Chemical Science Review and Letters ISSN 2278-6783

Research Article

Performance of Brinjal under Different Fertigation Levels

G.V. Rajalingam*, M. Prabhu, V. Rajashree, H. Ushanandhinidevi, M. Karthikeyan and R. Swarnapriya

Department of Vegetable science, Horticultural College and Research Institute, TNAU, Coimbatore, India

Abstract

The present study was carried out at orchard, Horticultural College and Research Institute, TNAU, Coimbatore during two seasons (2019-20 and 2020-21) to standardize the fertigation level for brinjal F_1 hybrid 'Lalita' under 35 % green shade net. The hybrid Lalita belongs to East West Seeds company. The crop was grown in sandy clay loam soil. Randomized block design was adopted with six treatments (five fertigation levels and one soil application) and it was replicated four times. The spacing adopted was 150 x 90 cm. Other regular agronomic practices were carried out. Results revealed that, among the treatments, 150:100:150 kg NPK per ha recorded significantly lower number of days for days to 50 % flowering (30.10 days) and days to first harvest (54.23 days). It recorded highest plant height (108 cm), No. of leaves (85.47) and No. of branches at final harvest (24.12), fruit set (49.26 %), number of fruits per plant (105.76), average fruit weight (52.59 g), fruit length (7.36 cm), fruit diameter (4.34 cm), yield per plant (5.53 kg), estimated yield per ha (37.11 t), leaf dry matter (1256.12 kg ha^{-1}), TSS (7. 42 ° brix) and B:C ratio (2.97).

Keywords: Brinjal, Fertigation, Growth and Yield Parameters

***Correspondence**

Author: G.V. Rajalingam

Email: rajalingamhort@rediffmail.com

Introduction

Brinjal (*Solanum melongena* L.) belongs to family Solanaceae and is one of the most common and popular vegetables crop grown in India. It contains 92.7 % water, 1.4 % protein, 4.0 % carbohydrates, 0.3 % fats, 0.3% minerals, 1.3 % fibre [1]. In India, brinjal was cultivated in an area of 7, 30, 400 hectares with a production of 12.80 million tonnes during 2017-18 with a productivity of 17.5 tonnes per hectare. In Tamil Nadu 15,080 hectare was under brinjal with a production of 3, 02, 410 metric tonnes [2]. When compared to some other states, the productivity of brinjal in Tamil Nadu is low [2]. Improper fertilizer application to the crop is one of the main reasons for getting poor yield. Fertilizer application should be followed precisely for a successful crop production. For brinjal hybrid TNAU, Coimbatore has standardized a dose of 200:150: 100 kg / ha.

Higher nutrient doses are adopted in traditional method. This results in nutrient losses and low fertilizer use efficiency. High chances of leaching and volatilization of nutrients, non-uniform and irregular supply, groundwater contamination and soil compaction are noticed in conventional fertilization. In this situation, fertigation is the only alternate way when drip irrigation is used.

Fertigation is the technique of supplying dissolved fertilizer to crops through an irrigation system. Fertigation saves labour, reduces compaction of the field, thereby enhance productivity [3]. Fertigation reduces the wastage of chemical fertilizers and subsequently optimizes the nutrient use by making them available at the point of their use and as per crop demand, which finally increase nutrient use efficiency. Relatively uniform application and distribution of fertilizers all over the field is possible in fertigation. Brinjal is affected by major sucking pests under open condition. Hence to explore the possibility of growing brinjal under shade net and under the "ICAR - AICRP on vegetable improvement project" trial, the present study was undertaken to standardize the fertigation dose for brinjal F_1 hybrid 'Lalita' under shade net condition.

Materials and Methods

The experiment was carried out at the University Orchard, Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. The crop was grown under green colour shade net and 35 % shade was used [4]. The study location is situated at 11° North latitude and 77° East longitude and at an elevation of 426.6 m above mean sea level. The soil of the experimental area belonged to sandy clay loam. The pH is 8.3. The soil contained available N 175 kg per ha, available P 15 kg per ha and available K 1250 kg per ha. The micro nutrient status was Iron 5.8 ppm, manganese 2.6 ppm, zinc 0.8 ppm and copper 0.6 ppm. Brinjal F_1 hybrid Lalita was used in this study which is popular in Coimbatore region. This hybrid belonged to East West seeds. The

plant is semi erect with spreading habit. It is an early and prolific yielder. The fruits are oval, violet in colour with white stripes, non-spiny and shiny.

