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Research Article

EFFECT OF INORGANIC FERTILIZERS, ORGANIC MANURES AND BIOFERTILIZERS ON QUALITY AND UPTAKE 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 treatment schedule. The N, P, K fertilizers, FYM, vermicompost and pressmud were applied as basal according to the treatments. The quality attributes viz ascorbic acid content, titrable acidity and total soluble solids were recorded on fresh fruit of brinjal at harvest and nutrient uptake (N, P, K and S) was also computed. 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 (T9) registered the maximum yield and improved the quality of brinjal fruit and nutrient uptake (N, P, K and S).

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INTRODUCTION

Brinjal is an important herb belonging to the family solanaceae. The cultivated brinjal is of Indian origin and has been in cultivation for long time. Brinjal is staple vegetable in almost all tropical countries in the world and liked by both poor and rich. It is quite high in nutritive value. Plant nutrition plays an important role for enhancing yield and quality of brinjal. Nitrogen is one of the major components of nucleic acid, co-enzymes and cell membranes and is involved in many metabolic processes viz., cell division, photosynthesis, protein synthesis and expansion of shoot and root growth in plants and has active role during vegetative growth. Phosphorus is a constituent of nucleic acid, pythin and phospholipids, stimulates root growth, early maturity of crops and poor availability of this nutrient markedly reduces their growth. Potassium functions mainly on regulation and maintenance of electrochemical equilibrium in cells and other compartments and regulation of enzyme activities. Brinjal crop demands good nutrition and responds well to fertilization.

Considering the ill effects by continuous use of inorganic fertilizers, different organic manures viz. FYM, vermicompost and pressmud and biofertilizers (*Azospirillum* and *Phosphobacteria*) were used in combination. Farm yard manure

is the decomposed mixture of dung and urine of farm animals along with litter and left over material from roughages or fodder fed to the cattle and also FYM consists of partially rotted straw of plants, urine and contains nutrients. Vermicompost is nutritionally rich organic manure which contains major and micro nutrients. 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. Based on this in mind, the study was conducted to find out the effect of integrated nutrient management on quality and nutrient uptake by 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 of inorganic fertilizers, organic manures and biofertilizers on yield, quality and nutrient uptake of brinjal 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:

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1. T1 -Recommended dose of fertilizers (control) (100:50:30)
2. T2 -75% Recommended dose of fertilizers + farm yard manure @ 10 t ha⁻¹ + pressmud @ 6 t ha⁻¹
3. T3 -75% Recommended dose of fertilizers + farm yard manure @ 10 t ha⁻¹ + pressmud @ 6 t ha⁻¹ + biofertilizers (Azospirillum and Phosphobacteria)
4. T4 - 75% Recommended dose of fertilizers + farm yard manure @ 10 t ha⁻¹ + vermicompost @ 2 t ha⁻¹
5. T5 -75% Recommended dose of fertilizers + farm yard manure @ 10 t ha⁻¹ + vermicompost @ 2 t ha⁻¹ + biofertilizers (Azospirillum and Phosphobacteria)
6. T6 -75% Recommended dose of fertilizers + pressmud @ 6 t ha⁻¹ + vermicompost @ 2 t ha⁻¹
7. T7 -75% Recommended dose of fertilizers + pressmud @ 6 t ha⁻¹ + vermicompost @ 2 t ha⁻¹ + biofertilizers (Azospirillum and Phosphobacteria)
8. T8 -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
9. T9 -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)
10. The yield, quality attributes and nutrient uptake (N, P, K and S) of brinjal plant and fruit were recorded.

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% RDF + FYM @ 7.5 t ha⁻¹ + vermicompost @ 1.5 t ha⁻¹ + pressmud @ 4.5 t ha⁻¹ + biofertilizers (T9) registered the highest fruit yield of 396.64 q ha⁻¹ in brinjal. This was followed by the treatment with application of 75% RDF + 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 T7, T6, T3, T2, T5, T4 and T1, which recorded the fruit yield of 354.14, 340.14, 327.34, 313.84, 299.04, 286.04 and 248.01 q ha⁻¹ respectively.

Quality attributes (Table 1)

Ascorbic acid

It was quite clear from the data that the 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 (T9) registered the maximum ascorbic acid content of 10.50 mg 100g⁻¹. This was followed by the treatment T8 (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 ascorbic acid content of 9.68 mg 100 g⁻¹. The treatment T1 (100 % RDF) recorded the minimum ascorbic acid content of brinjal (5.03 mg 100 g⁻¹) compared to other treatments. Among the major nutrients, N and K supplied from chemical fertilizers and organic manures play an important role in improving the quality of crops. These results corroborate with the findings of Rajendran *et al.* (2008)

RESULTS AND DISCUSSION

Yield (Table 1)

Table 1 Effect of inorganic fertilizers, organic manures and biofertilizers on yield and quality of brinjal at harvest (Mean of three replications)

