EFFECT OF NITOGEN ON PLANT GROWTH, YIELD AND ITS COMPONENTS IN BRINJAL: A REVIEW

*** PATEL, J. B.; VAJA, ARPANA D. AND DAKI, R. N.**

DEPARTMENT OF SEED SCIENCE AND TECHNOLOGY
JUNAGADH AGRICULTURAL UNIVERSITY, JUNAGADH,GUJARAT

****EMAIL: jbpatelvasai38@gmail.com***

ABSTRACT

The yield depends upon several production factors. Among these proper, balanced nutrition plays a significant role. Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield (Singh et al., 2003). Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as structural compounds of the chloroplast (Basela and Mahadeen, 2008). Nitrogen deficiency generally results in stunted growth and chlorotic leaves caused by poor assimilate formation that leads to premature flowering and shortening of the growth cycle. The present review, therefore, helps in planning the research on the nutrition requirement especially nitrogen to the researchers.

INTRODUCTION

The yield depends upon several production factors. Among these proper, balanced nutrition plays a significant role. Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield (Singh *et al.*, 2003). Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as structural compounds of the chloroplast (Basela and Mahadeen, 2008). The productivity of eggplant is highly responsive to N fertilization. Pal *et al.* (2002) reported that eggplant fruit yield increased with increase in N up to 187.5 kg N/ha. Sat and Saimbhi (2003) observed that increasing the nitrogen significantly delayed flowering of eggplant and increased the number of days taken to fruit setting of eggplant. Nitrogen fertilizer affected seed number, fruit pH, crude protein, total solid and ascorbic acid of eggplant; and nitrogen deficiencies reduced both physical and chemical properties (Akanbi *et al.*, 2007). Takebe *et al.* (1995) reported that increments in the leaf dry weight may be due to a combination of nitrogen with plant matter produced during photosynthesis such as glucose, ascorbic acid, amino acids and proteins. It was found that the increase of the N concentration in the nutrient solution stimulated dry mass accumulation, stem elongation and leaf expansion rate, but decreased the root: shoot dry weight ratio and root whole weight of eggplant (Balliu *et al.*, 2008). Wange and Kale (2004) observed significant improvement in plant height, number of leaves and yield (74%) of eggplant over recommended rate of N fertilizer with the application of 75 kg/ha. Devi *et al.* (2002) found better fruit girth, fruit weight and fruit yield level of eggplant with the application of 120 kg nitrogen

per hectare. It is a well known that adequate nitrogen is required by eggplant for satisfactory growth, development and high yield. Thus, an adequate level of nitrogen is very vital to increase the production and yield of eggplant.

Effect of nitrogen on plant growth, yield and its components

Plants treated with higher dose of nitrogen exhibited better growth in terms of plant height, dry matter production and leaf area index as compared to lower dose. The plant height, number of branches and leaves were observed highest at 90 kg N/ha in brinjal grown under Nagpur conditions, but early flowering was recorded by application of 67.5 kg N/ha (Patnaik and Farooqui, 1964). Mertia and Chauhan (1970) found that plant height, number of leaves per plant, number of flowers per plant, number of fruits per plant, fruit length, fruit diameter and individual fruit weight were increased with the increased nitrogen level. Under Ludhiana conditions, growth and yield of brinjal fruits were significantly increased by increasing the level of soil application of nitrogen up to 75 kg/ha. However, application of nitrogen beyond 75 kg/ha found to be uneconomical (Singh and Sandhu, 1970). The increased nitrogen levels resulted in to increase in plant height due to increased cell division and cell elongation (Singh and Sandhu, 1970 and Ingle *et al*., 2000).

According to Gnanakumari and Satyanaryana (1971), brinjal cultivar Pusa Purple Long supplied with 224 kg each of N, P and K bloomed 27 days earlier than control gave significantly better yield. Application of 280 kg/ha each of N, P and K gave the highest number and maximum weight of brinjal and consequently the highest yield of 59.9 t/ha along with higher contents of vitamin A and C. Umarani and Khot (1972) obtained the highest yield per hectare at 112 kg N/ha. Determining the effect of NPK fertilizer in conjunction with "Spartin" on the growth and yield of brinjal, Chandrasekhram and George (1973) found that the highest level of nitrogen (125 kg N/ha) gave the highest number of flowers and yield than the two lower levels, 75 and 100 kg N/ha). Higher nitrogen level also increased the fruits per plant and size of fruit.

