International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(3): 1224-1227

Received: 16-03-2018
Accepted: 20-04-2018

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Effect of INM on growth and yield components of Brinjal (*Solanum melongena* L.) under Teak (*Tectona grandis* L. f.) based silvi-horticultural system in South Gujarat region

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Abstract
The experiment entitled "Integrated nutrient management of Brinjal (*Solanum melongena* L.) Under Teak (*Tectona grandis* L. f.) based Silvi-horticultural system in South Gujarat region" was carried out at College Farm (Block-A, Plot No-21), N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat during the year of 2016-17. A Brinjal (*Solanum melongena* L.) Variety – Surati Ravaiya was grown under twenty three years old plantation of Teak (*Tectona grandis* L. f.) planted at 3m X 2m spacing. Growing of brinjal crop in open condition resulted in significant increase in various growth as well as yield parameters as compared to growing brinjal crop under INM treated teak based Silvi-horticultural system. The significantly maximum plant height (73.90 cm) and number of branches per plant (5.33) were noted in T_{14}: 100% RDF in open condition. Similarly, various yield parameters *viz.*, number of fruits per plant (24.89), fruit circumference (14.14 cm), fruit length (8.64 cm), average fruit weight (45.64 g) and yield (20357.35 kg/ha) were also recorded significantly maximum in T_{14}: 100% RDF in open condition. The same treatment was remained at par with 75 % RDF along with different organics for majority of growth and yield parameters. Moreover, INM treatment of T_2: Azotobactor alone under teak based Silvi-horticultural system reported minimum growth and yield parameters. The slight reduction was registered in INM treated teak based Silvi-horticultural system as compared to open condition.

Keywords: integrated nutrient management, brinjal, teak, silvi-horticultural system

Introduction
The Silvi-horticultural system has emerged as a viable option for achieving land cover on one hand and to fulfil the demand of vegetable crops and timber to human and industry on the other hand. It is an improved indigenous cropping system in India which fully utilizes the growing season and markedly increases the return per unit area per unit time. In this system we can increase the total output from land by growing mainly short duration crops within the alleys of such timber crops.

India is bestowed with vast diversity of flora, fauna, soil and agro-climatic conditions. This makes it feasible to grow the largest number of vegetable crops in the world and is regarded as a horticultural paradise (Saravaiya and Patel, 2005) [20]. Brinjal (*Solanum melongena* L.) belongs to the order Polemoniales, family *Solanaceae* and having chromosome no. 2n = 24. The cultivated brinjal is of Indian origin and has been in cultivation for long time (Thompson and Kelly, 1957) [23] and center of origin was in the Indo Burma region (Vavilov, 1951) [27]. Brinjal is one of the most common and popular vegetable crop grown in India and occupying a pride of place in every food of all people which is cultivated as one of the leading and the second major vegetable crops next to tomato. Brinjal is being cultivated in India over an area of 7.22 lakh ha with an average annual production of 134.43 lakh tonnes with productivity of 18.8 t/ha. Gujarat occupied an area of brinjal cultivation was 76,750 ha with an annual production of 13.41 lakh tonnes and productivity of 17.5 t/ha (Anonymous, 2013) [1]. 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.

Organic manure produced due to the activity of the earth worms is commonly referred to as vermicompost (VC). It is a rich source of macro and micronutrients, vitamins and growth hormones (Bhawalkar, 1991) [3]. The neem cake (NC) is rich in nitrogen and also contains phosphorous and potassium. Because of its low C/N ratio (3:15) its decomposition rate is faster than cereal residues and other bulky organic manures. The bio-fertilizers are efficient, ecofriendly; environmentally safe, cost effective, economically viable and ecologically sound. These are playing a significant role in improving nutrient availability to the plants. Hence, looking to the importance of all organics present study of integrated nutrient management in brinjal was undertaken.

