Original Research Article

Response to Foliar Spray of Boron along with Different Fertilizer Management Strategies on Growth, Yield and Quality of Brinjal *(Solanum melongena* L.*)*

ABSTRACT

A field experiment was conducted during rainy season of 2017–18 at Horticulture Farm, S.K.N. Agriculture University, Jobner, Jaipur, Rajasthan, to study the role of foliar spray specifically of boron on the growth, yield and quality of Brinjal (*Solanum melongena* L.) The study conducted was laid with 18 treatments *viz.*, INM levels (control, 100% NPK through inorganic source, 75% NPK through inorganic source+25%VC (vermicompost), 50% NPK through inorganic source+50%VC, 25% NPK through inorganic source+75% VC and 100%VC and boron levels (control, 100 ppm and 200 ppm). In three replications the total 18 treatment combinations were tested as per randomized block design. It was observed that there was a significant increase in the plant height and plant spread at 30, 60 and 90 DAT on the application of 75%NPK through inorganic source+25%VC on the brinjal crop, while the application of 50%NPK through inorganic source+50%VC significantly increased chlorophyll content (mg g^{-1}), fruit length(cm), fruit weight(g), fruit yield ha^{-1} (q), Nitrogen and Phosphorus content in fruit(%), as compared to control but statistically at par with 25%NPK through inorganic source+75%VC. The application of boron(200ppm) significantly increased the plant height and plant spread at 30, 60 and 90 DAT(cm), chlorophyll content (mg/g), fruit length(cm), fruit weight(g), fruit yield $hectare^{-1}$(q), NP content in fruit (%), as compared to control and boron(100 ppm).

Key words: Brinjal, NPK, vermicompost, growth, quality

1. Introduction

Brinjal (*Solanum melongena* L.) which is commonly known as eggplant and also called aubergine belongs the family solanaceae. It is believed that brinjal is native to southern India and is one of the most popular vegetable grown throughout the tropics and subtropics (Chowdhury and Tah, 2011). The main source of anti-ascorbic acid (vitamin- C) is its green leaves. Brinjal contain phyto-nutrients with an antioxidant role. They are useful in the fight against cancer, have an antiviral role, antimicrobial and reduce bad cholesterol. The eggplant fruits contain phenolic compound, the most abundant source of chlorogenic acid (Butu and Rodino, 2019). It is having medicinal properties and used as appetizer, aphrodisiac and "cardiotonic" in Ayurveda, sometimes it is used to provide relief from inflammation as its fruit exhibits laxative properties. White brinjal is to be good for diabetic patients. It is also reported to be useful for the treatment of bronchitis, asthma, dysentery, for controlling the blood cholesterol etc. Along with the antioxidant property it is rich in dietary fiber, potassium, calcium, manganese, copper and vitamin A & B (Anonymous, 2012).

Brinjal being a long duration crop requires a good manure and fertilizer (Manimegala and Gunasekaran, 2020). Nitrogen is considered to be a building block in the production of protein and is the main ingredient of protoplasm (Paul et al., 2017). Sat and Saimbhi (2003) reported that by increasing the nitrogen considerably then it can delay flowering of eggplant and the time requirement for fruit setting also increased significantly. Phosphorus plays a key role in the formation of plasma membrane, nucleic acids, coenzymes, organic molecules, many phosphorylated products, carbohydrates synthesis and nutrient contents like Ca, Mg, N, K and S (Badiger et al., 2006). Crop productivity can be significantly increased with the Potassium use, as it imparts increased vigour and resistance against diseases. It also regulates water balance within the plant cell through the process of anabolism, respiration and transpiration and in turn reduces the tendency to wilt. It improves the taste and quality in tomato through the formation of protein and chlorophyll by using available water.