Treatments	Fruit yield (q ha ⁻¹)	Ascorbic acid (mg 100 g ⁻¹)	Titration acidity (%)	TSS content (%)
T ₁ -RDF alone (Control)	248.01	5.03	0.26	5.43
T ₂ -75% RDF + FYM @ 10 t ha ⁻¹ + pressmud @ 6 t ha ⁻¹	313.84	7.06	0.35	6.25
T ₃ -75% RDF + FYM @ 10 t ha ⁻¹ + pressmud @ 6 t ha ⁻¹ + biofertilizers	327.34	7.67	0.39	6.48
T ₄ -75% RDF + FYM @ 10 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹	286.04	5.87	0.28	5.72
T ₅ -75% RDF + FYM @ 10 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹ + biofertilizers	299.04	6.51	0.32	5.99
T ₆ -75% RDF + pressmud @ 6 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹	340.14	8.50	0.42	6.70
T ₇ -75% RDF + pressmud @ 6 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹ + biofertilizers	354.14	9.02	0.44	6.86
T ₈ -75% RDF + FYM @ 7.5 t ha ⁻¹ + vermicompost @ 1.5 t ha ⁻¹ + pressmud @ 4.5 t ha ⁻¹	370.84	9.68	0.48	7.09
T ₉ -75% RDF + FYM @ 7.5 t ha ⁻¹ + vermicompost @ 1.5 t ha ⁻¹ + pressmud @ 4.5 t ha ⁻¹ + biofertilizers	396.64	10.50	0.51	7.21
SE _d	5.94	0.056	0.0066	0.042
CD (p=0.05)	12.60	0.120	0.0140	0.090

Table 2 Effect of inorganic fertilizers, organic manures and biofertilizers on nutrient uptake (kg ha⁻¹) by brinjal plant and fruit (Mean of three replications)

Treatments	N		P		K		S	
	Plant	Fruit	Plant	Fruit	Plant	Fruit	Plant	Fruit
T ₁ -RDF alone (Control)	32.63	50.59	12.26	8.43	41.42	42.40	4.86	5.77
T ₂ -75% RDF + FYM @ 10 t ha ⁻¹ + pressmud @ 6 t ha ⁻¹	38.88	70.30	16.11	13.49	47.84	57.74	6.90	7.87
T ₃ -75% RDF + FYM @ 10 t ha ⁻¹ + pressmud @ 6 t ha ⁻¹ + biofertilizers	40.91	78.88	17.15	15.38	50.15	60.88	7.65	8.34
T ₄ -75% RDF + FYM @ 10 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹	34.88	62.92	13.95	10.58	43.54	50.34	5.53	6.86
T ₅ -75% RDF + FYM @ 10 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹ + biofertilizers	37.00	66.98	15.14	12.26	45.94	53.22	6.20	7.32
T ₆ -75% RDF + pressmud @ 6 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹	43.66	82.65	18.83	18.02	52.40	64.62	8.18	8.84
T ₇ -75% RDF + pressmud @ 6 t ha ⁻¹ + vermicompost @ 2 t ha ⁻¹ + biofertilizers	45.78	87.41	19.94	19.47	54.77	68.34	9.26	9.34
T ₈ -75% RDF + FYM @ 7.5 t ha ⁻¹ + vermicompost @ 1.5 t ha ⁻¹ + pressmud @ 4.5 t ha ⁻¹	48.45	92.71	21.05	21.13	57.10	72.31	10.38	10.01
T ₉ -75% RDF + FYM @ 7.5 t ha ⁻¹ + vermicompost @ 1.5 t ha ⁻¹ + pressmud @ 4.5 t ha ⁻¹ + biofertilizers	51.05	100.74	22.26	24.19	59.95	79.32	11.27	10.90
SE _d	0.38	0.93	0.27	0.24	0.55	0.64	0.08	0.19
CD (p=0.05)	0.81	1.99	0.59	0.51	1.17	1.36	0.19	0.41

Titration Acidity

Among the different treatments tried, the maximum titration acidity of 0.51 per cent was registered 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 (T9). This was followed by the treatment T8 (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 titration acidity of 0.48 per cent. The treatments next in order were T7, T6, T3, T2, T5 and T4 recording the titration acidity content of 0.44, 0.42, 0.39, 0.35, 0.32 and 0.28 per cent respectively. The lowest titration acidity of 0.26 per cent was recorded in the treatment T1 with application of 100% RDF alone (T1). The possible reason for improved titration acidity in this treatment might be due to solubilization of native and applied nutrients and their subsequent uptake which in turn have physiological influence on the activity of number of enzymes and increased vegetative growth and balanced C:N ratio.

Total Soluble Solids

The highest content of total soluble solids (7.21 per cent) was registered 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 (T9). This treatment was followed by the application of 75 per cent recommended dose of fertilizers + FYM @ 7.5 t ha⁻¹ + vermicompost @ 1.5 t ha⁻¹ + pressmud @ 4.5 t ha⁻¹ (T8) and recorded the total soluble solids content of 7.09 per cent. The treatments next in order were T7, T6, T3, T2, T5 and T4. Application of 100 % RDF (T1) recorded the least total soluble solids content of brinjal (5.43 per cent). Besides, supply of potassium plays a major role in carbohydrates synthesis, and its breakdown, translocation and synthesis of protein and also neutralizes physiologically important organic acids. Apart from this, potassium favours the conversion of starch into simple sugars during ripening by activating sucrose synthetase enzyme thus resulting in higher TSS. Similar findings were reported by Lal and Kanaujia (2013).

