Madras Agric. J., **2018**, *105 (7-9)(2)*: 437-441; doi: 10.29321/MAJ.2018.000179

Effect of Composts and Industrial By-Products on Yield and Postharvest NPK Status of Brinjal under Coastal Saline Soil

D. Venkatakrishnan[1]*, G. Sathiyanarayanan[2] and D.S. Balaji[2]
[1]Department of Soil Science and Agricultural Chemistry,
[2]Department of Genetics and Plant Breeding,
Annamalai University, Annamalainagar.

Brinjal is the most common and popular vegetable crop. The application of composts and organic amendments influence organic matter and nutrient cycling and increase soil nutrient level. Pot experiment was conducted in Department of Soil Science and Agricultural Chemistry, Annamalai University to evaluate the response of brinjal with conventional, non-conventional organic sources, industrial by-products combined with inorganic fertilizers. The treatments imposed were T_1-Control (100% RDF), T_2-T_1 + Municipal solid waste compost @ 5 t ha^{-1}, T_3-T_1 + Municipal solid waste compost @ 10 t ha^{-1}, T_4-T_1 + Vermicompost @ 2.5 t ha^{-1}, T_5-T_1 + Vermicompost @ 5 t ha^{-1}, T_6-T_1 + Rice husk ash @ 5 t ha^{-1}, T_6-T_1 + Rice husk ash @ 5 t ha^{-1}, T_7-T_1 + Rice husk ash @ 10 t ha^{-1}, T_8-T_1 + Lignite Fly ash @ 5 t ha^{-1}, T_9-T_1 + Lignite Fly ash @ 10 t ha^{-1}. There were nine treatment combinations replicated thrice in CRD. The soil was sandy in texture pH 7.83 (saline), EC 0.22 dSm^{-1}, available N (257 kg ha^{-1}), available P (10.2 kg ha^{-1}) and available K (117 kg ha^{-1}) respectively which fell in fertility status of low. The soil classified taxonomically as Typic udisamments. The results showed that application of 100% RDF + Vermicompost @ 5 t ha^{-1} (T_5) significantly recorded brinjal fruit yield of 934.2 g $plant^{-1}$ and brinjal stover yield of 403.7g $plant^{-1}$. The post harvest organic carbon content (3.5 g kg^{-1}), available N (148 mg kg^{-1}) available (7.15 mg kg^{-1}) recorded in the treatment T_5 which received 100% RDF + Vermicompost @ 5 t ha^{-1}. The post harvest available K (77.48 mg kg^{-1}) was registered with application of 100% RDF + Lignite Flyash @ 10 t ha^{-1} (T_9).

Key words: Brinjal, Municipal solid waste compost, Vermicompost, Rice husk ash, Lignite flyash.

Brinjal (*Solanum melongena* L.) can be grown in almost all parts of India except higher altitudes, all the year round. In India, brinjal cultivation is taken up in an area of 66,200 hectares with an annual production of 1,25,15,000 metric tonnes with its productivity of 18.6 t ha^{-1} (Horticultural Statistics at a Glance, 2017). Municipal Waste (MSW) is largely made up of kitchen and yard waste and its composting has been adopted by many municipalities. Composting municipal solid waste is seen as a method of diverting organic waste material from landfills which creating a product, at relatively low cost that is suitable for agricultural purposes (Shamim Banu and Kangasabai, 2012).

In aerobic composting the bacterial conversion of the organics present in municipal solid waste in the presence of air under hot and moist condition is called composting and the final product obtained after bacterial activity is called compost (humus), which has very high agricultural value it is used as fertilizer and it is non-odorous and free of pathogen (Mufeed Sharholy *et al.,* 2008). Organic manures play a vital role in improving the fertility and productivity of soils. The recycling of organic waste through vermicomposting helps to minimizing environmental pollution and increase soil fertility for sustainable agriculture (Prabhu *et al.,* 2010).