A linear increase in yields of brinjal cultivars, Pusa Purple Long, Pusa Purple Round and Pusa Kranti, was found when nitrogen was applied from 50 to 150 kg/ha under Agra conditions. Yield contributing characters such as fruit weight per plant and length, diameter, volume and specific gravity of the fruit were gradually improved. Among the varieties, Pusa Purple Long gave the highest fruit yield (Verma *et al.*, 1974). Under Kanpur conditions, 160 kg N/ha was found to be beneficial for exploiting the yield potential of hybrid brinjal (Lal and Singh, 1976). Addae-Kagya and Norman (1977) reported that the effect of different nitrogen levels on flowering, fruit set and yield was, however, not significant. Nitrogen fertilization did not affect fruit size and pH, but it significantly influenced per cent TSS, per cent titratable acidity and the ascorbic acid content of the fruits. Gupta *et al.* (1978) reported that application of nitrogen and phosphorus increased plant height, fruit size and fruit yield. The highest yield was obtained at 150 kg N/ha, whereas 120 kg N/ha was found to produce optimum yields.

Kalyanasundaram and Sambandam (1979) found that the variety Annamalai showed the best response to nitrogen followed by SM-2 and SM-50A. The number of fruits per

plot increased with increasing nitrogen rate, except in SM-2 at 150 kg/ha. A similar trend was noted with regard to fruit weight per plot. The fruit bearing of Annamalai was appreciably longer than in the other two varieties. Rastogi *et al.* (1979) reported that 45 kg N/ ha at a spacing of 45 x 30 cm or 60 x 30 cm gave the highest fruit yield. They also reported that high dose of nitrogen increased the number of fruits per plant and the length of the fruit, but the diameter of the fruit was decreased. The absence of N in nutrient solution significantly and negatively affects stem and new leaves growth in brinjal (Haag and Homa, 1981). Razia and Islam (1981) reported that different nitrogen levels significant increasing the yield of brinjal cv. Singnath. The highest nitrogen level of 150 kg/ha produced the highest yield of 11973 kg/ha. Nitrogen was applied at the rate of 0, 30, 60, 90, 120 and 150 kg N/ha in form of urea.

Osman (1981) reported that fertilization of eggplant with N @ 30 to 120 kg/fed, significantly increased vegetative growth, fruits yield and yield components. He also mentioned that plant height and fresh and dry weights per plant of eggplant, increased with N application @ 80 - 120 kg N/fed. The number of fruits per plant and average fruit yield per ha in brinjal cv. Pusa Kranti were increased with increasing N level, with best results being observed at 162.50 kg N/ha (Hanchinamani, 1983). Subbiah *et al.* (1983) reported that increase in plant height was obtained with application of nitrogen in brinjal crop. They also reported that the application of 12.5 t/ha of FYM plus 50 kg of N/ha gave the highest yield. In two year trial with Pusa Purple Cluster variety growing on sandy loam soil, Gupta and Rao (1984) found highest yield of 239.6 q/ha with 150 kg N/ha. Srivastava and Singh (1985) obtained maximum net profit in cv. Pant Samarat with 100 kg N/ha, whereas Pusa Purple Long responded only up to 50 kg N/ha. In trials with brinjal cultivars Black Beauty, Florida Market, Local Long Black and Local Long White, El-Shal *et al*. (1986) reported that yields increased with increasing N rates up to 215 kg N/ha.

Jose *et al.* (1988) reported that substrate application of half N (50 kg) as poultry manure and half N (50 kg) as urea increased the dry matter and uptake of N, P, K, Ca and Mg. There was also higher plant height. The plants supplied with inorganic form of N showed early flowering, when compared to organic sources or their combination. The highest yield of 51.03 t/ha of fruits was recorded by the plants supplied with 50 kg N as poultry manure and 50 kg N as urea followed by plants supplied with 50 kg N as pig manure and 50 kg as urea (45.80 t/ha). Vadivel *et al*. (1988) recommended 300 kg N/ha for getting maximum yield (28.5 - 29.6 t/ha). Selvaraj and Ramamoorthy (1990) obtained highest brinjal fruit yield (17.4 t/ha) with 150 kg N/ha in cultivar PKCM-l at Bhavanisagar in Tamil Nadu. Singh and Maurya (1992) reported that growth and yield of brinjal variety Pusa Kranti was increased significantly with increasing rate of NPK fertilizer under Varanasi condition. The significantly highest yield was obtained with 120: 30: 60 kg NPK per ha. Subramanian *et al.* (1993) stated that plant height and quality were increased with increasing rate of N application. They obtained the highest yield with 150 kg N per ha. The levels used were 0, 5, 100 and 150 kg per ha.

