Available online at www.ijpab.com

ISSN: 2320 – 7051
Int. J. Pure App. Biosci. **2 (4):** 119-124 (2014)
Research Article

INTERNATIONAL JOURNAL OF PURE & APPLIED BIOSCIENCE

Effect of Microbial and Chemical Fertilizer on Egg Plant (*Solanum melongena* LINN.) C.*Var* CO-2

P. Latha[1] and S. Jeyaraman[2] and R. Prabakaran[1]*

[1]PG and Research Department of Botany, Government Arts College (Autonomous), Coimbatore-641018, India
[2]PG and Research Department of Botany, Government Arts College,Udhagamandalam,
The Nilgiris - 643 002, India
*Corresponding Author E-mail: raju.prabakaran@gmail.com

ABSTRACT

The application of microbial and chemical fertilizers solely or combined application had a great influence at all the growth stages of the crop. Significant differences in all parameters like, total biomass differs irrespective of the treatments differed significantly. Among all the treatments, the maximum biomass was observed in T10 (containing urea, super phosphate, Murate of potash, Azospirillum, Phosphobacteria and potassium mobilizer (each 5g / pot). The fresh weight was 89.67g/plant and dry weight 6.15g/plant during harvest time. Maximum total chlorophyll content was recorded in T10 (1.7490 mg/g). The maximum protein content was recorded in T10 which was 18.2mg/g at flowering stage. Total phenol content was recorded in T10 which was (19.6mg/g^{-1}). The level of total free amino acids ranged 25.0 mg/g was found increased at 80 days. The total carbohydrates were increased in T10 plant was 92mg/g at flowering stage in leaf samples.

Key words: *Total biomass, Chlorophyll, Carbohydrates, treatments and potassium mobilizer.*

INTRODUCTION

Eggplant (*Solanum melongena* L.), also known as Aubergine, Brinjal or Guinea squash is one of the non tuberous species of the night shade family Solananceae[1]. The varieties of *Solanum melongena* L. show a wide range of fruit shapes and colors, ranging from oval or egg-shaped to long club shaped; and from white, yellow, green through degrees of purple pigmentation to almost black. It is an economically important crop in Asia, Africa and the sub-tropics (India, Central America) and it is also cultivated in some warm temperate regions of the Mediterranean and South America[2]. Eggplant fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also a rich source of potassium, magnesium, calcium and iron[3]. Brinjal fruit contains high amount of carbohydrates (6.4%), protein (1.3%), fat (0.3%), calcium (0.02%), phosphorus (0.02%), iron (0.0013%) and other mineral matters. Apart from these, it also contains beta-carotene (34 mg), riboflavin (0.05 mg), thiamine (0.05 mg), niacin (0.5 mg) and ascorbic acid (0.9 mg) per 100 g of fruit[4]. Eggplant fruits are known for being low in calories and having a mineral composition beneficial for human health. They are also a rich source of potassium, magnesium, calcium and iron[3&5].

Biofertilizers like cow dung and poultry manures are the two suitable manures, but it is not possible to meet the nutritional requirements from the organic sources only[6]. The potentialities of organic source are very limited to afford higher crop production due to slow release of plant nutrients from organic matter. Only one fifth to half of the nutrient supplied from manure was recovered and reminder was released any by 24 hours per annum[6]. This may be concern for fertility maintenance but is obviously a barrier for higher plant nutrition uptake. To overcome this problem application of organic manures in combination with inorganic fertilizers, called integrated nutrient management, can play important role in brinjal cultivation. Integrated nutrient use has assumed great significance in vegetable production. This practice sustains the productivity of soils under highly intensive cropping systems[7]. Moreover the application of organic matter as a source of some portion of required nutrients will have positive impact on soil physical and chemical properties which ultimately will increase the productivity. Higher yields of eggplant with combined use of FYM and fertilizers. Considering the above facts, the present study was therefore under taken to investigate the effects of organic manure and inorganic fertilizer alone or in combination on yield and yield contributing characters of brinjal and on soil properties[8].