The technique of organic vegetable production plays a important role in produce high value of vegetable (Mishra et al., 2018). Vermicompost consistently encourage biological activity which can cause plant to germination of seed, to produce flower and better yield than in commercial used media, independent of nutrient availability (Arancon et al., 2004). Vermicompost increase the surface area and it's provide strong absorbability of nutrients and retain more nutrients for a longer time period (Mamta et al., 2012). Vermicompost is slow releasing organic manure which has most of the macro as well as micro nutrients in chelated from and full fill the nutrients requirement of plant for longer period, its use has been advocated in integrated nutrient management (INM) system in vegetable crops. Vermicomposts are characterized by high porosity, water-holding capacity, drainage, aeration and microbial activity (Manimegala and Gunasekaran, 2020).

Boron (B) is a micronutrient critical to the growth, health and essential element for carbohydrate metabolism of all crops. It is a component of plant cell wall and reproductive structures. It is a mobile nutrient in the soil, meaning it is prone to movement in the soil. Boron role plays in a diverse range of plant functions including maintenance of structural and functional integrity of biological membranes, cell wall formation and stability, movement of sugar, seed set and pollination. In plants deficiency of boron nutrients results into delaying in pollen germination, pollen tube development and ultimately it halts flowering and fruit setting (Jokanovi, 2020).

2. Materials and Methods

The field experiment was conducted at Horticulture farm, Department of Horticulture, S.K.N. COA, Jobner , Rajasthan, India during July to December 2017. The details regarding the use of experimental techniques, materials and criteria opted for the assessment of treatments during the course of investigation is provided.

The soil texture in experimental field were loamy sand, slightly alkaline, poor in organic carbon with low in available nitrogen (135.05 kg ha^{-1}), phosphorus (16.67 kg ha^{-1}) and medium in potassium content (150.83 kg ha^{-1}).

In the experiment Pant Rituraj variety of brinjal was used. Treatments were considered as six levels of INM & Vermicompost, *viz*., N_0= Control, N_1=100 per cent RD of NPK through inorganic fertilizers, N_2=75 per cent RD of NPK through inorganic fertilizers+25 per cent through VC, N_3=50 per cent RD of NPK through inorganic fertilizers+50 per cent through VC, N_4=25 per cent RD of NPK through inorganic fertilizers+75 per cent through VC, N_5=100% RD of NPK through vermicompost and three levels of boron *viz*., B_0= Control, B_1= 100 ppm, B_2= 200 ppm.

The experiment was laid out in a RBD (Randomized Block Design) with three replications. Thirty days old seedlings were transplanted at the spacing of 60×45 cm^2 in rainy season, 2017. The size of the experimental plots was 2.4×2.25 m^2. Harvesting was done during month of December 2017. Data were collected from five randomly selected plants for each plot and the recoded parameters were plant height (cm), Plant spread (cm^2) for both direction (E-W & N-S), Chlorophyll content in leaves (mg/g), Fruit length (cm), Average fruit weight (g), Yield per hectare (q), Nitrogen and Phosphorus content in fruit (per cent).

3. Results and Discussion

3.1. Plant height

The significantly maximum plant height at 30, 60 and 90 days after transplanting (19.15, 51.31 and 72.56 cm) were observed under the treatment N_2 (75% NPK+25% VC), which was statistically at par with application of treatment N_3 (50% NPK+ 50% VC) because inorganic fertilizer have more quantity of macronutrients that provide better vegetative growth of plants. The Nitrogen, Phosphorous and potassium are considered as major nutrients required for proper growth and development of the plant. This might be due to the better nutritional environment in the root zone for growth and development of the plant by the application of NPK with vermicompost. Potassium fertilization improved overall crop growth in terms of plant height and number of branches per plant. Whereas, minimum plant height at 30, 60 and 90 days after transplanting (12.80, 40.30 and 58.01 cm) were observed under control. The maximum plant height at 30, 60 and 90 days after transplanting (17.78, 49.68 and 69.98 cm) was recorded in treatment B_2 (200 ppm), and minimum plant height at 30, 60 and 90 days after transplanting (15.66, 43.25 and 61.13 cm) was observed under B_0 (control). Growth attributes of brinjal increased with application of boron at initiation of flowering. Boron is also associated with the development of plant cell wall and results in improved shoot growth (Basavarajeshwari et al., 2008) and thus increased plant height, branches per plant and leaves per plant (Oyinlola, 2004) which greatly confirmed the present results.