Lopez-Cantarero *et al.* (1997) reported that regardless of the P rate applied, an increase in the N fertilizer increased NO_3- assimilation as well as

total and commercial yield. Villora *et al.* (1998) concluded that excessive N applications lowered the yield quality and quantity, thereby substantially diminishing commercial profits, while appropriate rates increased the biological yield. They confirmed that the economical optimum N rate was 4 g/m^2, especially due to the presence of organic matter. While studying the effect of nitrogen application on brinjal, Ingle *et al.* (2000) reported that the number of branches per plant and dry matter content was increased up to the application of 100 kg N/ha in brinjal cv. Aruna under Akola condition.

Khattak *et al.* (2001) found maximum number of branches (7.84), leaves (285.38), fruits per plant (13.67), stem thickness (1.19 cm) and yield (17674.91 kg/ha) were noted for the plants receiving 125 kg N/ha, while minimum number of branches (6.37), leaves (280.77) and fruits per plant (11.08) in control treatment and minimum stem thickness (1.01 cm) and yield (14062.41 kg/ha) were found when 50 kg N/ha was applied. Maximum number of branches (7.47), number of leaves (342.91), fruit thickness (3.64 cm), plant height (63.46 cm) and yield (17287.96 kg/ha) were recorded for cultivars Long Purple, while minimum number of branches (6.63), leaves (127.41), plant height (58.81 cm) and fruit thickness (3.32 cm) were noted in cultivars Black Bahar, whereas stem thickness (1.06 cm) and yield (14365.74 kg/ha) were noted for Long Purple and Neelam Long, respectively. Devi *et al*. (2002) reported that combined application of organic manure, biofertl1izers and 50 per cent reduction in chemical fertilizer increased the growth, yield attributes and fruit yield of brinjal as compared to sole application of chemical fertilizer or chemical fertilizer at low dose in association with biofertilizer. The treatment 50% N + 25% PM + SF recorded a maximum fruit yield of 27.51 t/ha. Kamili *et al.* (2002) observed that each increment in the level of chemical nitrogen resulted in significant increase in plant height and yield and a maximum of plant height (61.13 cm) and fruit yield (180.40 q/ha) was recorded at 100 kg N/ha.

Nitrogen significantly increased average fruit weight as well as number of fruits per plant and were recorded maximum at 187.5 kg N/ha. Both marketable and total yield increased significantly with increase in nitrogen level (Pal *et al.*, 2002). Shahi *et al.* (2002) found that the yield response of applied nitrogen revealed that increase in N levels from 50 to 150 kg/ha enhanced yield of brinjal fruit, while further addition of nitrogen reduced it in both Pusa Hybrid-5 and Pusa Hybrid-6 varieties. Pusa Hybrid-5 had higher yield as compared to Pusa Hybrid-6 at all levels of nitrogen. Sat and Saimbhi (2003) observed that increasing the nitrogen significantly delayed flowering of eggplant and increased the number of days taken to fruit setting of eggplant. Bobadi and Van Damme (2003) got the best results with nitrogen supplied at 200 kg N/ha and produced significantly the highest number of flowers per plant, fruits per plant and yield (32.24 ton/ha) over control plants. Nitrogen application at 150 and 175 kg N/ha showed comparable results with nitrogen applied at 200 kg/ha. Wange and Kale (2004) found significant improvement in vegetative characters such as plant height, number of leaves and shoot dry weight. Significantly more (74%) yield of brinjal was recorded over the recommended dose of nitrogen fertilizer due to inoculation with mixture of *Azotobacter* + *Azospirillum*

+ 75kg nitrogen per hectare. The results further revealed that reducing nitrogen rate to 50 kg while using these biofertilizers did not help in achieving yields at par with recommended 100 kg nitrogen per hectare. Thus, only 25% nitrogen saving through the use of biofertilizers can be achieved with increase in yield over recommended 100 kg nitrogen per hectare.

