Effect Of Vermicompost And NPK Fertilizer On Growth And Yield Components Of Egg Plant (Solanum Melongena L.)

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Abstract: CThe experiment was conducted to evaluate the effect of Vermicompost and NPKs fertilizers on growth and yield components of egg plant in Clay loam soils of Sivapuri, Chidambaram, Tamil Nadu during the period from April to September 2008. There were 4 treatments viz., Control (FT_1), NPK alone (FT_2), Vermicompost (5 ton ha^{-1}) (FT_3), Vermicompost 50% + NPK 50% (FT_4). The experiment was laid out in RBD with three replications. The highest growth and yield of egg plant was found in FT_4, followed by FT_3. The highest yield increased by FT_4 (70.1%) than the FT_3, FT_2 and FT_1. The results showed that effects of vermicompost + NPK are more efficient for egg plant and maintenance of soil environment and also economically suitable.

Index Terms: Egg plant, Vermicompost, Growth, Yield and NPK fertilizers

1. INTRODUCTION

Earthworms are natural invertebrates of agroecosystem. Earthworms are extensively used for the production of vermicompost from organic wastes, vermiprotein, soil reclamation, soil detoxification and abatement of environmental pollution. Egg plant, popularly known as brinjal in India, is the most popular and widely cultivated vegetable crop. Brinjal being a long duration crop requires a good manure and fertilizer. Vegetables cannot be neglected from our daily meals. It is supposed also to contain certain medicinal properties and brinjal is said to be good for diabetic patients (Choudhury, 1976). Various sizes, shapes, colours and forms of cultivated as well as wild type of brinjal are found in India, white type brinjal fruits is said to be good for diabetic patients. The technique of organic farming plays a role in cultivation of high value of vegetable crops (Mishra et al., 2018). Vermicompost consistently promote biological activity which can cause plant to germinate, to produce flower and yield better than in commercial containing media, independent of nutrient availability (Arancon et al., 2004). Vermicompost is a good source of different macro and micronutrients particularly NPK. Use of vermicompost for vegetable production in large scale can solve the problem for disposal of wastes and also solve the lack of organic matter. The judicious combination of organic and inorganic sources of nutrients might be helpful to obtain a good economic return with good soil health for the subsequent crop (Alam et al., 2007a). Vermicompost increase the surface area provides strong absorbability and retention of nutrients as well and retain more nutrients for a longer period of time (Mamta et al., 2012). Application of vermicompost to field soils have also been reported to increase crop growth and yields (Mba, 1983; Kale et al., 1992; Arancon et al., 2004).Vermicompost application can enhance both quality and quantity of plants (Gutierrez –Miceli et al., 2007). Few researchers worked on vermicompost Tomar et al., (1998) in carrot, Saikia et al. (1998) in potato, Upadhayaay et al. (2003) in potato, Bongkyoon (2004) in potato, Alam (2005) in carrot, Alam et al. (2007a), in Red amarauthus. Patel and Puraji (2003) have stated that application of 50% recommended dose of fertilizer along with vermicompost at 2 t/ha increased the yield of Soybean. Vermicompost can influence the growth and productivity of plants (Doan et al., 2013). Fly ash amendment has been reported to modify soil pH, improve soil texture, provide essential plant nutrients for increasing crop production (Korcak, 1993) and increases in cation exchange capacity (Carlson and Adriano, 1993), since almost all naturally existing elements are present in fly ash (Adriano et al., 1980). The addition of different doses of cowdung manure had significant effect on vegetable growth of egg plant expressed by higher number of leaves, plant height and stem girth compared to the control (Abegunrin et al., 2016). The vermicompost can be utilized as plant growth media and soil conditions and also promote soil microbial biodiversity by inoculating the soil with a wide array of beneficial microbes (Broz et al., 2016). It was planned to find out the influence of vermicompost from fly ash mixture (FA + CLI +CD) T_2 on the growth component of vegetable crop brinjal. So, the present investigation was undertaken to study effect of vermicompost and NPKs fertilizers on growth and yield components of egg plant.

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2 MATERIALS AND METHODS

The vermicomposts produced from T_2 combination was selected for field study. Vermicompost generated from this treatment is comparatively nutrient rich, higher microbial population and higher enzymatic activity, than the vermicomposts produced from other treatments. Field study were conducted at Sivapuri, a village near Annamalai University, All the treatments were conducted in triplicates. Experiments were carried out in micro-plot ($2m^2$) and they were conducted from April-September 2008. The experiment set up was as follows:

F (Field trial) T_1 – Control plot (Without application of fertilizer and manure)

FT_2 – Plot where recommended dose of NPK alone (120:60:30 kg ha^{-1}) was applied.

