Effect of inorganic fertilizers, organic manures and biofertilizers on growth and yield of brinjal.

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ABSTRACT

A field experiment was conducted in a sandy clay loam soil with brinjal cv. Annamalai as the test crop in Sivapuri village, Chidambaram taluk, Cuddalore district, Tamil Nadu. The experiment was laid out in randomized block design and replicated three times. The treatments consisted of application of inorganic fertilizers, organic manures and biofertilizers in different combinations. The experimental plots received the fertilizers according to the treatments schedule. The N, P, K fertilizers, FYM, vermicompost and pressmud compost were applied as basal according to the treatments. The growth attributes were recorded on 30 DAT, 60 DAT, 90 DAT and at harvest and yield attributes and fruit yield were recorded at harvest. The results of the experiment clearly revealed that the application of 75% RDF + 7.5 t of FYM ha^{-1} + 4.5 t of pressmud ha^{-1} + 1.5 t of vermicompost compost ha^{-1} + biofertilizers (T_9) registered the maximum plant height, number of leaves $plant^{-1}$, number of branches $plant^{-1}$, fruit length, fruit diameter, single fruit weight and fruit yield.

Keywords: Brinjal, farm yard manure, vermicompost and pressmud compost

INTRODUCTION

Brinjal (*Solanum melongena*) is a biennial plant popularly known as egg plant belongs to the family solanaceae. It is a popular vegetable grown in India and other parts of tropical and sub tropical regions of the world. It has high nutritive value and remunerative price. It is a staple vegetable which contains carbohydrates, protein, fat, calcium, iron, other mineral matters and also vitamins A and B. Brinjal has ayurvedic medicinal properties and is good for diabetic and asthma patients. In India, 8% of the total area under vegetables is occupied by brinjal and is the second major crop next to tomato. Major states growing brinjal are West Bengal, Orissa, Bihar and Gujarat. India produces about 12.8 million tonnes of brinjal annually from about 0.73 million hectares of area, with an average productivity of about 12 per cent of India's total vegetable production (MOA, 2018). In Tamil Nadu, it is cultivated in 0.15

million hectares area with a production of 1.96 million tonnes and the average productivity is 13.29 t ha^{-1}. The average productivity of brinjal in Tamil Nadu is very low when compared to India.

Organic manures like farm yard manure, pressmud, vermicompost, sewage sludge, urban compost etc. are sustainable manures and are important sources of nutrients. Farm yard manure supplies macro and micronutrients to the soil and improves the physical, chemical and biological properties. Vermicompost is nutritionally rich organic manure which increases soil porosity, aeration, water holding capacity and retention of nutrients for a longer period of time. It contains higher amounts of N, P, K, Ca and Mg and can be effectively used as a source of nutrients for plant growth. Pressmud is the solid residue produced after filtration of sugarcane juice. It is rich in organic carbon, N, P, K, Ca, S and micronutrients. Calcium and sulphur present in pressmud have been found to reduce the alkalinity of the soil. Biofertilizers are natural living microbial inoculants. They augment the availability of nutrients to the plants Therefore, the objective of the present study was to find out the effect of pressmud compost on yield, yield attributes and growth attributes of brinjal.

MATERIALS AND METHODS

A field experiment was conducted at Sivapuri village in farmers's holding, Chidambaram taluk, Cuddalore district, Tamil Nadu to find out the effect effect of inorganic fertilizers, organic manures and biofertilizers on growth attributes, yield attributes and yield the test crop under irrigated condition with nine treatments replicated thrice in a randomized block design. Recommended dose of NPK fertilizers was applied uniformly to all plots. The details of the treatments are given below:

T_1 - Recommended dose of fertilizers (control)

T_2 - 75% Recommended dose of fertilizers + farm yard manure @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1}

T_3 - 75% Recommended dose of fertilizers + farm yard manure @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1} + biofertilizers (*Azospirillum* and *Phosphobacteria*)

T_4 - 75% Recommended dose of fertilizers + farm yard manure @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1}

T_5 - 75% Recommended dose of fertilizers + farm yard manure @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers (*Azospirillum* and *Phosphobacteria*)

T_6 - 75% Recommended dose of fertilizers + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1}

T_7 - 75% Recommended dose of fertilizers + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers (*Azospirillum* and *Phosphobacteria*)

T_8 - 75% Recommended dose of fertilizers + farm yard manure @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1}

T_9 - 75% Recommended dose of fertilizers + farm yard manure @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers (*Azospirillum* and *Phosphobacteria*)

The growth attributes, yield attributes and yield were recorded.