3.2. Plant spread (E-W)

The maximum plant spread (East-West) at 30, 60 and 90 DAT (30.65, 56.22 and 81.29 cm) were observed under the treatment N_2 (75% NPK+ 25% VC), which was statistically at par with treatment N_3 (50% NPK+ 50%VC). While, minimum plant spread (E-W) at 30, 60 and 90 DAT (22.45, 44.06 and 68.50 cm) was observed under control. The plant spread (East-West) at 30, 60 and 90 DAT under the treatment N_2 (75% NPK+25% VC) was registered 36.52, 27.59 and 18.67 per cent higher as compared to control, respectively. The nitrogen is a main constituent of protoplasm, cell nucleus, amino acids, proteins, chlorophyll and many other metabolic produces. Phosphorus is a constituent of nucleic acid, phytin and phospholipids. The beneficial influence of phosphorus in early stages of growth may be explained by early stimulation of root system through efficient translocation to the root or certain growth stimulation compounds formed on account of protoplasmic activity of tops in phosphorus fed plants, when enhanced absorption of nitrogen and other nutrients and their utilization (Parihar and Tripathi, 2003). Application of boron significantly influenced the plant spread (E-W) at 30, 60 and 90 DAT (29.33, 54.28 and 79.90) in treatment B_2 (200 ppm) and minimum plant spread (E-W) at 30, 60 and 90 DAT (25.64, 46.85 and 70.85) was observed under control. The plant spread (E-W) at 30, 60 and 90 DAT under the treatment B_2 (200 ppm) was noted 14.39, 15.85 and 12.87% more over control, respectively. Boron is associated directly and indirectly with several plant functions, as it involves in the growth of cells in newly emerging shoots and roots while in some plants, (Miwa et al., 2008).

3.3. Plant spread (N-S)

The maximum plant spread (N-S) at 30, 60 and 90 DAT (29.85, 58.15 and 85.50 cm) were observed under the treatment N_2 (75% NPK+25% VC), which was statistically at par with application of treatment N_3 (50% NPK+50% VC). The plant spread (N-S) at 30, 60 and 90 DAT under the treatment N_2 (75% NPK+25% VC) was found 28.11, 28.45 and 17.42% higher than control, respectively. The response to potassium fertilization in terms of overall improvement in growth parameters in further supported by the fact that the leaching losses of potassium were more in light textured soils. Most of these investigations have confirmed that manure compost and vermicompost usually has significant beneficial effects on plant growth, (Kashyap et al., 2014). Similarly, the application of different levels of boron also had significant increase plant spread (N-S) at 30, 60 and 90 DAT (28.88, 55.86 and 84.46) in treatment B_2 (200 ppm), and minimum plant spread (N-S) at 30, 60 and 90 DAT (24.86, 47.95 and 75.17) was noted under control. The plant spread (N-S) at 30, 60 and 90 DAT under the treatment B_2 (200 ppm) was recorded 16.17, 16.49 and 12.35 per cent more over control, respectively. Foliar sprays of Boron increased the nitrogen content of the leaves. Leaf area of plant was significantly increased by nitrogen, possibly because nitrogen helps in greater assimilation of food material by the plant which resulted in greater meristematic activities of cells and accordingly the number of leaves, length and width of leaf of plant. The findings is also in agreement with the findings of Solanki et al. (2017) in brinjal.