FT_3 - Plot where recommended dose of vermicompost (5 ton ha^{-1}) was applied.

FT_4 – Plot where 50% vermicompost was supplemented with 50% NPK (w/w)

2.1 Selection of soil, inorganic fertilizer and vermicompost

The soil used for the field experiments was sandy loam soil (SLS). Inorganic fertilizers (NPK) were purchased from

local shop. NPK is used in the form of urea (N), single superphosphate (P) and muriate of potash (K). In the field trials vermicompost produced by L. mauritii was used.

2.2 Growth parameters

Plant height
The height of the plant from the cotyledonary leaf node to the tip of plant was measured at 60, 90 and 120 DAT and the mean values were expressed in cm.

Number of primary branches
Total number of primary branches per plant was counted on 60, 90 and 120 DAT and recorded.
Number of leaves
Total number of leaves produced plant^{-1} were counted on 60, 90 and 120 DAT and recorded.

Leaf area
The leaf area was measured by using leaf area meter on 60, 90 and 120 DAT and expressed as cm^2.

Yield parameters

Number of flowers
The number of flowers plant^{-1} was recorded from transplanting to harvest and expressed in numbers.

Mean fruit length
Five fruits were tagged in five plants selected at random per treatment and the length was measured from the calyx to tip of the fruit and the mean expressed in centimetre.

Mean fruit girth
Five fruits were tagged in five plants selected at random per treatment and the girth was measured at the centre of the fruit and the mean expressed in centimetre.

Mean single fruit weight
Five fruits were tagged in five plants selected at random per treatment and the weight was taken with an electronic balance. The mean weight was calculated and expressed in grams.

Yield
At each harvest the fruits per plant were weighed in a mono-pan balance and total yield was expressed in kg plant^{-1}.

Statistical analysis
The significant difference between treatments were analysed statistically using one-way analysis of variance (ANOVA) with the help of the computer package SYSTAT (Wilkinson, 1986). The critical difference (CD) values were also computed.

3 RESULTS

Effect of NPK and vermicompost on the growth parameters and yield of brinjal are represented in Tables 1 to 3. The growth components of brinjal include plant height, number of branches, number of leaves and leaf area. The yield attributes include number of flowers, fruit length, fruit girth, mean single fruit weight and fruit yield per plant. In all the treatments all the growth components showed an increasing trend from 60 DAT to 120 DAT. Among the treatments in FT_4 showed conspicuous effects and ranked first in the enhancement of growth and yield components. Brinjal plants grown in recommended dose of VC 50% + NPK 50% (FT_4) plots showed enhanced values in all the growth parameters. For example plant height (cm) (cultivated in FT_4 plants) increased 78.9%, 44.8%, 37.9% respectively in 60, 90, and 120 DAT over control (FT_1). Number of branches (no. p^{-1}) increased 150.1%, 90.5%, 89.2% respectively on 60, 90 and 120 DAT over control (FT_I). Number of leaves increased 61.7%, 39.4%, 52.3% respectively on 60, 90 and 120 DAT. Leaf area (cm^2) increased 146.7%, 99.9%, 104.8% respectively on 60, 90 and 120 DAT over control. The comparison of percent change over control values between treatments FT_1-FT_4 clearly proved that the recommended dose of vermicompost supplemented with 50% NPK (FT_4) and (FT_3) plots showed more number of flowers, fruit length, fruit girth, mean single fruit weight and fruit yield. For instance, the number of flowers (no. p^{-1}) cultivated in FT_4 plots increased 146.8% on 60 DAT, 74.7% on 90 DAT and 58.1% on 120 DAT over control. Fruit length (cm) increased to 29.9% on 90 DAT and 18.8% on 120 DAT over control. Fruit girth (cm) 58.2% on 90 DAT and 52.7% on 120 DAT over control. Mean single fruit weight (g) increased 63.8% on 90 DAT and 52.2% on 120 DAT over control. Finally the fruit yield per plant (kg p^{-1}) increased 70.1% on 120 DAT over control. The efficiency of NPK, VC, VC + NPK to support or enhance the growth and yield components of vegetable plants of brinjal could be ranked in the following order: FT_4 (50% VC + 50% NPK) > FT_3 (VC alone) > FT_2 (NPK) > FT_I (control).

