg) and estimated fruit yield (31.67 t $ha^{-1}$) (Anburani and Manivannan , 2002). Application of either 100 per cent of recommended dose of nitrogen and phosphorus (100:80 kg NP/ha)+ FYM @ 20 t $ha^{-1}$ or 75 per cent of recommended dose of N and P+ FYM @ 20 t $ha^{-1}$ was found to be more beneficial for sustaining growth and yield of brinjal crop (Singh and Mukherjee, 2010). Jose *et a*l., (1988) recorded the greater plant height (75.15 cm), number of fruits plant-1 (13.07) and weight of fruits (1224.95 g $plant^{-1}$) from the brinjal plants receiving 50 kg N as urea and 50 kg N as PM.

**Effect of integrated nutrient management on yield and quality parameters of brinjal :** Increase in the N rate increased the number of fruits, fruit weight and yield per plant and fruit circumference and fruit volume in summer brinjal (Wange and Kale, 2004). Doikova (1978) reported that application of FYM + NPK increased dry matter production in brinjal; while, FYM alone proved less effective. Sulikeri *et al*., (1977) conducted an experiment on brinjal cv. 'Malapur', planted at 75 x 45 cm or 75 x 75 cm along with a basal dressing of FYM at 10 t $ha^{-1}$; while, NPK was applied at 3 different levels. The highest yields were obtained at the closer spacing, with NPK at 80: 60: 40 kg $ha^{-1}$.The brinjal fruit yields were highest (59.65 t $ha^{-1}$) in plots receiving FYM at 12.5 t $ha^{-1}$ + NPK at half the standard rate. The highest FYM and NPK rates gave 53 t $ha^{-1}$; while, the control plants yielded 29.7 t $ha^{-1}$ according to Subbiah *et al*., (1983). Doikova (1979) obtained highest yield of brinjal cv. 'Trakiets' with 20 tonne FYM + 240 kg N, 120 kg P and 240 kg K2O $ha^{-1}$; while, FYM alone proved less effective in brinjal.

An investigation on the effect of INM was conducted by Nanthakumar and Veeraragavathatham (1999, 2000 & 2001) on yield of brinjal, variety 'Palur -1' during three seasons viz., kharif, rabi and summer. The results clearly indicated that a combined application of organic manure through 12.5 t $ha^{-1}$ of FYM and 75 per cent of the recommended dose of inorganic N, P and K (75 kg N, 37.5 kg P and 30 kg K $ha^{-1}$) registered the highest yield of 36 t $ha^{-1}$. Further, they also reported that the keeping quality of brinjal was also favourably influenced with the same treatment. Gattani *et al*., (1976) reported that if N fertilizer is used in combination with P and K plus FYM, higher yields can be obtained without causing any deterioration of soil physical properties. Som *et al*., (1992) recorded the highest yield (22.56 t $ha^{-1}$) of brinjal cv. 'Garia' when neemcake was applied @ 50 q $ha^{-1}$ along with NPK fertilizers (80: 60: 60 kg $ha^{-1}$). Selvi *et al*., (2004) reported that combination of NPK (100 : 50 : 50 kg $ha^{-1}$) + organic manures (CCP 25 t $ha^{-1}$) + micronutrients ($ZnSO_4$ @ 25 kg $ha^{-1}$ and $FeSO_4$ @ 50 kg $ha^{-1}$) recorded the highest brinjal yield (21.90 t $ha^{-1}$) compared with NPK application alone (16.28 t $ha^{-1}$).

**Quality parameters :** Maximum number of fruits per plant (12.9), percentage of fruit set (32.5) and means weight of fruit (68.8 g) with the treatment receiving 75 kg N, 20 kg $P_2O_5$ and 25 kg $K_2O$ $ha^{-1}$ in brinjal cv. 'Surya' (Philip, 1995) The plant height, number of branches $plant^{-1}$ and other growth parameters were significantly increased due to the application of N through organic and inorganic combinations (Shelke *et a*l., 1999). Godse (1996)) recorded that the fresh weight of brinjal plant varied from 153 to 433 g under different treatments of organic manures and fertilizers under South Gujarat conditions. Maximum ascorbic acid, carbohydrate and crude protein contents were

recorded in 100% NPK (100:50:30 kg $ha^{-1}$) + FYM + Azospirillum + phosphobacteria treatment (Nanthakumar and Veeraragavathatham, 2001). Increased N and P rates increased the root lengths when N: P at 200:100 kg per ha was applied in brinjal hybrid COBH-1 (Prabhu *et al*., 2003). Combined application of farmyard manure at 25 t $ha^{-1}$ along with 100:50:50 kg of NPK per ha and biofertilizers was the best in increasing the quality of fruits (Anburani *et al*., 2003) Applying additional trace elements to the soil increased growth and flowering compared with NPK alone. application of 100% recommended dose of N, P and K (80:80:60 kg $ha^{-1}$) +5 t $ha^{-1}$ vermicompost with 125% recommended dose of N, P and K+ 5 t $ha^{-1}$vermicompost (Choudhary *et al*., 2007) It was at par with 125% recommended dose of N, P and K+5 tones ha-1 of vermicompost and exhibited maximum of nitrogen, phosphorus, potassium, iron and crude protein content in brinjal fruit.