Table:1 Effect of NPK with vermicompost and boron on Plant height & Plant spread at different growth stages of brinjal

Treatments	Plant height (cm)			Plant spread (cm)					
				(E-W)			(N-S)		
	30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest	30 DAT	60 DAT	At harvest
INM levels									
N_0-Control	12.80	40.30	58.01	22.45	44.06	68.50	23.30	45.27	72.81
N_1-100% NPK	16.85	46.56	65.52	28.11	51.31	74.79	27.19	52.15	79.31
N_2-75% NPK+25% VC	19.15	51.31	72.56	30.65	56.22	81.29	29.85	58.15	85.50
N_3-50% NPK+50% VC	17.88	48.61	68.99	29.36	52.89	79.77	27.88	54.69	84.34
N_4-25% NPK+75% VC	17.57	47.29	65.78	28.70	51.67	75.22	27.45	52.57	79.46
N_5-100% VC	15.43	44.79	63.50	25.82	48.56	74.49	25.73	49.96	78.56
SEm±	**0.44**	**1.15**	**1.90**	**0.72**	**1.47**	**1.77**	**0.73**	**1.56**	**2.00**
CD (P=0.05)	**1.28**	**3.32**	**5.47**	**2.06**	**4.21**	**5.09**	**2.09**	**4.47**	**5.73**

Boron levels									
B_0-Control	15.66	43.25	61.13	25.64	46.85	70.85	24.86	47.95	75.17
B_1-100 ppm	16.84	46.51	66.07	27.58	51.22	76.28	26.96	52.59	80.36
B_2-200 ppm	17.78	49.68	69.98	29.33	54.28	79.90	28.88	55.86	84.46
SEm±	**0.31**	**0.82**	**1.35**	**0.51**	**1.04**	**1.25**	**0.51**	**1.10**	**1.41**
CD (P=0.05)	**0.90**	**2.34**	**3.87**	**1.45**	**2.98**	**3.60**	**1.47**	**3.16**	**4.05**

3.4. Chlorophyll content in leaves

Maximum chlorophyll content in leaves at 45 DAT (1.315 mg g^{-1}) was observed under the treatment N_3 (50% NPK+50% VC), which was statistically at par with application of treatment N_4 (25% NPK+75% VC).Whereas, minimum chlorophyll content in leaves at 45DAT (1.014 mg g^{-1}) was observed under control. The chlorophyll content in leaves under the treatment N_3 (50% NPK+50% VC) was found 29.68 per cent higher than control. This might be due to the fact that NPK with vermicompost helped in the expansion of leaf area and chlorophyll content which together might have accelerated the photosynthetic rates and in turn increased the supply of carbohydrates to plants. Potassium helps in the chlorophyll formation ultimately the NPK are used for better vegetative growth. The effect of vermicompost on physico-chemical properties imparts favorable soil structure for root growth which influenced better plant growth. The maximum chlorophyll content in leaves at 45 DAT (1.270 mg/g) was recorded in treatment B_2 (200 ppm) and minimum (1.130 mg g^{-1}) was observed under control. The chlorophyll content in leaves under the treatment B_2 (200 ppm) was recorded 12.38 per cent more over control. These results point out that the spray of boron, it also helps in enhancing quality parameters such as chlorophyll content of brinjal (Selvi et al., 2004).

3.5. Fruit length

The application of treatment N_3 (50% NPK+50% VC) produced significantly maximum fruit length (8.36 cm), which was statistically at par with application of treatment N_4 (25% NPK+75% VC).While, the minimum fruit length (7.19 cm) was observed under control. The fruit length under the treatment N_3 (50% NPK+50% VC) was registered 16.27 per cent more as compared to control and application of boron produced maximum fruit length (8.25 cm) in treatment B_2 (200 ppm), which was minimum (7.41 cm) under control. Application of treatment B_2 (200 ppm) registered an increase of 11.33 per cent higher fruit length over control. These results indicated that the spray of boron, it also helps in enhancing fruit size. Similar quality parameters were also reported by Selvi et al. (2004).