Feleafel (2005) reported that increasing N applied rate was accompanied with significant increases in vegetative growth characters; *i.e.* plant height, number of branches and leaves, leaf area and dry weight per plant. Moreover, early and total fruits yield, fruits numbers per plant and fruits firmness as well as leaf N, P and K contents were significantly increased with increasing N applied rate up to 120 kg N/ha. Increasing number of split N applications up to six equal split doses, significantly increased the previous mentioned vegetative growth characters as well as total yield, fruits numbers per plant and average fruit weight. Under 175: 100 kg of NP/ha, the earliest flowering was obtained during *kharif* (36.95 days from planting) as well as *rabi* (35.85 days from planting) season. The total yield per hectare was significantly increased with increasing doses of N and P. The highest yield was obtained from 200: 100 kg NP /ha during *kharif* as well as *rabi* seasons (Prabhu *et al.*, 2006). Aujla *et al.* (2007) found that fruit yield increased significantly with increasing N level up to N_{150} in each furrow as well as in alternate furrow irrigation, although yield was significantly higher in each furrow irrigation. The highest yield under drip was obtained under $D_{0.75}$ at N_{120}, which was 23 per cent higher and obtained with the saving of 25 per cent water and 30 kg N/ha as compared to maximum yield obtained under each furrow irrigation at N_{150}. The marked effect of nitrogen on yield might be due to the cumulative stimulating effect of nitrogen on the vegetative growth characters which form the base for flowering and fruiting. Chauhan *et al*. (2007) reported that application of each incremental dose of nitrogen significantly increased number of fruits, weight of fruit, yield per plant, circumference of fruit and volume of fruit. Each incremental dose of nitrogen was noted positive increase in length of fruit, but it was at per.

Jilani *et al.* (2008) found that nitrogen application @ 100 kg/ha produced significantly maximum survival percentage (95.66 %), fruit length (16.45 cm), fruit diameter (9.25 cm), fruit volume (601.7 cm^3), fruit weight (257.4 g) and yield per hectare (42.6 t). However, 150 kg N excelled in plant height (91.3 cm), number of leaves (16.23) and days to flowering (49.98). Aminifard *et al.* (2010) found the highest lateral stem number and leaf chlorophyll content were obtained in plants receiving 150 kg N/ha. Nitrogen fertilizer affected flower number and days to first flowering. It was observed that fertilization with 100 kg N/ha resulted in the highest average fruit weight and fruit yield.

The growth, dry matter and yield of eggplant under varying levels of NPK 15:15:15 were evaluated in both pot and field trials by Kehinde *et al.* (2011). Results from the pot trial showed a significant enhancement in fruit yield with increasing fertilizer level up to 200 kg/ha, while other shoot's characteristics (leaf number, branch number and stem length) were favoured up to 300 kg/ha. Unexpectedly, a significant branch number increment at 300 kg NPK/ha did not lead to a significant yield increase. Field trial's results showed

that growth, yield and other shoot's characteristics greatly increased up to 200 kg NPK/ha application, after which there was either insignificant increment or a decline. Increment of dry weight towards maturity suggests that there was no cessation in eggplant growth even when partitioning of assimilates towards fruit development took place. The study concluded that 200kg NPK/ha is adequate for optimum growth, dry matter production (pre-anthesis and anthesis stages) and yield in both field and greenhouse conditions. Moraditochaee *et al.* (2011) reported that the effects of nitrogen usage on all studied traits were highly significant. Comparison of mean between nitrogen fertilization rates showed that the highest amount of fruit yield (35.03 t/ha), number of fruits per plant (6.34), fruit length (26.61 cm) and plant height (118.2 cm) were recorded from N_4 treatment. Oloniruha (2011) observed that F_0 and F_1 had comparably poor vegetative growth. Application of 130 kg N/ha had consistently highest plant height and number of leaves. Fruit yield was however better with 70 kg N/ha.

Al-Solimani and Byari (2012) reported that nitrogen fertilizer significantly increased all plant traits compared to control (50 kg N/ha). Plant height significantly increased from 48.03 cm with 50 kg N/ha to 68.28 cm with 125 kg N/ha, leaf area per 5 plants from 1960.43 to 3688.25 cm^2, number of fruits per plant from 16.45 to 30.77 and yield from 20153.66 to 27052.48 kg/ha at 50 and 125 kg N/ha, respectively during the 2009 season. Also fruit yield per ha increased from 18002.1 to 24129.41 kg/ha at 50 and 125 kg N/ha, respectively in 2010 season. Amiri *et al.* (2012) illustrated that plants received 120 kg N/ha produced the highest fruit yield and yield determining traits than those in the control treatment. In addition, regarding the interaction effects between irrigation intervals and nitrogen fertilizer, it could be concluded that irrigation of eggplants every 6 days and application of 120 kg N/ha resulted in the highest yield and yield attributes. Results of interaction effects comparison indicated that WUE varied from 4.36 to 11.6 kg m^3 and the highest amount of WUE was recorded in plants irrigated every 6 days and received 120 kg nitrogen per hectare. Azarpour *et al.* (2012) reported that the effect of foliar humic acid spraying on all measured traits had highly significant differences. Also, effect of nitrogen fertilizer management on fruit yield, number of fruits per square meter, plant height, fruit length and fruit width was highly significant and on number of branches per plant was significant. Interaction effect of foliar humic acid spraying and nitrogen fertilizer management on fruit yield was highly significant and on number of fruits per square meter, plant height, fruit length and fruit width was significant and on number of branches per plant was non-significant. The highest fruit yield was obtained from use of 50 mg/l humic acid spraying and also from 80 kg/ha nitrogen fertilizer.