TABLE 1
Effect of vermicompost and NPK on growth and yield parameters of brinjal (S. melongena) on 60 DAT

Parameters	Sandy loam soil				CD values p = 0.05
	FT_1 (Control)	FT_2 (NPK)	FT_3 (VC)	FT_4 (VC + NPK)	
Plant height	28.02 ± 1.59	36.47±2.18 (30.1)	42.03 ± 1.73 (50.0)	50.13 ±2.29 (78.9)	2.56
No. of branches	3.33 ± 1.34	4.16 ± 1.57 (24.9)	5.50 ± 1.70 (65.1)	8.33 ±2.98 (150.1)	2.66
No. of leaves	30.36 ± 2.28	37.04 ±1.79 (22.0)	41.01 ± 1.45 (35.1)	49.10± 1.46 (61.7)	2.42
Leaf area	70.35 ±2.35	91.56 ±2.82 (30.1)	127.10 ± 4.70 (80.6)	173.60 ±6.55 (146.7)	5.65
No. of flowers	7.83 ± 2.47	10.66 ± 1.88 (36.1)	13.16 ± 2.26 (68.0)	19.33 ± 1.97 (146.8)	1.22

Values are mean of six observations.

TABLE 2
Effect of vermicompost and NPK on growth and yield parameters of brinjal (S. melongena) on 90 DAT

Parameters	Sandy loam soil				CD values p = 0.05
	FT_1 (Control)	FT_2 (NPK)	FT_3 (VC)	FT_4 (VC + NPK)	
Plant height	59.23 ± 1.65	73.47 ± 1.77 (24.0)	77.46 ±2.31 (30.7)	85.80 ± 1.80 (44.8)	2.50
No. of branches	8.66 ± 1.97	10.33 ± 1.88 (19.2)	11.16 ± 1.57 (28.8)	16.50 ±2.28 (90.5)	1.37
No. of leaves	52.01 ± 1.53	61.03 ± 1.84 (17.3)	66.37 ±2.22 (27.6)	72.54 ±2.29 (39.4)	2.88

Leaf area	101.8 ± 2.14	161.5 ±4.85 (58.6)	180.8 ±4.45 (77.6)	203.5 ±3.20 (99.9)	23.67
No. of flowers	29.66 ± 1.24	34.16 ± 3.18 (15.1)	40.33 ± 1.88 (35.9)	51.83 ± 3.48 (74.7)	2.06
Fruit length	11.76 ±0.57	14.01 ±0.42 (19.1)	14.33 ± 0.40 (21.8)	15.28 ± 0.47 (29.9)	1.54
Fruit girth	7.25 ±2.33	8.45 ± 2.24 (16.5)	9.44 ±2.17 (30.2)	11.47 ±2.06 (58.2)	0.61
Mean single fruit wt	60.80 ±2.63	81.82 ± 1.91 (34.5)	96.45 ± 1.26 (58.6)	99.62 ± 2.28 (63.8)	0.92

Values are mean of six observations.

TABLE 3

Effect of vermicompost and NPK on growth and yield parameters of brinjal (S. melongena) on 120 DAT

Parameters	Sandy loam soil				CD values p = 0.05
	FT_1 (Control)	FT_2 (NPK)	FT_3 (VC)	FT_4 (VC + NPK)	
Plant height	65.91 ± 1.82	75.98 ± 1.80 (15.2)	80.90 ± 1.91 (22.6)	90.94 ± 1.73 (37.9)	1.57 [1]
No. of branches	9.33 ± 1.79	10.83 ± 1.57 (16.6)	11.66 ±2.42 (24.9)	17.66 ± 1.97 (89.2)	1.05
No. of leaves	59.66 ±2.15	71.66 ±2.29 (20.11)	81.51 ±2.15 (36.6)	90.92 ± 1.77 (52.3)	2.30
Leaf area	102.1 ± 5.92	164.2 ± 8.37 (60.8)	183.3 ± 10.2 (79.5)	209.2 ±9.08 (104.8)	15.89
No. of flowers	40.16 ± 1.77	46.33 ± 1.79 (15.3)	50.83 ± 1.86 (26.5)	63.50 ± 3.20 (58.1)	2.08
Fruit length	13.80 ±0.72	15.35 ±0.42 (11.2)	15.67 ±0.43 (14.3)	16.4 ±0.38 (18.8)	0.65
Fruit girth	8.45 ± 2.05	9.61 ±2.18 (13.7)	10.60 ±2.05 (25.4)	12.91 ± 1.80 (52.7)	2.47
Mean single fruit wt	70.67 ± 2.00	86.65 ± 1.22 (22.6)	96.45 ±3.37 (36.4)	107.6 ± 1.30 (52.2)	2.65
Fruit yield	6.29 ± 0.51	7.78 ± 0.40 (23.6)%	8.05 ±0.41 (27.8,)%	10.71 ±0.45 (70.1)	0.64

Values are mean of six observations.