Nutrient Uptake (Table 2)

Nitrogen

Application of different combinations of inorganic fertilizers, organic manures and biofertilizers significantly influenced the nitrogen uptake by brinjal plant and fruit at harvest. Among the different treatments tried, 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 (T9) registered the highest nitrogen uptake of 51.05 and 100.74 kg ha⁻¹ at by plant and fruit at harvest respectively. The treatment T8 (75% recommended dose of fertilizers + FYM @ 7.5 t ha⁻¹ + vermicompost @ 1.5 t ha⁻¹ + pressmud @ 4.5 t ha⁻¹) was next in order registering the nitrogen uptake of 48.45 and 92.71 kg ha⁻¹ at by plant and fruit at harvest. These treatments were followed by T7, T6, T3, T2, T5 and T4. The treatment with application of 100 % RDF (T1) recorded the lowest N uptake of 32.63 and 50.59 kg ha⁻¹ by plant and by fruit at harvest respectively. It might be also due to the fact that the addition of mineral nutrients through chemical fertilizers along with organic sources narrowed the C:N ratio of organic manures and

thereby enhanced the rate of mineralization resulting in rapid release of nitrogen from organic sources which resulted in increased dry matter production at different stages of growth and fruit yield and this ultimately resulted in higher N uptake by plant and fruit. The results of present investigation are in accordance with those reported by Laxminarayanan and Patiram (2006).

Phosphorus

It is clear from the data that the application of inorganic fertilizers, organic manures and biofertilizers significantly influenced the phosphorus uptake by brinjal plant and fruit at harvest. Of the various combinations tried, 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 (T9) registered the maximum phosphorus uptake of 22.26 and 24.19 kg ha⁻¹ by plant and fruit at harvest respectively. This treatment was followed by T8 (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 phosphorus uptake of 21.05 and 21.13 kg ha⁻¹ by plant and fruit at harvest. The least P uptake of 12.26 and 8.43 kg ha⁻¹ by plant and fruit at harvest was found in the treatment T1 (100% RDF). The application of Phosphobacteria along with the organic manures and chemical fertilizers solubilized the phosphorus from the soil and increased the P content in plant and fruit. Apart from these reasons, the production of chelating substances, H₂S, CO₂ and mineral acids are also involved in P solubilization by application of phosphate solubilizing bacteria making it available to the plants (Mudasir *et al.*, 2009).

Potassium

The addition of different combinations of inorganic fertilizers, organic manures and biofertilizers significantly increased the potassium uptake by brinjal plant and fruit at harvest. Among the various treatments tried, the maximum potassium uptake was observed in 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 + biofertilizers (T9) with the values of 59.95 kg ha⁻¹ by plant and fruit at harvest respectively. The treatment next in order was T8 (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 potassium uptake of 57.10 and 72.31 kg ha⁻¹ by plant and fruit at harvest respectively. The treatment T1 (100% RDF) registered the minimum K uptake of 41.42 and 42.40 kg ha⁻¹ by plant and fruit at harvest respectively. The higher uptake of potassium might also be due to more growth, enabling the plant to explore wider areas and higher depth for absorption of potassium. Chaitanya *et al.* (2013) reported similar findings.

Sulphur

The conjoint application of inorganic fertilizers, organic manures and biofertilizers at various levels significantly influenced the sulphur uptake by brinjal plant and fruit at harvest. Of the different combinations tried, 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 (T9) registered the leading sulphur uptake of

11.27 and 10.90 kg ha⁻¹ by plant and fruit at harvest respectively. This was followed by the treatment T8 (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 sulphur uptake of 10.38 and 10.01 kg ha⁻¹ by plant and fruit at harvest respectively. The treatment T1 (100 % RDF) was found to record least S uptake of 4.86 and 5.77 kg ha⁻¹ by plant and fruit at harvest respectively. The increased S content and uptake in this conjoint application might be due to the supply of sulphur from organic sources viz. pressmud and vermicompost. The higher uptake of sulphur in this treatment T9 might also be attributed to increased sulphur content and dry matter production of plant and fruit yield. These results are in consonance with findings of Chumyani *et al.* (2010).

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) is beneficial, for higher yield, nutrient uptake and quality of brinjal. Organic manures and biofertilizers have been observed to excel in promoting vegetable yields and restoring soil fertility in a sustainable way when applied in combination with inorganic fertilizers. This will lead to increased nutrient use efficiency and maintenance of productivity, profitability and quality of vegetable crops. More steps should be taken to spread awareness among farmers to bridge the gap in technology and actual practices for promoting INM to enhance yield, quality and uptake of brinjal.

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