Bozorgi (2012) reported that application of nitrogen and iron fertilizer showed highly significant effects on all studied traits. Interaction effect of nitrogen and iron on fruit yield, number of fruits per plant, plant height and number of branches per plant showed significant differences. Between nitrogen treatments, application of 60 kg/ha nitrogen and between nano iron treatments, foliar spraying of 2 g/l nano iron chelate recorded the highest yield of 34.63 and 38.03 t/ha, respectively than other treatments in this study. El-Nemr *et al.*

(2012) observed that the vegetative growth parameters (plant height, number of leaves and branches, fresh and dry weight of leaves and branches) and fruit yield of eggplant as well as fruit quality and nutritive value were improved by fertilized eggplant with 100% Super Veit (SV) followed by using 100% Lant Fort (LF). However, using 50% Lant Fort (LF) gave the lowest values. Oliveira *et al.* (2012) reported that nitrogen levels above 5 g/plant did not increase fruit yield of eggplant. The agronomic efficiency of nitrogen is reduced with increasing dose of nitrogen.

Latha *et al.* (2014) observed significant differences in all parameters like, plant height, number of leaves, leaf area and number of branches due to the combined application of microbial fertilizer and chemical fertilizer. Maximum plant height (94 cm) was well as maximum values for number of flowers per plant (36/plant), number of branches per plant (12/plant), pod weight (1133.3 mg) and number of leaf (33/plant) in treatment T_{10} containing urea, super phosphate, murate of potash, *Azospirillum*, Phosphobacteria and potassium mobilizer (each 5g / pot). Lima *et al.* (2014) found that application of nitrogen had significant effect on all variables except stem diameter. The dose of 100 and 150 kg/ha of nitrogen provided the best results. Oyewole *et al.* (2014) showed that the application of organic, inorganic and the mixture of both had significant influence on the parameters measured compared to the control. However, inorganic nutrient source influenced the best performance, thus, recommended. Due to the high cost of Agro-chemicals and access to fertilizer, the use of organic source of nutrient can be adopted at 300 kg N + 177 kg P_2O_5 for the production of eggplant. Tanko (2015) reported that fertilizer application significantly increased the yield of the two varieties. However, NC-2 (green variety) appears to respond more to higher N-application (up to 200 kg N/ha) as compared to NC-1 (off white variety). Also, fertilizer had significant effect on vegetative characters, yield and some yield components. The yield was found to be statistically at par.

REFERENCES

Addae-Kagya, K. A. and Norman, J. C. (1977). The influence of nitrogen levels on local cultivars of eggplant (*Solanum integrifolium* L.). *Acta Hort. (ISHS)*, **53**: 397-402.

Akanbi, W. B.; Togun, A. O.; Olaniran, O. A.; Akinfasoye, J. O. and Tairu, F. M. (2007). Physico- chemical properties of eggplant (*Solanum melongena* L.) fruit in response to nitrogen fertilizer and fruit size. *Agri. J.*, **2**(1): 140-148.

Al-Solimani, S. G. and Byari, S. H. (2012). Effect of pozzolan and nitrogen fertilizer in reducing irrigation water and soil moisture stress in three eggplant cultivars (*Solanum melongena*). *JKAU: Met. Env. Arid Land Agric. Sci*., **23**(2): 3-13.

Aminifard, M. H.; Aroiee, H.; Fatemi, A.; Ameri, A. and Karimpour, S. (2010). Response of eggplant (*Solanum melongena* L.) to different rates of nitrogen under field condition. *J. Central European Agric.*, **11**(4): 453-458.