CD – Critical difference % per cent increase (+) over control

FT_1 – Control (without application of inorganic fertilizer or manure)

FT_2 – Recommended dose of NPK (kg ha^{-1})

FT_3- recommended dose of vermicompost (5 tons ha^{-1})

FT_4 – application of 50% vermicompost + 50% NPK

4 DISCUSSION

In the intensive cultivation, heavy use of chemical fertilizers is an essential ingredient for having the higher yield. But the slow poisoning of soil by artificial manures is one of the problems faced by the farmers. This trend certainly indicates that by continuous use of chemical fertilizers we cannot keep the soil fertility sustainable for long, in this context organic agriculture emerges out as a viable alternative for sustainable agriculture development of third world countries like ours. The importance of organic manure in agriculture and their role in increasing world food production has been extensively discussed by Abad et al., (1997). The fertilizing quality of vermicompost is determined by its effect on plant growth and yields. The present findings where the 50% NPK + 50% VC (FT_4) shows enhanced growth and yield of brinjal than the plants treated with vermicompost (FT_3) or NPK (FT_2). Manivannan et al. (2009) reported that conspicuous effects were observed on the growth and yield of beans in plots fertilized with 50% vermicompost supplemented with 50% NPK than plots treated either with vermicompost or NPK. The increased growth and yield of brinjal are due to application of fly ash vermicompost along with NPK which improved the physical conditions of the soil which supported better aeration to plant root, facilitation of cations N, P and K exchange, sustained availability of nutrients and there by the uptake by the plants resulting in better growth. Jala and Goyal (2006) suggested that the presence of different fly ash-soil combination was attributed to increased availability of major plant nutrients. The application of macrophytes based vermicompost in quite beneficial in field grown S. melongena significant higher rate of germination, increased plant growth and yield parameters with higher marketable fruits. Bellit et al. (2017) reported that the positive effect of vermicompost increased P and K content of vegetable crops (pepper and egg plant).

5 CONCLUSION

It can be concluded that the organic amendments of soil increase the growth and yield of egg plants. The use of vermicompost could be a better option in general. This will also reduce the addition burden of synthetic fertilizers in our vegetable gardens that in turn will decrease the pollution load on our environments.

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REFERENCES

[1] T.P. Abegunrin, G.O. Awe and K.O. Ateniolo, Soil amendment for vegetable production : An example with cowdung manure and egg plant (Solanum melongena). Int. J. Curr. Microbiol. Appl. Sci., vol. 5(8), pp. 901-915, 2016.

[2] D.C. Adriano, A.L. Page, A.A. Elseewi, A.C. Chang and I. Straughan, Utilization and disposal of fly ash and other coal residues in terrestrial ecosystems: A review. J. Environ. Qual., vol. 9, pp. 333-344, 1980.

[3] M.N. Alam, Effect of vermicompost and NPK fertilizers on growth, yield and components of carrot (cv. New Kuroda). Ban. J. Environ. Sci., vol. 11(2), 398-403, 2005.

[4] M.N. Alam, M.S. Jahan, M.K. Ali and M.A.T. Khandaker, Effect of vermicompost and NPK fertilizers on growth yield components of red Amarnath. Aus. J. Basic Appl. Sci., vol. 1(4), pp. 706-716, 2007a.

[5] N.Q. Arancon, C.A. Edwards, R.M. Atiyeh and J.D. Metzger, Effects of vermicomposts produced from food waste on green house peppers. Biores. Technol., vol. 93, pp. 139-144, 2004.

[6] O.K. Bellit, S. Adiloglu, Y. Salmaz, A. Zahmaologlu and A. Adiloglu, Effect of increasing doses of vermicompost application on P and K contents of pepper (Capsicum annum L.) and egg plant (Solanum melongena L.). J. Adv. Agri. Tech., vol. 4(4), pp. 372-375, 2017.