A suitable drip set was laid out for irrigating the crop through drip irrigation. The irrigation system mainly consists of mainline, sub mainline, online lateral, screen filter, fertigation tank, accessories such as control valve, Tee, reducer, elbow, coupling, etc. Drippers were spaced at 60 cm interval in a lateral with a discharge rate of 4 liter per hour Every day, the drip system was run for 1 hour [5]. Raised beds having 120 cm width were formed. The height of the bed was 30 cm. The space between beds was 30 cm. Seeds were sown in protrays and 35 days old seedlings were transplanted on 27.9.2019 (for 2019-20) and 16.7.20 (for 2020-21). The spacing of 150 x 90 cm as suggested in the "ICAR - AICRP on vegetable improvement project" was adopted.

The six treatments are

T_1 –125:75:125 kg NPK per ha.
T_2 –150:100:150 kg NPK per ha.
T_3 –175:125:175 kg NPK per ha.
T_4 –200:150:200 kg NPK per ha.
T_5 –225:175:225 kg NPK per ha.
T_6 –200:150:200 kg NPK per ha. (control)

The experiment was arranged in a randomized block design with six treatments with four replications. Every day drip irrigation was given for all the treatments. For the treatments 1 to 5, fertilizers were given through fertigation. Here, only 75 % of the recommended dose of P is applied through soil along with 25 tonnes of Farm Yard Manure (FYM) per hectare. Remaining 25 % P and 100 % N and K was applied through fertigation. Water soluble fertilizers *viz*., urea, Mono Ammonium Phosphate (MAP) and Muriate of Potash (MOP) (white) were used for the study. The fertigation was given once in 3 days for a total crop duration of 110 days after transplanting (36 splits). For the control treatment (T_6), 100:150:200 kg NPK per ha was applied as basal along with 25 tonnes of FYM and 100 kg N was applied at 30 days after transplanting as top dressing in soil. Regular agronomic practices *viz*., Pendimethalin 1.0 kg a.i. / ha was sprayed as pre-emergence herbicide. One hand weeding was done. To control shoot and fruit borer, Dimethoate 30 % EC was sprayed @ 0.7 ml per liter of water.

Five plants from each replication were selected at random and labelled for recording various observations. Observations on plant height at final harvest (cm), No. of leaves at final harvest, No. of branches at final harvest, days to 50 % flowering, days to first harvest, fruit set (%), Number of fruits/plant, average fruit weight (g), fruit length (cm), fruit diameter (cm) and yield/plant (kg) were recorded. Estimated yield per hectare (tonnes) was derived from yield per plant and plant population. Dry matter content per plant was recorded at harvest. The selected plants for this purpose was pulled out carefully and sun dried for two days followed by oven drying at 60 °C till a constant weight was obtained and the weights were read for recording dry matter. Total soluble solids (TSS) in fruits were determined by hand held refractometer. Cost of cultivation and benefit cost ratio were worked out. It was Rs. 1,50,000 per ha for control (Field preparation cost Rs. 20,000, Nursery Rs. 20, 000, Weeding Rs. 30,000, plant protection Rs. 20,000, fertilizers Rs. 30,000 and labour Rs. 30,000). The data on various parameters recorded were subjected to statistical analysis [6]. The pooled analysis was carried out for two years.

Results and Discussion

The data obtained for all the parameters is presented in **Table 1**.

Plant height

Plant height was recorded at final harvest., It is seen from the observations that, the maximum plant height (108 cm) was noticed in T_2 (150:100:150 kg NPK per ha). It was significantly higher than control (T_6), T_1, T_4 and T_5 and on par with T_3.The increment in plant height in fertigation treatment may be due to increased nitrogen availability through drip as compared to traditional fertilizer application. Nitrogen plays role in cell elongation and cell division. Similar findings were reported by [7] in hybrid brinjal who found that increase in nitrogen fertilizer caused increment in plant height significantly. On the other hand, increasing the dose beyond T_2 (150:100:150 kg NPK per ha) reduced the height. This indicates that the plants were able to utilize these nutrients efficiently at this level only. The lowest plant height was noticed in T_6 (0.96 m) and it was at par with T_1.