3.6. Fruit weight

The maximum fruit weight (81.66 g) was recorded under the treatment N_3 (50% NPK+50% VC), which was statistically at par with application of treatment N_4 (25% NPK+75% VC), While the minimum fruit weight (70.53 g) was observed under control. The Fruit weight under the treatment N_3 (50% NPK+50% VC) was found 15.78 per cent more as compared to control. The application of boron gave significantly maximum fruit weight (80.38 g) was recorded in treatment B_2 (200 ppm), and minimum fruit weight (72.76 g) was observed under control. Application of treatment B_2 (200 ppm) registered an increase of 10.47 percent over control. Increased number of fruits due to foliar spray of micronutrients might be attributed to enhanced photosynthetic activity, resulting in increased production and accumulation of carbohydrates and favorable effect on vegetative growth and retention of flowers and fruits, which might have increased number and weight of fruits. Boron plays an important role in uptake of calcium and transport of carbohydrates. In case of B deficiency the rate of respiration increases and therefore more water loss. In boron deficient plants enzymatic activity increases which increase the loss of water from the fruit surface. Boron availability increases calcium synthesis which reduces respiration that might decrease amount of moisture loss from the fruit surface Stanley *et al*., (1995) also obtained similar results.

3.7. Fruit yield

The maximum fruit yield ha^{-1} (332.10 q ha^{-1}) was observed under the treatment N_3 (50% NPK+50% VC), which was statistically at par with application of treatment N_4 (311.95 q ha^{-1}).Whereas, minimum fruit yield per hectare (212.49 q ha^{-1}) was observed under control. The per cent increase in fruit yield per hectare under the treatment N_3 (50% NPK+50% VC) was found to be 56.28 per cent more over control. The application of treatment N_3 (50% RD of NPK+50% VC) favored the metabolic and auxin activities in plant and ultimately resulted in increased fruit size, fruit weight, number of fruits per plant, yield per plant and yield ha^{-1}, (Kumar, and Gowda, 2010). Application of different boron levels also had significantly effect on fruit yield per hectare as compared to control. The significantly increase fruit yield per hectare (328.52 q ha^{-1}) was recorded in treatment B_2 (200 ppm), and minimum (236.11) was observed under control. The fruit yield per hactare under the treatment B_2 (200 ppm) was recorded 39.13% more over control. Boron deficiency commonly results in empty pollen grains, poor pollen strength and a reduced number of flowers per plant. The highest fruit set percentage might be due to optimum boron application, as boron plays important role in maintaining cell integrity, improving respiration, enhancing metabolic activities and uptake of nutrients. Nonnecke (1989) and Suganiya and Kumuthini (2015) also obtained similar results.

3.8. Nitrogen content in fruit

The maximum nitrogen content in fruit (3.16%) was observed under the treatment N_3 (50% NPK+50% VC), followed by N_4 (25% NPK+75% VC) and followed by N_2 (75% NPK+25% VC).Whereas, minimum nitrogen content in fruit (2.17%) was observed under control and the application of different levels of boron brought out significant increase nitrogen content in fruit as compared to control. Similar results reported by Laxmi et al., 2015. The maximum nitrogen content in fruit (3.01%) was recorded in treatment B_2 (200 ppm), which was 11.89% more over the control and minimum (2.69%) was observed under control. These results clearly indicated that the spray of boron, besides increasing the growth and yield it also helps in enhancing quality parameters brinjal fruits. Similar parameters were also reported by Selvi et al. (2004). Adequate B is also required for effective nitrogen fixation and nodulation in legume crops. The results showed that the effect of different treatments on nutrient concentration and seed protein were significant, (Salih and Hemn, 2013).