RESULTS AND DISCUSSION

Growth attributes (table 1)

Plant height

Among the various combinations tried, application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} (T_8) registered the maximum plant height of 34.2 cm at 30 DAT. But, the treatments T_5 and T_3 were on par with each other in recording the plant height at 30 DAT. The treatment T_1 (100 % RDF) registered the least plant height of 21.7 cm. The application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @1.5 t ha^{-1} + biofertilizers (T_9) registered the maximum plant height of 77.3 and 115.6 cm at 60 and 90 DAT respectively. This was followed by the treatment (T_8) with application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @1.5 t ha^{-1} recording the plant height of 74.2 and 111.5 cm at 60 and 90 DAT respectively. The treatments next in order were T_7, T_6, T_3, T_2, T_5 and T_4. The lowest plant height of 52.4 and 85.6 cm at 60 and 90 DAT respectively was recorded in the treatment with the application of 100 % recommended dose of fertilizers alone (T_1). In addition, the added biofertilizers in this treatment might have produced growth promoting substances like auxin, gibberellin and cytokinin which contributed towards the mycorrhizal development and vigorous growth and height of the plant (Satesh and Sharma, 2007)

Number of leaves plant^{-1}

The data presented in table revealed that the addition of different levels of inorganic fertilizers, organic manures and biofertilizers significantly increased the number of leaves plant^{-1}. Among the treatments tried, application of 75 % RDF + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers (T_7) registered the maximum number of leaves plant^{-1} (15.3) at 30 DAT. The treatment T_1 was found to be least in recording the number of leaves plant^{-1} (7.1) at 30 DAT. The application of 75 % RDF + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + biofertilizers (T_9) registered the maximum number of leaves plant^{-1} of 77.3 and 101.6 at 60 and 90 DAT respectively. The treatment with application of 75% RDF + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} (T_8) was next in order in registering the number of leaves plant^{-1} of 74.5 and 97.9 at 60 and 90 DAT respectively. This was followed by the treatments T_7, T_6, T_3, T_2, T_5, T_4 and T_1. However, the treatments T_2 and T_3 were not significantly different from each other in recording the number of leaves plant^{-1} at 60 DAT. The lowest number of leaves plant^{-1} of 57.8 and 72.3 at 60 and 90 DAT respectively was recorded in the treatment with application of 100 % recommended dose of fertilizers (T_1). This adequate nitrogen supply from inorganic fertilizers and organic manures might have associated with higher photosynthetic activity and vigorous vegetative growth. Similar findings were reported by Veeranna *et al*. (2001).

Number of branches plant^{-1}

Of the various combinations tried, the maximum number of branches plant^{-1} of 5.3, 20.6 and 35.2 at 30, 60 and 90 DAT respectively were noticed with the application of 75% RDF + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + biofertilizers (T_9). This was followed by the treatment with application of 75 % RDF + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} (T_8) registering 4.9, 19.3 and 33.3 branches plant^{-1} at 30, 60 and 90 DAT respectively. These treatments were followed by T_7, T_6, T_3, T_2, T_5, T_4 and T_1. But, the treatments T_2 and T_3 and T_4 and T_5 were not significantly different from each other in recording the number of branches plant^{-1} at 30 DAT. The least number of branches plant^{-1} of 2.9, 13.6 and 19.6 at 30, 60 and 90 DAT respectively were recorded in control (100 % RDF) as compared to other treatments. This increased number of branches plant^{-1} with this integrated application of nutrients might be

also attributed to the stimulatory effect of bio-fertilizers especially *Azospirillum* and *Phosphobacteria* for the development of photosynthetic structures like size of the chloroplast and the number of grana as reported by Duhhoon *et al*. (2001).

Yield attributes (table 2)

Fruit length

Among the various treatments tried, the maximum fruit length of 14.60 cm was recorded in the treatment T_9 (75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers). The treatment next in order was T_8 (75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1}) which registered the fruit length of 13.79 cm. The least fruit length of 7.38 cm was recorded in the treatment T_1 (100 % RDF). The increased fruit length in this treatment might be ascribed to the fact that organic sources provide available nutrients which increased the production of leaves, increased photosynthetic activity, chlorophyll formation, nitrogen metabolism and auxin contents in the plants which ultimately improved the fruit length of brinjal. The above results corroborates with findings of Meenakumari and Shekhar (2012).

Fruit diameter

The application of different combinations of inorganic fertilizers, organic manures and biofertilizers significantly increased the diameter of brinjal fruit. The fruit diameter of 6.5, 6.1, 5.6, 5.2, 4.7, 4.3, 3.9 and 3.7 cm was recorded in the treatments T_9, T_8, T_7, T_6, T_3, T_2, T_5, T_4 respectively. The treatment T_1 (100% RDF) recorded the lowest fruit diameter of 3.2 cm compared to other treatments. The increased availability of nutrients throughout the crop growth period might have increased food production and vigorous growth of plant resulted in increase of fruit diameter. Similar results were obtained by Meena *et al*. (2014).

Single fruit weight

Addition of inorganic fertilizers, organic manures and biofertilizers in various combinations significantly influenced the single fruit weight of brinjal. Significant variations were recorded between the treatments. The highest single fruit weight of 61.60 g was noticed with application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers (T_9) and

this treatment was followed by T_8 (75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1}) recording the single fruit weight of 58.60 g. The treatment with the application of 100% RDF (T_1) recorded the least fruit weight of 41.52 g. The maximum single fruit weight recorded in this treatment might be due to accelerated mobility of photosynthates from sources to sink as influenced by growth hormones released which are synthesized due to the organic sources of nutrients like farm yard manure, vermicompost and pressmud. These results are in conformity with the findings of Christo *et al*. (2011).