Table 1 Effect of fertigation on growth and yield parameters in brinjal (pooled analysis of two years)

Treatments	Plant height at final harvest	No. of leaves at final harvest	No. of branches at final harvest	Days to 50 % flowering	Days to first harvest	Fruit set (%)	No. of fruits /plant	Ave.fruit weight (g)	Fruit length (cm)	Fruit dia. (cm)	Yield/plant (kg)	Estimated yield /ha (tonnes)	Leaf dry matter (kg /ha)	TSS (° brix)
T_1	101	77.85	20.82	33.12	59.54	45.13	92.59	48.27	6.72	3.80	4.43	29.80	1082.76	7.20
T_2	108	85.47	24.12	30.10	54.23	49.26	105.76	52.59	7.36	4.34	5.53	37.11	1256.12	7.42
T_3	105	80.37	22.27	31.22	56.43	47.18	101.13	50.28	7.17	4.10	5.09	33.84	1195.71	7.23
T_4	103	78.74	21.63	32.46	57.73	46.42	92.06	50.13	6.91	3.96	4.63	30.76	1147.34	7.14
T_5	102	77.49	20.22	32.18	57.92	47.74	90.59	49.67	6.84	3.85	4.55	30.21	1168.55	6.96
T_6 (contrtol)	96	72.61	19.51	35.25	62.28	42.29	87.65	46.22	6.74	3.76	4.07	27.67	1037.48	6.86
S. Ed.	1.36	2.23	1.00	1.03	1.31	1.54	2.26	1.02	0.11	0.12	0.20	1.04	29.02	0.12
CD 5%	3.82	4.80	2.02	2.10	2.64	3.18	4.60	2.10	0.25	0.30	0.42	2.12	58.12	0.30

T_1 –125:75:125 kg NPK per ha., T_2 –150:100:150 kg NPK per ha., T_3 –175:125:175 kg NPK per ha., T_4 –200:150:200 kg NPK per ha. T_5 –225:175:225 kg NPK per ha., T_6 –200:150:200 kg NPK per ha. (control)

No. of leaves

Number of leaves at final harvest was significantly highest (85.47) in T_2 (150:100:150 kg NPK per ha). It was followed by T_3. Application of optimum level of water-soluble fertilizers through drip directly in root zone helped in increasing the vegetative growth. Similar findings were recorded by [7] in hybrid brinjal. Increasing the dose beyond T_2 showed a reduction in number of leaves. The lowest number of leaves was recorded in T_6 (72.61).

No. of branches

The treatment T_2 (150:100:150 kg NPK per ha) recorded maximum number of branches (24.12) per plant at final harvest. It was significantly higher than control (T_6), T_1, T_4 and T_5 and on par with T_3. When fertilizers applied through drip, nutrients are directly applied to the root zone and fully utilized by plants, hence the number of branches was more as compared to traditional method of fertilization [8]. Increasing the dose beyond T_2, showed a reduction in number of branches. The lowest number of branches was recorded in T_6 (19.51).

Days to 50 % flowering

The treatment T_2 (150:100:150 kg NPK per ha.) recorded minimum number of days (30.10) for 50 % flowering. It was significantly lower than T_6 (control), T_1 and T_4 and on par with T_3 and T_5. Increasing the dose beyond T_2 recorded more number of days for flowering. Delayed flowering with increased level of fertilizers might be due to the effect of higher level of nitrogen. Excess nitrogen causes prolonged vegetative phase and extended duration for flower bud appearance [9]. Findings of [10] revealed that, the maximum dose of phosphorus caused adverse effects on time of flowering. Because, it is converted to insoluble phosphate by making a complex with calcium and magnesium.

Excess or deficit K reduced carbon assimilation accumulation and its distribution ratio in roots. The results suggested that appropriate K supply was optimal as it enhanced photoassimilate transport from leaves to roots and increased nutrient use efficiency by influencing photosynthesis, C and N metabolizing enzyme activities, nitrate assimilation gene activities, and nitrate transport [11]. The control treatment (T_6) took more number of days (35.25) for flowering.

Days to first harvest

Days to first harvest was minimum (54.23 days) in T_2 (150:100:150 kg NPK per ha.). It was significantly lower than T_6 (control), T_1, T_4 and T_5 and it was on par with T_3. Beyond T_2, it took more number of days for harvest. It might be due to higher level of nitrogen. Excess nitrogen causes prolonged vegetative phase. The control treatment (T_6) took more number of days (62.28) for harvest.

Fruit set (%) and No. of fruits

The treatment T_2 (150:100:150 kg NPK per ha) recorded maximum fruit set (49.26 %) and number of fruits per plant (105. 76). It was significantly higher than control (T_6), T_1, T_4 and T_5 and on par with T_3. It may be due to frequent and

required application of nutrients along with irrigation water within effective root zone of crop thereby, increasing the availability of nutrients in soil which has increased the number of fruits [5]. As the plant height was maximum in T_2, new nodes for flower and fruit development will appear and ultimately results in increased number of fruits also. Increasing the dose beyond T_2 showed a reduction in number of fruits. Excess nitrogen fertilizer application is associated with vigorous vegetative growth, leading to the reduction in potential number of fruits per plant. The lowest fruit set (42.29 %) and number of fruits (87.65) were recorded in T_6.