MATERIALS AND METHODS

The experiment was carried out in a Randomized Complete Block Design (RCBD) at the Government Arts College Coimbatore. The mechanical compositions, physical and chemical properties of experimental soil, which was used for pot culture study. The soil physical and chemical properties such as p^H, Nitrogen[9], Phosphorus[10] and potassium[10] contents were analyzed. Micronutrients such as Zn, Fe, Cu, and Mn were analyzed. Seed material of Brinjal variety- CO2 were obtained from Tamilnadu Agricultural University, Coimbatore. The raised seed bed of 2x2m size was prepared, and Brinjal seeds were soaked in one centimeter depth in the rows spaced at 5 to 6 cm and covered with thin layer of soil. 30 days seedlings were transplanted to the trial pot. The treatments, were T-1 Urea (5g / pot),T-2 Super phosphate (5g / pot), T-3Murate of potash (5g / pot),T-4 Azospirillum (5g / pot), T-5 Phosphobacteria (5g / pot), T-6 Potassium mobilize (5g / pot), T-7 Urea, super phosphate, Murate of potash (each 5g / pot), T-8 Azospirillum, Phosphobacteria and potassium mobilizer (each 5g / pot), T-9 VAM alone (5g / pot), T-10 Urea, super phosphate, Murate of potash, Azospirillum, Phosphobacteria and potassium mobilizer (each 5g / pot) and T-11 Control. The N, P and K contents of the manures were tested in the laboratory and according to the results, the doses of manures were set in such a way that all the treatments contain same amount of N, P and K. Five plants were selected randomly from each unit plot to record yield contributing characters.

All practical managements included; mulching, weeding and other agronomic treatments were done mechanically. Irrigation was done based on plant requirements. In maturity time, total dry matter Biochemical parameters like chlorophyll '*a*, *b*', and total chlorophyll contents, total soluble protein, total free amino acids, total carbohydrate total phenol content, Plant major nutrients N,P,K, and micro nutrients calcium, magnesium, zinc, iron, manganese, copper, were analyzed. The collected data were analyzed statistically by F-test to examine the treatment effects and the mean differences were adjudged by Duncan's Multiple Range Test (DMRT) [11].

Total dry matter production

From each replication a single plant were carefully removed after harvest and first sun dried and oven dried at 80°C for two days and the dry weight was taken and expressed in gm plant[12]. The percentage of bio mass was calculated using following formula.

$$\% \text{ Bio mass} = \frac{\text{Fresh weight of the plant sample} - \text{dry weight of the plant sample}}{\text{Fresh weight of the sample}} \times 100$$

Biochemical parameters

Biochemical parameters were estimated after ten days after application of fertilizers at flowering stage. The fully opened fifth leaf from the top was used for biochemical analysis[13]. Chlorophyll '*a*', chlorophyll '*b*' and total chlorophyll contents were estimated as per the method and expressed as mg g^{-1} fresh weight of the leaf [14]. The amount of chlorophyll was calculated in the extract mg chlorophyll per gram tissue using the following equations:

$$\text{Mg chlorophyll a/g of tissue} = \frac{12.7(A663) - 2.69(A645) \times V}{1000 \times W}$$

$$\text{Mg chlorophyll b/g of tissue} = \frac{22.9(A645) - 4.68(A663) \times V}{1000 \times W}$$

Mg total chlorophyll a/g of tissue= $\frac{20.2(A645)+8.02(A663)\times V}{1000\times W}$

Where,
A=absorbance at specific wavelength
V=final volume of chlorophyll extract in 80% acetone
W =fresh weight of tissue

Total soluble protein content of the leaf was estimated[15]. Total free amino acids content of the leaves were estimated according to[16]. Expressed as mg g^{-1} of fresh weight. Total carbohydrate content was estimated by ethanol extraction method and was expressed as mg g^{-1} fresh weight[17]. Amount of carbohydrate present in 100mg of the sample. Total phenol content was assayed and expressed as mg g^{-1}. The estimation was carried out with the Folin-Ciocalteau reagent[18].