3.9. Phosphorus content in fruit

The maximum phosphorus content in fruit (0.54%) was observed under the treatment N_3 (50% NPK+50% VC), which was statistically at par with application of treatment N_4 (25% NPK+75% VC), whereas, minimum phosphorus content in fruit (0.43%) were observed under control. The per cent increase phosphorus content in fruit under the treatment N_3 (50% NPK+50% VC) was found to be 25.58% over control. Among the various organic manures, the compost produced by earthworms (vermicompost), is a rich source of macro and micronutrients. It is evident form data that phosphorus content in fruit with the application of boron 200 ppm (B_2) was recorded maximum phosphorus content in fruit (0.52%) as compared to other treatment, while minimum phosphorus content was recorded under control (0.45%). Boron deficiency adversely affect the quality and yield of many vegetables especially tomato (Imtiaz *et al*., 2010).

Table:2 Effect of NPK with vermicompost and boron on fruit length, fruit weight, fruit yield, cholorophyll content in leaves, nitrogen and phosphorous content in fruit of brinjal

Treatments	Fruit length (cm)	Fruit weight (g)	Fruit yield (q ha^{-1})	Nitrogen Content in Fruit (%)	Phosphorous Content in Fruit (%)	Chlorophyll content in leaves (mg/g)
INM levels						
N_0-Control	7.19	70.53	212.49	2.17	0.43	1.014
N_1-100% NPK	7.78	76.12	284.11	2.92	0.48	1.204

N_2-75% NPK+25% VC	7.85	76.30	286.13	2.95	0.49	1.214
N_3-50% NPK+50% VC	8.36	81.66	332.10	3.16	0.54	1.315
N_4-25% NPK+75% VC	8.21	79.39	311.95	3.06	0.52	1.275
N_5-100% VC	7.68	75.97	281.00	2.89	0.46	1.198
SEm±	**0.17**	**1.41**	**11.07**	**0.05**	**0.01**	**0.025**
CD (P=0.05)	**0.48**	**4.05**	**31.81**	**0.14**	**0.03**	**0.073**
Boron levels						
B_0-Control	7.41	72.76	236.11	2.69	0.45	1.130
B_1-100 ppm	7.88	76.84	289.26	2.88	0.49	1.210
B_2-200 ppm	8.25	80.38	328.52	3.01	0.52	1.270
SEm±	**0.12**	**1.00**	**7.83**	**0.04**	**0.01**	**0.018**
CD (*p*=0.05)	**0.34**	**2.86**	**22.49**	**0.10**	**0.02**	**0.051**