**Effect of integrated nutrient management on nutrient content, uptake and soil status :** Santhy *et al*., (2002) concluded that organic carbon was recorded higher under the treatment of 100 per cent NPK (90: 45: 17.5 kg $ha^{-1}$) + FYM at the rate of 10 t $ha^{-1}$.Prasad and Singhania (1989) reported that combination of inorganic fertilizers with organic manures is better than the fertilizer alone in respect of some soil chemical characteristics. (Shelke *et al*., 2001) recorded highest organic carbon (0.62 %) under the treatment combination of 40 % N through urea + 60 % N through PM at Rahuri with brinjal cv. 'Krishna Hybrid'.

Application of 25 t FYM $ha^{-1}$ + 75 % N + 100 % P + 100 % K resulted in the highest available N (299.9 kg $ha^{-1}$), $P_2O_5$ (44.2 kg $ha^{-1}$) and $K_2O$ (321.9 kg $ha^{-1}$) and the highest uptake of N, P and K at harvest tomato cv. 'Megha' (Harikrishna *et al*., 2002). Selvi *et al*., (2004) under Coimbatore conditions, noticed that N, P and K uptake by brinjal cv. 'CVK' ranged from 80.9 to 172.2, 7.6 to 14.4 and 81.0 to 134.0 kg $ha^{-1}$, respectively whereas, N, P and K contents of fruits were recorded from 2.60 to 3.16, 0.36 to 0.45 and 3.00 to 3.84 per cent, respectively in combination with NPK, organic manures and micronutrients.

A study was undertaken to compare the efficacy of organic versus inorganic forms of nitrogen on growth and yield of brinjal cv. 'MDU-1' by (Jose *et al*., 1988). The results indicated that application of half N (50 kg) as PM and half N (50 kg) as urea increased the dry matter (39.4 to 95 g $plant^{-1}$) and uptake of N (27.9 to 135.5 kg $ha^{-1}$), $P_2O_5$ (8.5 to 34.0 kg $ha^{-1}$) and $K_2O$ (50.9 to 126.3 kg $ha^{-1}$).

**Micronutrients and brinjal :** In brinjal cv. Bhagyamathi, soil application of 12.5 kg $ZnSO_4$ $ha^{-1}$ along with 3 sprays of 0.2% $ZnSO_4$ and 0.5% $FeSO_4$ thrice at weekly interval at later stages recorded significantly highest fruit yield of 37.7 t $ha^{-1}$ with 23.6% increased over control (Singh and Mukherjee, 2010). A maximum yield (21.90 t $ha^{-1}$) was obtained under the combined application of NPK (100: 50: 50 kg $ha^{-1}$) + $ZnSO_4$ @ 25 kg $ha^{-1}$ + $FeSO_4$ @ 50 kg $ha^{-1}$ + organic product over NPK (100: 50: 50 kg $ha^{-1}$) application alone (16.28 t $ha^{-1}$) and control (12.90 t $ha^{-1}$) in brinjal cv. 'CVK (Coimbatore Var Kathiri)'. He also recorded that the 'Fe' uptake ranged from 2.16 to 3.49 kg $ha^{-1}$ as well as 'Fe' content in brinjal fruit ranged from 313 to 401ppm. They concluded that brinjal responded well to the application of micronutrient alone and in combination with NPK and other organic sources (Raj *et al*., 2001). Application of 0.3 per cent borax as foliar spray improved the fruit size, ascorbic acid content, TSS and also reduced the fruit cracking (Selvi *et al.,* 2004). The content of 'Zn' in brinjal fruit ranged from 112.8 to 154.4 ppm and the 'Zn' uptake ranged from 278 to 493 g $ha^{-1}$. It was also recorded that the 'Fe' uptake ranged from 2.16 to 3.49 kg $ha^{-1}$ as well as 'Fe' content in brinjal fruit ranged from 313 to 401 ppm in brinjal cv. 'CVK' in Coimbatore They also concluded that brinjal responded well to the application of micronutrient alone and in combination with NPK and other organic source (Selvi *et al*., 2004).

**Economics :** Selvi and Thiageshwari (2002) studied the effect of INM on yield of brinjal reported that the integrated nutrient application yielded higher net return over the application of NPK alone. Similarly, effect of INM on yield and economics of brinjal cv. 'Jhuri Local' was studied in Nadia, West Bengal by (Devi *et al*., 2002b). Treatment with 50 % N + 25 % poultry manure recorded the highest benefit: cost ratio (7.72: 1).

From the discussion, it can be concluded that higher growth, yield, quality, nutrient uptake can be achieved by appropriate combine application of organic and inorganic fertilizers in brinjal. Results proved that integrated ways of nutrient management on brinjal crop have multipurpose on the improvement of soil fertility and crop productivity in the sustainable manners. It is commonly believed that the combination of organic and inorganic fertilizer will increase synchrony, enhancing the efficiency of the fertilizers, and also reducing environmental problems that may

arise from their use. Nutrient management research in the next decade should basically help to maintain the soil productivity and to enhance and fertilizer use efficiency for a sustainable production without harming the environment.

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