Fruit weight, length and diameter

The treatment T_2 (150:100:150 kg NPK per ha) recorded maximum fruit weight (52.59 g), fruit length (7.36 cm) and fruit diameter (4.34 cm). For all the parameters, it was followed by T_3. This could be attributed to the fact that the nitrogen up to certain level increases shoot and leaf growth, which would have helped in the synthesis of greater amount of carbohydrates and more efficient protein synthesis and then the same is translocated into the developing fruits and that might have resulted in increased number of cells as well as elongation of individual cells. This in turn might have enhanced the size of the fruits [12]. Phosphorus as an important constituent of nucleoproteins is involved in high energy transfer compounds such as adenosine diphosphate and adenosine triphosphate and plays a key role in energy transfer in the metabolic processes. The potassium up to certain level would have also encouraged better utilization of assimilates through efficient transport to the developing fruits which acts as active sinks in brinjal [13]. Potassium also is essential for translocation of sugars and forming starch. It encourages root growth and increases crop resistance to diseases. It is known to regulate transpiration and water conductance in plant cells, thereby increasing the photosynthetic activity of the leaves. This dose (T_2) was presumed to be more effective in controlling these physiological parameters resulting in increased fruit characters. Increasing the dose beyond T_2 showed a reduction for all the parameters. The lowest values were recorded in T_6 (control).

Yield

The highest yield of fruits per plant (5.53 kg) and estimated yield per hectare (37.11 tonnes) were observed in T_2 (150:100:150 kg NPK per ha). It was significantly higher than other treatments. This might be due to frequent and required application of nutrients through drip system which might cause higher uptake of nutrients by plants [14]. Another reason was due to regular availability of nutrients to plants at three days interval, avoiding leaching of fertilizers applied with measured quantity.

Lowest yield of brinjal was observed in the control treatment (T_6) which might be due to less availability of nutrients at flowering and fruiting stage of crop, as whole fertilizer dose was given in vegetative growth stage itself [14]. It results in leaching of nutrients in later stages, which may affect the availability of nutrients at flowering and fruiting stage of crop [5]. Fertilizers applied under traditional methods are generally not utilized efficiently by the crop; while in drip fertigation, nutrients are applied directly into the zone of maximum root activity and consequently fertilizer-use efficiency can be improved over conventional method of fertilizer application [12]. Increasing the dose beyond T_2 (150:100:150 kg NPK per ha) caused a reduction in yield. Because, excess fertilizers especially nitrogen given in more than optimum level may increase the crop susceptibility to pests, diseases and physiological disorders. It will not always ensure that marketing yield is increased [13].

Leaf dry matter

Leaf dry matter was highest (1256.12 kg ha^{-1}) in T_2 (150:100:150 kg NPK per ha) and it was significantly higher than other treatments. Increased plant height and more number of leaves and branches observed in this treatment would have contributed to accumulation of highest dry matter production. Nitrogen being a chief constituent of protoplasm might increase the synthesis of carbohydrates in leaves which might have added to the dry matter production [5]. Lowest drymatter (1037.48 kg ha^{-1}) was recorded in control (T_6).

TSS

The treatment T_2 (150:100:150 kg NPK per ha) recorded maximum values for TSS (7.42 ° brix). It was significantly higher than control and T_5. Lowest TSS (6. 86) was recorded in control (T_6). The highest fruit quality might be due to optimum nitrogen which stimulated the functioning of enzymes in the physiological processes leading to improved total soluble solids content of the fruits [5]. Optimum dose of potassium is also essential for the translocation of sugars which might have contributed for increased TSS.

Table 2 Effect of fertigation on benefit cost ratio in brinjal (mean of two years)

Treatments	Cost of cultivation per ha (Rs.)	Gross return per ha (Rs.)	Net return per ha (Rs.)	B:C ratio
T_1	1,18,000	2,98,000	1,80,000	2.53
T_2	1,25,000	3,71,100	2,46,100	2.97
T_3	1,32,000	3,38,400	2,06,400	2.56
T_4	1,40,000	3,07,600	1,67,600	2.20
T_5	1,48,000	3,02,100	1,54,100	2.04
T_6 (contrtol)	1,50,000	2,76,300	1,26,300	1.84