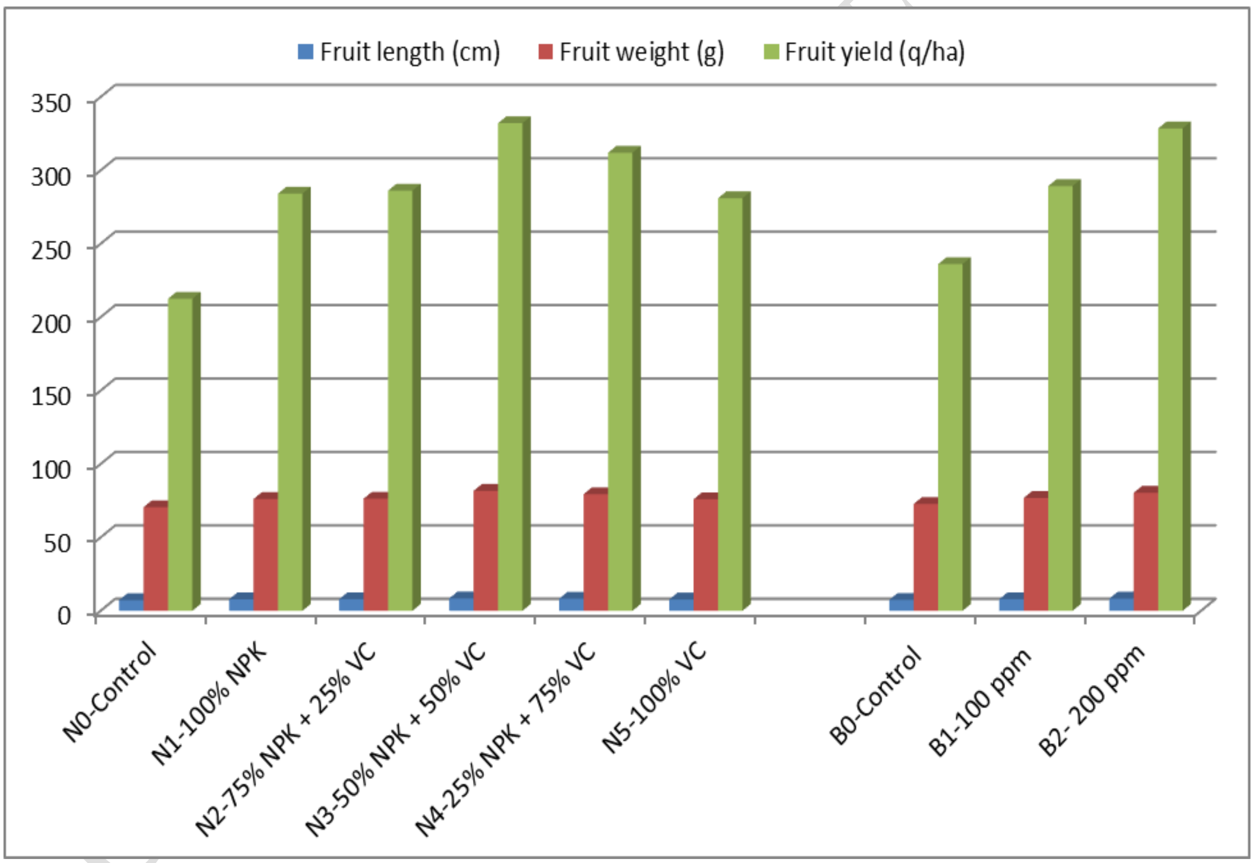

Fig. 1 Effect of NPK with vermicompost and boron on fruit length, fruit weight and fruit yield of brinjal

4. Conclusion

The treatment 50% NPK+50% VC or treatment boron (200 ppm) was found significantly better in terms of growth, yield and quality compared to other treatment. Thus, application of 50 % NPK+50% VC or Boron 200 ppm to brinjal is recommended. The results are only indicative and require further experimentation to arrive at more consistent and final conclusion.

5. References

Abusaleha, Shanmulagavelu, K.G., 1988. Studies on the effect of organic and inorganic source of nitrogen on growth, yield and quality of okra (*Abelmoschus esculentus).* Indian Journal of Horticulture 45(3-4), 312–318.

Anonymous, 2012. KAU-Agri.Infotech portal http://www.celkau.in/Crop/Vegetables/Brinjal /brinjal.aspx (accessed on 08.08.2014).

Arancon, N.Q., Edwards, C.A., Atiyeh, R.M., Metzger, J.D., 2004. Effects of vermicomposts produced from food waste on green house peppers. Bioresource Technology 93, 139–144.

Badiger, M.K., Subbareddy, N.P., Roselind M., Shivaraj, B., 2006. Influence of phosphorus fertilizer on the yield and quality attributes of tomato. Journal of the Indian Society of Soil Science 43, 123–129.

Basavarajeshwari, C.P., Hosamani, R.M., Ajjappalavara, P.S., Naik, B.H., Smitha, R.P., Ukkund, K.C., 2008. Effect of foliar application of micronutrients on growth and yield components of tomato (*Lycopersicon esculentum*). Karnataka Journal of Agriculture Science 21(3), 428–430.

Butu, M., Rodino, S., 2019. Fruit and Vegetable-Based Beverages—Nutritional Properties and Health Benefits. The Science of Beverages 13, 303–338.

Chowdhury, R., Tah, J., 2011. Estimation of heritable components of variation and character selection in eggplant (S*olanum melongena* L.). Continental Journal of Biological Sciences 4, 31–36.