Materials and Methods

The present investigation was carried out at the College Farm (Block-A, Plot No-21), N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat during the year of 2016-17. The twenty three year old plantation of Teak (*Tectona grandis* L. f.) planted at 3m X 2m spacing and vegetable crop *viz*., Brinjal (*Solanum melongena* L.) Variety – Surati Ravaiya were selected for the present study. FYM was applied at the rate of 10 tonnes per hectare to all the plots uniformly and incorporated in soil before ridges and furrows were formed. The phosphorus and potash were applied uniformly as a basal dose to all the plots at the rate of 50 kg/ha in each plot of treatment T_1 and other treatment of inorganic fertilizer. The experiment consists of fourteen treatments *viz*., T_1: 100% RDF (100:50:50 NPK/ha), T_2: Azotobactor, T_3 : Vermicompost, T_4 : Neem cake, T_5 : Bio-compost, T_6 : 50 % RDF + T_2, T_7 : 50 % RDF + T_3, T_8 : 50 % RDF + T_4, T_9 : 50 % RDF + T_5, T_{10} :75 % RDF + T_2, T_{11} :75 % RDF + T_3, T_{12} : 75 % RDF + T_4, T_{13} : 75 % RDF + T_5 and T_{14} : 100% RDF (100:50:50 NPK/ha) in Open condition with three replications. All the organics and bio-fertilizers were applied on the basis of nitrogen content. Brinjal were planted in the plot with the spacing of 90 cm x 60 cm. Observation were recorded with respect to growth parameters i.e. plant height and number of branches per plant and for yield parameters *viz.*, number of fruits per plant, fruit circumference, fruit length, average fruit weight and yield. Recorded observations were analyzed with the help of Randomized Block Design as prescribed by Panse and Sukhatme (1967).

Result and Discussion

Growth parameters

The data pertaining to various growth parameters of Brinjal as affected by various INM treatment under teak based Silvi-horticultural system and open condition are presented in Table – 1. From the data it is evident that the application of INM had a great influence at all the growth stages of the brinjal crop. Significant differences were observed in growth parameters.

The plant height (73.90 cm) and number of branches per plant (5.33) were registered significantly higher in T_{14}: 100% RDF and brinjal was grown in open condition. The same treatment was remained at par with 75 % RDF along with different organics as well as 100 RDF under teak. Moreover, INM treatment of T_2: Azotobactor alone under teak based Silvi-horticultural system reported minimum plant height (57.63 cm) and number of branches per plant (3.25). It might be due to less availability of light under Teak as compared to open condition. The results are in line with Mulugeta (1998) [11] in Maize, Rao (2000) [17] in Cowpea, Mammo (2000) [10] in Maize, Panneerselvam (2003) in Sunflower, Panneerselvama and Arthanarib (2011) [14] in Sunflower, Tripathi *et al.* (2014) [24] in Mungbean, Lata *et al.* (2014) [8] in Aswagandha and Panwar and Wani (2014) [15] in Potato. Moreover, positive response of INM treatments under open condition on various crops was also reported by Mallanagouda *et al.* (1995) [9] in Chilli, Reddy and Reddy (2005) [18] in Onion, Prabhu *et al.* (2006) [16] in cucumber; Kumar and Gowda (2010) [6], Vijay and Seethalakshmi (2011) [28], Umalaxmi *et al.* (2015) [26], Kumar (2016) [7] and Barman *et al.* (2017) [2] in Brinjal.

Yield parameters

The data pertaining to various yield parameters of Brinjal as affected by various INM treatment under teak based Silvi-horticultural system and open condition are presented in Table – 1. It can be seen from the data presented in Table – 1 that the application of INM significantly influenced the various yield parameters.