Yield (table 2)

The data presented in table revealed that the application of inorganic fertilizers, organic manures and biofertilizers in different combinations significantly increased the fruit yield of brinjal. Application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers (T_9) registered the highest fruit yield of 396.64 q ha^{-1} in brinjal. This was followed by the treatment with application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} which recorded the fruit yield of 370.84 q ha^{-1}. The treatments next in order were T_7 (75% recommended dose of fertilizers + vermicompost @ 2 t ha^{-1} + pressmud @ 6 t ha^{-1} + biofertilizers), T_6 (75% recommended dose of fertilizers + vermicompost @ 2 t ha^{-1} + pressmud @ 6 t ha^{-1}), T_3 (75% recommended dose of fertilizers + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1} + biofertilizers), T_2 (75% RDF + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1}), T_5 (75 % RDF + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1}+ biofertilizers), T_4 (75% recommended dose of fertilizers + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1}) and T_1(100% RDF), which recorded the fruit yield of 396.64, 370.84, 354.14, 340.14, 327.34, 313.84, 299.04, 286.04 and 248.01 q ha^{-1} respectively. The probable reason for enhanced fruit yield of brinjal might be due to cumulative effect of macro and micro nutrients from inorganic fertilizers and organic manures on vegetative growth which ultimately improved the photosynthetic activities as well as improved water metabolism in plants. These results are in conformity with findings of (Laxmi *et al*., 2015).

Table 1. Effect of inorganic fertilizers, organic manures and biofertilizers on growth attributes of brinjal at different stages of growth (Mean of three replications)

Treatments	Plant height (cm)			Number of leaves plant^{-1}			Number of branches plant^{-1}		
	30 DAT	30 DAT	30 DAT	30 DAT	30 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1–RDF alone (Control)	21.7	7.1	2.9	2.9	2.9	85.6	7.1	57.8	72.3
T_2–75% RDF + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1}	23.1	9.6	3.4	3.4	3.4	98.3	9.6	65.2	82.9
T_3–75% RDF + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1} + biofertilizers	26.0	12.1	3.6	3.6	3.6	98.7	12.1	65.9	86.6
T_4–75% RDF + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1}	27.7	8.1	3.1	3.1	3.1	90.3	8.1	60.5	75.9
T_5–75% RDF + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers	25.1	10.4	3.3	3.3	3.3	94.3	10.4	63.3	79.7
T_6–75% RDF + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1}	29.9	13.9	4.0	4.0	4.0	103.4	13.9	68.5	90.3
T_7–75% RDF + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers	31.3	15.3	4.6	4.6	4.6	107.6	15.3	71.6	94.2
T_8–75% RDF + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1}	34.2	10.9	4.9	4.9	4.9	111.5	10.9	74.5	97.9
T_9–75% RDF + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers	33.5	12.7	5.3	5.3	5.3	115.6	12.7	77.3	101.6
SE_d	**0.67**	**0.46**	**0.14**	**0.14**	**0.14**	**1.83**	**0.46**	**1.21**	**1.66**
CD (p=0.05)	**1.42**	**0.98**	**0.30**	**0.30**	**0.30**	**3.88**	**0.98**	**2.58**	**3.53**

Table 2. Effect of inorganic fertilizers, organic manures and biofertilizers on yield and yield attributes of brinjal at harvest (Mean of three replications)

Treatments	Fruit length (cm)	Fruit diameter (cm)	Single fruit weight (g)	Fruit yield (q ha^{-1})
T_1–RDF alone (Control)	7.38	3.2	41.52	248.01
T_2–75% RDF + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1}	9.98	4.3	48.61	313.84
T_3–75% RDF + FYM @ 10 t ha^{-1} + pressmud @ 6 t ha^{-1} + biofertilizers	11.18	4.7	51.13	327.34
T_4–75% RDF + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1}	8.29	3.7	44.06	286.04
T_5–75% RDF + FYM @ 10 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers	9.09	3.9	46.16	299.04
T_6–75% RDF + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1}	12.02	5.2	54.18	340.14
T_7–75% RDF + pressmud @ 6 t ha^{-1} + vermicompost @ 2 t ha^{-1} + biofertilizers	12.98	5.6	56.36	354.14
T_8–75% RDF + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1}	13.79	6.1	58.60	370.84
T_9–75% RDF + FYM @ 7.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + biofertilizers	14.60	6.5	61.60	396.64
SE_d	**0.37**	**0.16**	**0.98**	**5.94**
CD (p=0.05)	**0.79**	**0.35**	**2.09**	**12.60**

CONCLUSION

It can thus be concluded that, application of 75% recommended dose of fertilizers + FYM @ 7.5 t ha^{-1} + pressmud @ 4.5 t ha^{-1} + vermicompost @ 1.5 t ha^{-1} + biofertilizers (*Azospirillum* and *Phosphobacteria*) can be resorted to, for higher yields and quality of brinjal. This combined application of chemical fertilizers, organic manures and biofertilizers will not only increase the production of brinjal,

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