Amiri, E.; Gohari, A. A. and Esmallian, Y. (2012). Effect of irrigation and nitrogen on yield, yield components and water use efficiency of

eggplant. *African J. Biotech.*, **11**(13): 3070-3079.

Aujla, M. S.; Thind, H. S. and Buttar, G. S. (2007). Fruit yield and water use efficiency of eggplant (*Solanum melongena* L.) as influenced by different quantities nitrogen and water applied through drip and furrow irrigation. *Scientia Hort.*, **112**(2): 142 -148.

Azarpour, E.; Motamed, M. K.; Moraditochaee, M. and Bozorgi, H. R. (2012). Effects of bio, mineral nitrogen fertilizer management, under humic acid foliar spraying on fruit yield and several traits of eggplant (*Solanum melongena* L.). *African J. Agric. Res.*, **7**(7): 1104-1109.

Balliu, A.; Sallaku, G. and Kusi, S. (2008). Nitrogen concentration in nutrient solution and module volume effect on the growth characters and yield potentials of eggplant seedlings. *J. Acta. Hort.*, **801**: 1373-1377.

Basela, O. and Mahadeen, A. (2008). Effect of fertilizers on growth, yield, yield component, quality and certain nutrient content in broccoli (*Bracica oleracea*). *J. Agric. Boil.*, **10**: 627-632

Bobadi, S. and Van Damme, P. (2003). Effect of nitrogen application on flowering and yield of eggplant (*Solanum melongena* L.). *J. Commun. Agric. Appl. Biol. Sci.*, **68**(1): 5-13.

Bozorgi, H. R. (2012). Study effects of nitrogen fertilizer management under nano iron chelate foliar spraying on yield and yield components of eggplant. *ARPN J. Agril. Biol. Sci.*, **7**(4): 233-237.

Chandrasekhram, P. and George, C. M. (1973). Effect of NPK fertilizer in conjunction with "Spartin" on the growth and yield of brinjal. *Agril. Res. J.*, **11**(2) 106-108.

Chauhan, K. S., Bhadoria, S. K. S. and Nagaich, K. N. (2007). Effect of different levels of nitrogen and phosphorus with NAA concentration on quality characters of summer brinjal. *Bhartiya Krishi Anusandhan Patrika*, **22**(2): 167-170.

Devi, H. J.; Maity, T. K.; Pariya, N. C and Thapa, U. (2002). Response of brinjal (*Solanum melongena* L.*)* to different sources of nitrogen. *Veg. Sci.*, **29**(1): 45-47.

El-Nemr, M. A.; EL-Desuki, M.; Fawzy, Z. F. and El-Bassiony, A. M. (2012). Yield and fruit quality of eggplant as affected by NPK sources and micronutrient application. *J. Appl. Sci. Res.*, **8**(3): 1351-1357.

El-Shal, M.; Kamar, M. E.; Eslhalkawy, A. M. and Osman, E. A. (1986). Effect of nitrogen fertilizer on the characteristics of four egg plant cultivars. *Alexanderia J. Agric. Res.*, **31**(2): 213-244.

Feleafel, M. N. (2005). Response of growth, yield and quality of eggplant to varying nitrogen rates and their application systems. *J. Agric. Env. Sci. Alex. Univ.*, **4**(1): 122-136.

Gnanakumari and Satyanarayana, G. (1971). Effect of N, P and K fertilizers and different rates on flowering, yield and composition of brinjal (*Solanum melongena* L). *Indian J. Agric. Res.*, **41**: 259-264.

Gupta, A. and Rao, G. G. (1984). Response of brinjal to soil moisture regime and nitrogen fertilization. *Indian J. Hort*., **41**: 259-264.

Gupta, A.; Shukla, V.; Srinivas, K. and Rao, J. N. (1978). Response of brinjal (*Solanum melongena* L) to nitrogen, phosphorus and potassium fertilization with different plant spacings. *Indian J. Hort*., **35**: 352~358.

Haag, H. P. and Homa, P. (1981). Mineral nutrition of vegetables. Eggplant macronutrient deficiencies. In: Haag, H. P. and Minami, K. *Nutricao mineral emhortalicas. Campinas: Fundacao Cargill*. pp. 419-431.

Hanchinamani, P. S. (1983). Response of 'PusaKranti' brinjal (*Solanum melongena* L.) to varying schedules of fertilizers and spacings. M.Sc. (Ag.) Thesis (unpublished) submitted to University of Agricultural Sciences, Dharwad.