[7] K. Bongkyoon, Effect of vermicompost on growth of fall cropping potato in volcanic ash soil. Korean J. Crop. Sci., vol. 49(4), pp. 305-308, 2004.

[8] A.P. Broz, P.O. Verma and C. Appel, Nitrogen dynamics of vermicompost use in sustainable agriculture. J. Soil Sci. Environ. Manag., vol. 71(11), pp. 173-183, 2016.

[9] C.L. Carlson and D.C. Adrino, Environmental impacts of coal combustion residues. J. Environ. Qual., vol. 22: pp. 227-247, 1993.

[10] B. Choudhury, In evolution of crop plants. (Ed.) N.W. Simmonds. Longman Inc. London and New York. pp. 278-279, 1976 .

[11] T.T. Doan, P.T. Ngo, C. Rumpe, B.N. Nguyen and P. Jouquet, Interactions between compost, vermicompost and earthworms influence plant growth and yield : A one – year green house experiment. Sci. Hortic., vol. 160, pp. 148-154, 2013.

[12] F. Gutierrez-Miceli, J. Santiago-Boraz, J.A.M. Molina, C.C. Nafete, M. Abdul-Archila, M.A.O. Llaven, R. Rincon-Rosales and L. Dendooven, Vermicompost as a soil supplement to improve growth, yield and fruit quality of tomato (Cycoperscium esulentum). Biores. Technol., vol. 98, pp. 278-286, 2007.

[13] S. Jala and D. Goyal, Fly ash as a soil ameliorant for improving crop production - A review. Biores. Technol., vol. 97, pp. 1136-1147, 2006.

[14] K.D. Kale and K. Bano, Niche divergence – A limiting factor for recommendation of earthworms for biotechnology. Proc. Nat. Sem. Org. Fmg., Bangalore, pp. 42-44, 1992.

[15] R.F. Korcak, Utilization of coal combustion by-products in agriculture and horticulture, In: Agricultural Utilization of Urban and Industrial by-products: (Eds.) D.L. Karlen Wright, R.J., Kemper. W.D., American Society of Madison, WI, pp. 107-130, 1993.

[16] Mamta, A.W. Khursheed and R.J. Roa, Effect of vermicompost on growth of brinjal plant (Solanum melongena) under field conditions. J. New Biol. Rep., vol. 1(1), pp. 25-28, 2012.

[17] S. Manivannan, M. Balamurugan, K. Parthasarathi, G. Gunasekaran and L.S. Ranganathan, Effect of vermicompost on soil fertility and crop productivity-beans (Phaseolus vulgaris). J. Environ Biol., vol. 30(2), pp. 275-281, 2009.

[18] CC. Mba, Utilization of Eudrilus eugeniae for disposal of cassava peel. In: Earthworm Ecology: from Darwin to Vemiculture (Satchell, J.E. (Ed)]. Chapman and Hall, London, pp. 315-321, 1983.

[19] V.K. Mishra, S. Kumar and V.K. Pandey, Effect of organic manure and biofertilizers on growth, yield and quality of brinjal (Solanum melongena L.). Int. J. Pure Appl. Biosci., vol. 6(1), pp. 704-707, 2018.

[20] I.A. Najar, A.B. Khan and A. Hai, Int. J. Recycle Organic waste Agriculture, vol. 4,pp. 73, 2015.

[21] M. Patel and B.T. Puraj, Effect of organic manures and fertilizers on growth, yield parameters and yield of irrigated soybean. Pro. ISOR National Seminar: Stress management in oil seeds. pp. 276-277, 2003.

[22] M. Saika, D.J. Rajkhowa and M. Saikia, Effect of planting density and vermicompost on yield of potato raised from seeding tubers. J. Indian Potato Assoc. vol. 25(3-4), pp. 141-142, 1998.

[23] K.N. Sudha, Response of rainfed groundnut (Arachis hypogaea) to sand mulching and organics in vertic inceptisoils. M.Sc. (Ag.) Thesis, Univ. Agrl. Sci., Dharwad, India, 1999.

[24] V.K. Tomar, R.K. Bhatnagar and P.K. Palto, Effect of vermicompost on production of brinjal and carrot. Bhartiya Krishi Arusardhar Patrika. vol. 13(3-4), pp. 153-156, 1998.

[25] N.C. Upadhayay, N. Singh, S. Rawal and P. Kumar, Response of two potato cultivars to vemicompost and inorganic fertilizers. J. Indian Potato. Assoc., vol. 30(1/2), pp. 85-86, 2003.