Mineral nutrients

Plant nutrient contents were analyzed during early harvest stage of the crop. The plant samples (leaves) were collected from respective treatments and dried. The dried plant samples were used for the estimation of following nutrients.

The total nitrogen content of the plant samples was estimated by microkjeldahl method[19]. Expressed as percentage on dry weight basis. The total phosphorous content of the plant samples was estimated by colorimetry method as proposed and expressed as percentage on dry weight basis[20]. The potassium content of the plant sample drawn from leaves was analyzed by Flame photometer using triple acid extracts method and expressed as percentage on dry weight basis[20].

Estimation of micronutrients

Micronutrients analysis was carried out using Atomic Absorption Spectrophotometer (model ECIL AAS 4127). The contents of calcium, magnesium, zinc, iron, manganese, copper, were analyzed with the respective cathode lamps proposed by[21].

RESULTS AND DISCUSSION

The present result was observed that the application of microbial and chemical fertilizers solely or combined application had a great influence at all the growth stages of the crop. Significant differences in all parameters like, total biomass differs irrespective of the treatments differed significantly. Among all the treatments, the maximum biomass was observed in T10. The fresh weight was 89.67g/plant and dry weight 6.15g/plant during harvest time (Table 1).

In this study the biochemical changes in the level of total soluble proteins, total amino-acids, total carbohydrates leaf total phenol chlorophyll –a, b and total chlorophyll of plant was assayed from each treatment. Maximum total chlorophyll content was recorded in T10 (1.7490 mg/g) followed by T7 (1.3883 mg/g). In VAM treated plants it was recorded as 1.1503 mg/g. In control it was recorded as 0.9097 mg/g at flowering stage. The maximum protein content was recorded in T10 which was 18.2mg/g at flowering stage. The total free amino acid content was also increased and is given in (Table 1). The maximum phenol content was recorded in T10 which was (19.6mg/g^{-1}) (Table 1) at flowering stage followed by T10 19.600mg/g^{-1}. The level of total free amino acids ranged 25.0 mg/g was found increased at 80 days in leaf sample (Table 1) this result correlated with the earlier findings that there was an increase in protein content of vegetable crop by application of FYM along with other organic manures[22].

The total carbohydrates were increased in T10 plant was 92mg/g at flowering stage in leaf samples. Manganese is an essential micronutrient that plays a primary role in the increase of carbohydrate, (Table 1). Amino acids, and starch content in tomato, brinjal and also plays an important role in the synthesis of chlorophyll[23]. The results were such that although the application of only organic manures maintained the good health of soil, they were slow to release adequate nutrients timely.

From the other side, only inorganic fertilizers application could affect the soil health, which in turn may affect flowering and fruiting. So the combined application of manures and fertilizers may supply the nutrients timely and also maintain the suitable condition for flowering, fruiting and their growth. The finding is supported by[24]. The highest fruit yield with replacing of 60 % Urea-N by Poultry manure[25, 26] and also reported that the combined use of organic manures and nitrogen resulted in higher yields of tomato, eggplant, pepper and chili than either N fertilizer or organic sources used alone.

Higher chlorophyll content has an advantage in increasing crop growth and yield and the same has been reported in several crops[27, 28]. The enzyme, nitrate reductase catalyses the reduction of nitrate to nitrite, which is the first step in the assimilation of nitrite by the plants. The reaction takes place in the cytoplasm of the cell in both roots and shoots[29]. The dry matter accumulation is significantly and positively associated with corresponding nitrate reductase activity[30]. In the present investigation, T10 differed significantly among the treatments at all stages. This might be due to more availability of nitrogen in the form of nitrate fixed by *Azospirillum*, also may be higher nitrate reductase activity in leaves. These findings are in agreement with[31].