Cost of brinjal fruits: Rs. 10/kg; T_1 –125:75:125 kg NPK per ha., T_2 –150:100:150 kg NPK per ha., T_3 –175:125:175 kg NPK per ha., T_4 –200:150:200 kg NPK per ha. T_5 –225:175:225 kg NPK per ha., T_6 –200:150:200 kg NPK per ha. (control)

Benefit cost ratio

The details are given in **Table 2**. The treatment T_2 (150:100:150 kg NPK per ha) recorded highest net return of Rs. 2,46,100 and benefit cost ratio of 2. 97. It was followed by T_3. The lowest net return of Rs. 1, 26,300 and benefit cost ratio of 1.84 were recorded in control treatment (T_6). Hence, T_2 (150:100:150 kg NPK per ha) may be recommended for cultivation of brinjal under shade net house.

Conclusion

It was concluded that, the fertilizer dose of 150:100:150 kg NPK per ha can be recommended for brinjal hybrid 'Lalita' for fertigation under shade net condition. The standardization of fertigation level will minimize the fertilizer usage among the brinjal farmers.

References

[1] Aykroyd, W.R., (1963) Composition of brinjal fruit. ICMR Special Rept.pp.42.

[2] Anonymous, (2018) Horticultural statistics at a glance, (2018) Horticulture Statistics Division, Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare, Govt. of India, Controller of publication.

[3] Jat, R. A., S. P. Wani, K. L. Sahrawat, P. Singh and B. L. Dhaka, (2011) Fertigation in vegetable crops for higher productivity and resource use efficiency. Ind. J. Fertilizer 7: 22-37.

[4] Nangare, D. D., Jitendra Singh, V. S. Meena, Bharat Bhushan, and P.R. Bhatnagar, (2015) Effect of green shade nets on yield and quality of tomato (Lycopersicon esculentum Mill) in semi-arid region of Punjab. Asian J. Adv.Basic Applied Sci., 1 (1): 1-8.

[5] Anonymous, (2020) Crop production guide – Horticulture crops 2020. Directorate of Horticulture and plantation crops, Chepauk, Chennai and Tamil Nadu Agricultural University, Coimbatore.

[6] Panse, V.G. and P.V. Sukatme, (1985) Statistical methods for agricultural workers, Indian Council of Agricultural Research, New Delhi.

[7] Sollapur, D. L., S. M. Hiremath, (2017) Effects of planting geometry and fertilizer levels on growth and yield of hybrid brinjal. Int. J. Agr. Sci.,13 (1) : 97- 100.

[8] Hadole, S. S., Gopal Patidar, Sarap, A. B. Age, E. Sathyanarayan, and J. N. Parmar, (2020) Effect of fertigation on growth, quality and yield of Brinjal. J. Pharmacogn. Phytochem., 9 (3): 526-530.

[9] Suthar, M. R., G. P. Singh, M. K. Rana and L. Makhan (2005) Growth and fruit yield of brinjal (Solanum melongena L.) as influenced by planting dates and fertility levels. Crop Res. J., 30 (1): 77-79.

[10] Abid Khan, Seema zubair and Nadeem khan, (2020) Effect of phosphorus with and without phosphate solubilizing bacteria on growth and yield of tomato. Pure Appl. Biol., 9 (3): 2111-2121.

[11] Xinxiang Xu, Xin Du, Fen Wang, Jianchuan Sha, Qian Chen, Ge Tian, Zhanling Zhu, Shunfeng Ge and Yuanmao Jiang, (2020) Effects of Potassium Levels on Plant Growth, Accumulation and Distribution of Carbon, and Nitrate Metabolism in Apple Dwarf Rootstock Seedlings. Front. Plant Sci., 11:1-13.

[12] Hebbar, S., B. Ramachandrappa, H. Nanjappa, M. Prabhakar, (2004) Studies on NPK drip fertigation in field grown tomato (Lycopersicon esculentum Mill.). Euro. J. Agron., 21 (1):117-127.

[13] Ndereyimana Assinapol, S. Praneetha and V. Rajasree, (2017) Performance of grafted brinjal (Solanum melongena L) under different spacing and fertigation levels. J. Pharmacogn. Phytochem., 6 (2): 307-311.

[14] Mayur Adawadkar, Mahendra Deshmukh and Sudhir Wadatkar, (2019) Effect of drip fertigation with different fertilizer levels and traditional method of fertilizer application on growth and yield of brinjal. Int. J. Curr. Microbiol. App. Sci., 8 (9): 2793- 2800.

Publication History
Received 08.02.2022
Revised 18.04.2022
Accepted 19.04.2022
Online 31.05.2022