The results presented in Table – 1 indicated that that when brinjal was grown in open condition with T_{14}: 100% RDF registered maximum number of fruits per plant (24.89), fruit length (8.64 cm), fruit circumference (14.14 cm), fruit weight (45.64 g), fruit yield (20357.35 kg/ha) as compared to brinjal grown under INM treated teak based silvi-horticultural system. Majority of yield parameters was remained at par with 75 % RDF along with different organics as well as 100 RDF under teak. Whereas, minimum number of fruits per plant (13.09), fruit length (5.24 cm), fruit circumference (12.30 cm), fruit weight (31.50 g/plant) and fruit yield (8369.08 kg/ha) was noted in T_2: Azotobactor under teak based Silvi-horticultural system. The various yield parameters performed well in open condition as compared to INM treated under teak based Silvi-horticultural system. The probable reason for it might be good availability of light in open condition as compared to INM treated teak based Silvi-horticultural system. The results are analogues with earlier findings of Mulugeta (1998) [11]. In Maize, Srinivas *et al.* (2008) in Coleus, Panneerselvama and Arthanarib (2011) [14] in Sunflower, Tripathi *et al.* (2014) [24] in Mungbean and Lata *et al.* (2014) [8] in Aswagandha. However, positive impact of INM in open condition on various crops was also noted by Sendur *et al.* (1998) [21] in Tomato, Giraddi and Smitha (2002) [4] in Chilli, Reddy and Reddy (2005) [18] in Onion, Prabhu *et al.* (2006) [16] in cucumber; Ullah *et al.* (2008) [25], Kumar and Gowda (2010) [6], Vijay and Seethalakshmi (2011) [28], Munshi (2014) [12], Kashyap *et al.* (2014) [5], Rehman *et al.* (2015) [19], Kumar (2016) [7] and Barman *et al.* (2017) [2] in Brinjal.

Table 1: Growth and yield parameters of Brinjal (*Solanum melongena* L.) as affected by various INM treatment under Teak (*Tectona grandis* L. f.) based Silvi-horticultural system and in open condition

Treatment	Plant height (cm)	Number of branches per plant	Number of fruits per plant	Fruit circumference (cm)	Fruit length (cm)	Fruit weight (g)	Fruit yield (kg/ha)
T_1	71.32	5.00	23.07	13.84	8.14	43.46	20221.61
T_2	57.63	3.25	13.09	12.30	5.24	31.50	8369.08
T_3	61.30	3.73	15.81	12.72	6.02	34.76	10924.66
T_4	58.84	3.41	14.00	12.43	5.50	32.59	9172.06

T_5	60.07	3.57	14.90	12.58	5.76	33.67	10034.02
T_6	62.52	3.89	16.72	12.86	6.28	35.86	11835.99
T_7	66.26	4.37	19.44	13.26	7.07	39.11	14908.82
T_8	63.75	4.05	17.63	12.83	6.54	36.94	12059.47
T_9	65.01	4.21	18.53	13.12	6.81	38.03	13847.75
T_{10}	67.50	4.53	20.35	13.45	7.33	40.21	15979.90
T_{11}	72.61	5.17	23.98	14.01	8.38	44.55	18916.59
T_{12}	68.76	4.69	21.26	13.57	7.59	41.29	17120.09
T_{13}	70.05	4.85	22.17	13.70	7.85	42.38	18346.28
T_{14}	73.90	5.33	24.89	14.14	8.64	45.64	20357.35
S.Em.±	2.50	0.12	0.75	0.29	0.23	1.16	634.10
C.D. @ 5 %	7.08	0.34	2.12	0.81	0.65	3.28	1797.89
C.V.%	9.32	6.79	9.63	5.33	8.08	7.35	10.76

Conclusion

From the above findings, it is concluded that, growing of brinjal crop in open condition resulted in significant increase in various growth as well as yield parameters as compared to growing brinjal crop under INM treated teak based Silvi-horticultural system. The significantly maximum plant height and number of branches per plant was noted in T_{14}: 100% RDF in open condition. Similarly, various yield parameters *viz.,* number of branches per plant, number of fruits per plant, fruit circumference, fruit length, average fruit weight and yield was also recorded significantly maximum in T_{14}: 100% RDF in open condition. The same treatment was remained at par with 75 % RDF along with different organics for majority of growth and yield parameters. Moreover, INM treatment of T_2: Azotobactor alone under teak based Silvi-horticultural system reported minimum growth and yield parameters. The slight reduction was observed in INM treated teak based Silvi-horticultural system as compared to open condition.

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