Similarly Nitrogen, phosphorus and potassium are major essential macronutrients present in the soil and they will helpful for plant growth and developed hence they are commonly added as fertilizer to optimize yield (Table-2). The micro nutrients are present in the soil only in minute quantities. The micronutrients although required by the plant in very minute quantities, are essential for the plant growth as the major elements. So in this present study the micro nutrients such Fe, Mn, Zn, Cu were also analyzed after harvest and thus the results were enumerated (Table-2). The increase in the nitrogen content of the post-harvest soil sample treated with biofertilizer might be due to the release of more of nitrogenous substance in the soil. Another result observed an increase in the available status of nitrogen and phosphorous in soil after crop harvest over the initial status[32]. Similar reported that in the post-harvest soil the available potassium level was low, because of the intake of potassium by the crops[33].

Table 1-The effect of microbial and chemical fertilizer on brinjal total biochemicala (mg/g $^{-1}$) c.var.co-2

Treatments	Free amino acid (mg/g^{-1})	Phenol content (mg/g $^{-1}$)	Total soluble protein (mg/g-1)	Total carbohydrate (mg/g $^{-1}$)	Chlorophyll-a	Chlorophyll-b	Total chlorophyll	Brinjal total biomass (grams)		
								F.wt)	D.wt)	Biomass
T-1	17.067 d	18.200 b	14.600 e	83.100 d	0.9950 d	0.3183 d	1.2200 cd	62.30	3.70	94.06
T-2	13.800 g	15.400 e	13.600 g	77.900 h	0.8360 f	0.2110 h	1.0477 ef	65.80	3.80	94.22
T-3	10.700 i	15.800 d	12.800 i	81.400 e	1.0410 c	0.3007 e	1.3417 bc	62.85	3.73	94.07
T-4	17.100 d	16.200 c	14.200 f	80.500 f	0.8540 f	0.2600 f	1.1140 de	68.79	4.18	93.92
T-5	14.400 f	15.500e	13.000 h	77.800 h	1.4032 e	0.3180 d	1.3190 bc	65.45	3.82	94.16
T-6	12.000 h	15.600 de	15.000 d	79.500 g	1.0127 d	0.3380 c	1.2123 cd	70.50	4.07	94.22
T-7	21.400 b	19.500 a	17.800 b	86.200 c	1.1320 b	0.3750 b	1.3883 b	80.12	4.00	93.76
T-8	18.400 c	16.200 c	16.400 c	87.400 b	1.0453 c	0.3180 d	1.3633 bc	75.32	4.50	94.03
T-9	14.900 e	15.800 d	14.200 f	80.500 f	0.9253 e	0.2240 g	1.1503 de	89.67	6.15	93.14
T-10	**25.000 a**	**19.600 a**	**18.200 a**	**92.300 a**	**1.2730 a**	**0.4760 a**	**1.7490 a**	70.90	4.08	94.26
T-11	9.000 j	11.400 f	11.600 j	74.300 i	0.7387 g	0.1710 i	0.9097 f	42.86	4.88	88.61
MEAN	**15.797**	**16.291**	**14.673**	**81.900**	**0.9870**	**0.3009**	**1.2559**			

Means followed by a common letter are not significantly different at the 5% level by DMRT.

Table -2. The effect of microbial and chemical fertilizer on Soil nutrients analysis after harvest c.var.co-2

Treatments	Soil Macro nutrients analysis after harvest			Soil Micro nutrients analysis after harvest				brinjal leaf nutrients analysis						
	(N) ppm	(P) (ppm)	(K) ppm	Fe ppm	Mn ppm	Zn ppm	Cu ppm	N ppm	P ppm	K ppm	Zn ppm	Fe ppm	Cu ppm	Mn ppm
Soil before harvest	38	65	110	2.51	2.81	1.8	0.16							
T-1	53	80	125	2.97	3.44	7.78	0.37	-	-	-	-	-	-	-
T-2	67	85	140	3.42	3.3	5.27	0.72	-	-	-	-	-	-	-
T-3	64	89	145	4.49	5.3	5.18	0.92	-	-	-	-	-	-	-
T-4	62	70	115	3.33	2.16	9.16	0.21	-	-	-	-	-	-	-
T-5	62	75	120	2.61	1.41	2.52	0.12	-	-	-	-	-	-	-
T-6	70	88	145	3.3	1.61	1.45	0.3	-	-	-	-	-	-	-
T-7	80	100	235	6.65	6.68	10.07	0.92	0.72	0.051	0.68	71.5	560	8.9	123.7
T-8	76	87	180	5.39	5.23	9.07	0.88	-	-	-	-	-	-	-
T-9	50	81	125	4.85	3.51	0.42	0.38	-	-	-	-	-	-	-
T-10	**87**	**112**	**235**	**8.54**	**6.85**	**13.31**	**1.19**	**0.84**	**0.055**	**0.74**	**89.2**	**604**	**12.0**	**153.5**
T-11	39	62	115	2.61	2.82	1.95	0.16	0.62	0.047	0.62	53.5	458	5.8	96.2