Imtiaz, M., Rashid, P., Khan, M.Y., Memon, Aslam, M., 2010. The role of micronutrients in crop production and human health. Pakistan Journal of Botany 42(4), 2565–2578.

Jokanovi, M.B., 2020. Boron toxicity and deficiency in agricultural plants. International Journal of Molecular Science 21(4), 1424.

Kashyap, S., Kumar, S., Maji, S., Kumar, D., 2014. Effect of organic manures and inorganic fertilizers on growth, yield and quality of brinjal (*Solanum melongena* L.) *cv*. Pant Rituraj. International Journal Agriculture Science 10(1), 305–308.

Kumar, A.B., Gowda, N.C., 2010. Effect of different organic manures and inorganic fertilizers on growth and yield of brinjal (*Solanum melongena* L.). Asian Journal Horticulture 5(2), 444–449.

Laxmi, P.R., Saravanan, S., Naik, M.L., 2015. Effect of organic manures and inorganic fertilizers on plant growth, yield, fruit quality and shelf life of tomato (*Solanum lycopersicon* L.) *cv.* PKM-1. International Journal of Agricultural Science and Research 5(2), 7–12.

Mamta, A.W., Khursheed, Roa, R.J., 2012. Effect of vermicompost on growth of brinjal plant (*Solanum melongena*) under field conditions. Journal of New Biological Reports 1(1), 25–28.

Manimegala, G., Gunasekaran, G., 2020. Effect of vermicompost and NPK fertilizer on growth and yield components of eggplant (*Solanum melongena* L.). International Journal of Scientific and Technology Research 9(1), 1388–1391.

Mishra, V.K., Kumar, S., Pandey, V.K., 2018. Effect of organic manure and biofertilizers on growth, yield and quality of brinjal (*Solanum melongena* L.). International Journal of Pure and Applied Bioscience 6(1), 704–707.

Miwa, K., Takano, J., Fujiwara, T., 2008. Molecular mechanisms of boron transport in plants and its modification for plant growth improvement. Tanpakushitsu Kakusan Koso 53(9), 1173–1179.

Nonnecke, I.B.L., 1989. Vegetable Production. Avi Book Publishers. New York, USA. pp. 200–229.

Oyinlola, E.Y., 2004. Response of irrigated tomatoes (*Lycopersicon lycopersicum* Karst) to boron fertilizer: Growth and nutrient concentration. Nigerian Journal of Soil and Environmental Research 5, 62–69.

Salih, Hemn, O., 2013. Effect of foliar fertilization of Fe, B and Zn on nutrient concentration and seed protein of cowpea "*Vigna unguiculata*". IOSRJ. Agricultural Veterinary Science 6, 42–46.

Sat, P., Saimbhi, M.S., 2003. Effect of varying levels of nitrogen and phosphorus on earliness and yield of brinjal hybrids. Journal Reasearch Crops 4(2), 217–222.

Selvi, D., Thiageshwari, S., Santhy, P., Kannan, B.R., 2004. Fruit yield and nutrient uptake by brinjal due to integrated nutrient management in an Inceptisol. Journal of Maharashtra Agricultural University 29(2), 220–223.

Solanki, M.M., Solanki, M.S., Thakare, G., Jogi, P.D., Sapkal, R.D., 2017. Effect of zinc and boron on growth of brinjal (*Solanum melongena* L.). International Journal of Plant Sciences 12(2), 160–163.

Stanley, D.W., Bourne, M.C., Stone A.P., Wismer, W.V., 1995. Low temperature blanching effects of chemistry, firmness and structure of canned green beans and carrots. Food Science (60), 327–333.

Suganiya, S., Kumuthini, H.D., 2015. Effect of boron on flower and fruit set and yield of raton brinjal crop. International Journal of Scientific Research and Innovative Technology 2(1), 135–141.