Ingle, V. J.; Jadhao, B. J. and Joshi, P. S. (2000). Response of brinjal to nitrogen and phosphorus cv. Aruna. *J. Soils Crops*, **10**(1): 163-164.

Jilani, M. S.; Afzal, M. F. and Kashif, W. (2008). Effect of different nitrogen levels on growth and yield of brinjal (*Solanium melongena* L). *J. Agri. Res.*, **46**(3): 245 – 251.

Jose, D.; Shanmugavelu, K. G. and Thamburaj, S. (1988). Studies on the efficiency of organic vs. inorganic form of nitrogen in brinjal. *Indian J. Hort*., **45**: 100-103.

Kalyanasundaram, N. and Sambandam, L. (1979). Performance of three brinjal varieties to various levels of nitrogen. *J. Sci. India*, **25**(2): 54-58.

Kamili, I. A.; Zargar, M. Y. and Chattoo, M. A. (2002). Effect of microbial inoculants, chemical nitrogen and their combinations on brinjal (*Solanium melongena* L). *Veg. Sci.*, **29**(1): 87-89.

Kehinde, N. A.; Adeniyi. O. T.; Olabiyi, A. M. and Okechukwu, C. V. (2011). Effects of NPK fertilizer on growth, dry matter production and yield of eggplant in southwestern Nigeria. *Agric. Biol. J. N. Am*., **2**(7): 1117-1125.

Khattak, M. N.; Muhammad, I. and Nisar, N. (2001). Effect of different levels of nitrogen on the growth and yield of different cultivars of eggplant under the agro-climatic conditions of Peshawar. *Sarhad J. Agric.*, **17**(3): 339-346.

Lal, S. and Singh, D. N. (1976). Response of hybrid brinjal to nitrogen fertilization. *Indian J. Hort.*, **33**: 258-261.

Latha, P.; Jeyaraman, S. and Prabakaran, R. (2014). Study effects of microbial and chemical fertilizer on yield components in brinjal (*Solanum melongena* Linn.) C. *Var* CO-2. *Int. J. Curr. Microbiol. Appl. Sci.*, **8**(3): 817-822.

Lima, P. R.; Carlesso, R. E.; Borsoi, A.; Ecco, M.; Fernandes, F. V.; Mezzalira, E. J.; Rampim, L.; Rosset, J. S.; Battistus, A, G.; Malavasi, U. C. and da Fonseca, P. R. B. (2014). Effects of different rates of

nitrogen (N) and phosphorus pentoxide (P_2O_5) on eggplant yield. *Afr. J. Agric. Res.*, **9**(19): 1435-1441.

Lopez-Cantarero, I.; Ruiz, J. M.; Hernandez, J. and Romero, L. (1997). Nitrogen metabolism and yield response to increases in nitrogen-phosphorus fertilization: Improvement in greenhouse cultivation of eggplant (*Solanum melongena* cv. Bonica). *J. Agril. Food Chem.*, **45**(11): 4227-4231.

Mertia, N. S. and Chauhan, K. S. (1970). Effect of different levels of nitrogen and phosphorus on vegetative growth and yield of brinjal (*Solanum melongena*). *The Allahabad Farming*, **44**(6): 439-445.

Moraditochaee, M.; Bozorgi, H. R. and Halajisani, N. (2011). Effects of vermicompost application and nitrogen fertilizer rates on fruit yield and several attributes of eggplant (*Solanum melongena* L.) in Iran. *World Appl. Sci. J.*, **15**(2): 174-178.

Oliveira, M. L.; Cardoso, M. O. and Kano, C. (2012). Crescimento inicial na berinjela em plantio direto com fitimassa da leguminosa arbustiva Tefhrosia candida cobrindo o solo, com e sem nitrogenio mineral. *Horticultura Brasileira*, **30**(2): 3190-3195.

Oloniruha, J. A. (2011). Effect of graded levels of nitrogen on growth and yield of eggplant (*Solanum melongena*) in Kabba, Southern Guinea Savanna ecological zone of Nigeria. *J. Life Sci.*, **5**: 725-727.

Osman, E. A. (1981). Evaluation of the characters of four eggplant cultivars (*Solanum melongena* L.) as affected by different levels of nitrogen fertilization. M. Sc. Thesis, Faculty of Agriculture, Alexandria University, Egypt.

Oyewole, C. I.; Akogu, E. S. and Attah, E. S. (2014). Response of egg plant (*Solanum melongena L.*) to nutrient sources and rates of application: I. Yield components and fruit yield. *Int. J. Agri. Biosci.*, **3**(4): 166-172.