Means followed by a common letter are not significantly different at the 5% level by DMRT.

CONCLUSION

Several attempts have been made in past to increase the yield potential of crops, but they are concerned with use of chemical fertilizers. Unfortunately, not only the productivity potential is low, but the quality is also deteriorating. Hence, it is time to think not only of increasing the production potential but also to improve the quality by applying advancements in scientific production to meet the increasing demand and boost up the export earnings. Therefore, a study was undertaken to find out the influence of microbial fertilizer and chemical fertilizer on growth, yield and quality parameters of brinjal. The benefit cost ratio was found lesser in using both biofertilizer and chemical fertilizer compared to using chemical fertilizer alone in brinjal crop cultivation.

REFERENCES

1. Kantharajah, A.S Golegaonkar, P.G, Somatic embryogenesis in eggplant Review. *J. Sci. Hortic.* **99**: 107- 117(2004)
2. Sihachkr, D., M.H., Chaput, L., Serraf, G., Ducreux, Regeneration of plants from protoplasts of eggplant (*Solanum melongena* L.). In: Bajaj, Y.P.S. (Ed.), Biotechnology in Agriculture and Forestry, Plant Protoplasts and Genetic Engineering. Springer, Berlin. pp. 108-122 (1993)
3. Zenia, M. Halina, B., Content of microelements in eggplant fruits depending on nitrogen fertilization and plant training method. J. Elementol. **13(2)**: 269-274 (2008)
4. Choudhary, B., Vegetables, (4th edn.,). National Book Trust, New Delhi, pp. 50-58 (1976)
5. Marschner, H., Mineral Nutrition of Higher Plants, 2nd Edition. Academic Press, London, San Diego. 1976. 889pp (1995)
6. Miah, M.M.U., Prospects and Problems of organic farming in Bangladesh. Paper presented at the workshop on integrated nutrient management for sustainable agriculture held at SRDI, Dhaka. 26-28 (1994)
7. Singh, G.B., Yadav, D.V., Integrated plant nutrition system in sugarcane. Fertilizer News **37**: 15-22 (1992)
8. Subbiah, K. Sundararajan, S. Muthuswami, S. Perumal, R., Responses of tomato and brinjal to varying levels of FYM and macronutrients under different fertility status of soil. South Indian Horticulturalist. **33**: 198-205 (1985)
9. Jackson, M.L. Soil Chemical analysis. Prentice Hall, London. (1958)
10. Peach, K. Tracey, M.V., Modern Methods of Plant Analysis. Vol. I, Springer Verlag, Berlin. (1956)

11. Gomez, K.A. Gomez, A.K., Statistical Procedures for Agricultural Research. 2nd edn. John Wiley and Sons. New York. 207-215 (1984)
12. A.O.A.C., Official methods of analysis of the association of official analytical chemists. 13 thed. pp 123, Washington D.C (1980)
13. Bradley, G.A., Fleming, J.W., The effects of position of leaf and time of sampling on the relationship of phosphorus and potassium to yield of cucumber, tomatoes and watermelons. Proc. Amer.Soc.Hort.Sci., **75** : 617-623 (1960)
14. Arnon, D.I., Copper., enzymes in isolated chloroplast. Polyphenol oxidase in Beta vulgaris.Plant physiol: 241-15 (1949)
15. Lowry, O.H. Rosebrough, N.J. Farr, A.L. Randhall R.J. Protein measurement with Folin-Phenol reagent. *J. Biol.Chem*. **193**: 268-275 (1951)
16. Sadasivam, S. Manickam, A., Biochemical analysis for agricultural crops Wiley Easter. Limited Publishers, Tamil Nadu Agricultural University, Coimbatore (1991)
17. Hofreiter, B.T., Hedge, J.E., In Carbohydrate Chemistry 17 (Eds Whistler R L and Be Miller, J.N) Academic Press New York. (1962)
18. Malick, C.P., Singh, M.B., Plant Enzymology and Histo Enzymology. Kalyani Publishers, New Delhi, pp. 286 (1980)
19. Humphries, E.C., The dependence of photosynthesis on carbohydrates sinks. Currentconcepts proceedings of international symposium on tropical root crops, *Univ.West Indies,* II, II, pp. 34-35 (1969)
20. Jackson, M.L., Soil chemical analysis. Prentice Hall of India (Pvt) New Delhi (1973)
21. Tandon, Hls (Ed). Methods of Analysis of Soils, Plants, Waters and fertilizers.Fertilizers Development and consultation Organization, New Delhi, India. Pp 144 (1993)
22. Bhadoria, P.B.S., Prakash, Y.S., Rakshit, A., Importance of Organic Manures in Improving Quality of Rice and Okra, Environmental and Ecology, **20(3)**: 628-633 (2002)
23. Foy, C.D., Chaney, R.L., White, M.C., The physiology of metal toxicity in plants. Ann. Rev. Plant Physiol. **29**: 511-566 (1978)
24. Shelke, S.R., Adsule, R.N., Amrutsagar, V.M., Nitrogen management through organics and inorganics in Brinjal. J. Maharashtra Agric. Univ., **24 (3)**: 297-298 (1999)
25. Jablonska, C.R., Straw as an organic fertilizer in cultivation of vegetables. Part II. Effect of fertilization with straw on the growth of vegetable plants. Hort. Abstr., **63**: 244 (1990)
26. Hosmani, M.M., *Chili Crop* (*Capsicum annuum* L.). 2nd Edition. Mrs. S.M. Hosmani, Dharwad, kalkatta. (1993)
27. Edna Antony, Nitrogen utilization studies in groundnut (*Arachishypogaea*L.) genotypes. M. Sc. (Agri.) *Thesis*, Uni. Agric. Sci., Dharwad (India). (1995)
28. Kalpana, M., Morpho physiological traits associated with productivity in cowpea (*Vigna unigiculata* (L.) Walp.). M. Sc. (Agri) Thesis, Uni. Agric. Sci., Dharwad (India) (2000)
29. Kumar, P.A. Nair, T.V. Abrol Y.P. Nitrate reducatse: localization and source of reluctant. *Proc. Indian Natl. Sci. Acad.,* B. **54**: 409-412 (1989)
30. Bowerman, A., Goodman, P.J., Variation in Nitrate reductase activity in lohien.*Ann Bot.,* 35: 353-366 C*apsicum frutescens*L.). *Punjab Horticultural Journal*, 9: 82-86 (1971)
31. Bashan, Y. Levanonyh, Klein, E., Evidence for a weak active external adsorption of *Azospirillum brasilense* to wheat roots. *J Gen. Micro.,* **132**: 3069-3079 (1986)
32. Rosaiah, S.D., Kumari Sathyanarayana, A., Rajeshwari, V., Naidu, N.V., Genetics of seed size, protein and sugars in mungbean, *Intern. J.Trop.Agric*. **13(1- 4)**:123-127 (1995)
33. Subehia, S.K. Minhas, R.S., Phosphorus availability from Udaipur rock phosphate as influenced by different organic amendments. *Journal of Indian Society of Soil Science,* **41**: 96-99 (1993)