Pal, S.; Saimbhi, M. S. and Bal, S. S. (2002). Effect of nitrogen and phosphorus levels on growth and yield of brinjal hybrid *(Solanum melongena* L.*). Veg. Sci.*, **29**: 90–91.

Patnaik, B. P. and Farooqui, M. M. (1964). Effect of nitrogen single and in combination with P_2O_5 and K_2O in brinjal. *Fertilizer News*, **9**(7): 21-25.

Prabhu, M.; Veeraragavathatham, D.; Srinivasan, K. and Natarajan, S. (2006). Effect of nitrogen and phosphorus on earliness and yield of brinjal hybrid COBH 1. *Agril. Sci. Digect*, **26**(3): 218-220.

Rastogi, K. B.; Korla, B. N.; Peshin, S. N. and Saini, S. S. (1979). Effect of different levels of nitrogen and spacing on fruit yield of eggplant (*Solanum melongena* cultivar Pusha Purple Long) grown in the mid hill region of Himachal Pradesh, India. *Indian J. Agril. Sci.*, **49**(9): 680-682.

Razia, S. and Islam, M. S. (1981). The yield response of brinjal to nitrogen fertilizer. *Bangladesh Hort.*, **9**(1-2): 15-18.

Sat, P. and Saimbhi, M. S. (2003). Effect of varying levels of nitrogen and phosphorus on earliness and yield of brinjal hybrids. *J. Res. Crops*, **4**(2): 217-222.

Selvaraj, K. V. and Ramamoorthy, K. (1990). Response of brinjal to varying levels of irrigation and nitrogen. *Prog. Hort.*, **22**(1-4): 147-150.

Shahi, U. P.; Singh, S.; Srivastava, B. K. and Singh, M. P. (2002). Effect of nitrogen and phosphorus application on residual fertility and yield of hybrid brinjal in Mollisol. *Veg. Sci.,* **29**(2): 195-196.

Singh, K. and Sandhu, D. S. (1970). Effect of soil and foliar applications of nitrogen on the growth and yield of brinjal (*Solanum melongena* L,). *Punjab Hort. J.,* **10**: 103-110.

Singh, S. S., Gupta, P. and Gupta A. K. (2003). Handbook of Agricultural Sciences. Kalyani Publisher, New Delhi, India. pp. 184-185.

Singh, S. S. and Maurya, A. N. (1992). Effect of nitrogen, phosphorus and potash on growth and yield of brinjal. *Agril. Sci. Digest*, **12**(1): 29-31.

Srivastava, B. L. and Singh, M. P. (1985). Response of brinjal cultivars to spacing and N and P nutrition. *Prog. Hort*., **17**: 103 -108.

Subbiah, K.; Sundararajan, S. and Muthuswamy, S. (1983). Effect of varying levels of organic and inorganic fertilizer on yield and nutrient uptake of brinjal. *South Indian J. Hort*., **31**: 287-290.

Subramanian, K. S.; Selvaraj, K. V.; Selvakumari, G. and Shanmugasundram, V. S. (1993). Influence of moisture regimes and nitrogen on growth and yield of brinjal (*Solanum melongena*). *South Indian J. Hort.,* **41**(1): 16-21.

Takebe, M.; Ishihara, T.; Mastuna, K.; Fojimota, J. and Yoneyama. T. M. (1995). Effect of nitrogen application on the content sugars, ascorbic acid, nitrate and oxalic acid in spinach (*Spinacia oleracea* L.) and Kamatsuna (*Nrasia compestris* L.). *Jpn. J. Soil Sci. Plant Nutri.,* **66**: 238-246.

Tanko, U. M. (2015). Influence of N-Fertilizer application on the yield and yield components of two varieties of eggplant (*Solanum melongena* L.) in Anyigba, Kogi State. *J. Biol. Agric. Healthcare*, **5**(17): 202-208.

Umarani, N. K. and Khot, B. D. (1972). Response of brinjal (*Solanum melongena* L.) to nitrogen, phosphorus and irrigation intervals. *Indian J. Agril. Sci*., **43**(8): 786-788.

Verma, J. P.; Rathore, S. V. S. and Dayal, R. (1974). Response of certain varieties of brinjal to varying levels of nitrogen. *Prog. Hort*., **6**(1): 25-30.

[MS received: July 3, 2016] ***[MS accepted: August 6, 2016]***