*Corresponding author's email: mahemasree@yahoo.co.in

Vermicompost contains high percentage of humus substances (humic acid, fulvic acid) that contribute to maximum chemical reaction (Mihai Lazar et al., 2014). Flyash a coal combustion residue is an amorphous Ferro aluminium silicate with a matrix very similar to soil. Addition of Flyash may improve the physico-chemical properties as well as nutritional quality of the soil and the extent of change depends on soil and fly ash properties (Vimal Chandra Pandey and Nandita Singh, 2010). Rice husk is one of the agro industrial waste by products used as fuel in rice mill industry. Rice husk ash consist silica with significant amounts of P, K, S, Fe, Ca, Mg and Na (Thind et al., 2012). The application of composts and industrial by-products influence soil organic matter and nutrient cycling and increase soil NPK levels. In order to utilize conventional organic source like vermicompost, non conventional source like municipal solid waste compost, industrial by-products like lignite flyash and rice husk ash are used to study brinjal fruit and stover yield and post-harvest NPK status under coastal saline soil.

Material and Methods

The study involved pot experiment during February to June 2016 at Department of Soil Science and Agricultural Chemistry, Annamalai University with brinjal as a test crop. Municipal solid waste compost (termed as partially segregated waste compost) was subjected to turned windrows composting process. A heap of manually reported mixed municipal solid waste of 4’ height, 8’ breadth was placed on paved ground on composting windrow type and was watered regularly to maintain moisture level between 50-60 % and turned manually every 3-5 days for first 6 weeks of composting cycle. From the seventh week, the moisture was allowed to drop when optimum biosolid decomposition was achieved. The process was completed in about 8-9 weeks without turning. Pressmud vermicompost was prepared by pit method (5 m ´ 4 m ´ 0.5 m) and spread to 30 cm height in shade and allowed to decompose. After one mouth, the temperature subsides, the cow dung slurry (1:10 dung:water) was added and thoroughly turned and mixed. At this stage earthworms were allowed into it (1000 number t-1) and optimum moisture of about 50 per cent was maintained. After eight weeks, the compost was ready and used in experiment.

Flyash

Flyash is generated by the combustion of lignite in thermal power plant. Lignite apart from clay matter consists of non-combustible inorganic matter, which during combustion produce 80 % Flyash and 20 % bottom ash which is disposed in wet and dry disposal system. The Lignite Flyash (LFA) in dry form collected from Neyveli Lignite Corporation (NLC), Neyveli, and Tamil Nadu was used to in the experiment.

Rice husk ash

Rice husk ash (RHA) also called husk char or black ash is the resultant product of burning rice husk fired furnace of conventional and modern rice mill. It was obtained from modern rice mill nearly and used in the experiment. The NPK content of municipal solid waste compost vermicompost, Fly ash and rice husk ash are presented in Table 1.

Pot experiment

Pot experiment was conducted at pot culture yard of Department of Soil Science and Agricultural Chemistry, Annamalai University, Annamalainagar using light textured soil collected from Killai village. The experiment was conducted in a Completely Randomized Design (CRD) with the following nine treatments and each treatment was replicated thrice, 20 kg of air-dried processed soil was filled in 35 cm x 30 cm cement pots. Fertilizer recommendation 100:75:75 kg N, P_2O_5 and K_2O ha^{-1} (RDF) was adopted. The required quantities of N, P and K were supplied through Urea, DAP and Muriate of potash. The composts and industrial by-products were applied basally. The brinjal seedlings of variety Annamalai were transplanted in the experimental plot. The treatments are as follows:

Treatment details of the pot experiment

T_1 – Control 100% RDF

T_2 – 100% RDF + Municipal Solid Waste Compost @ 5 t ha^{-1}

T_3 – 100% RDF + Municipal Solid Waste Compost @ 10 t ha^{-1}

T_4 – 100% RDF + Vermicompost @ 2.5 t ha^{-1}

T_5 – 100% RDF + Vermicompost @ 5 t ha^{-1}

T_6 – 100% RDF + Rice husk ash @ 5 t ha^{-1}

T_7 – 100% RDF + Rice husk Ash @ 10 t ha^{-1}

T_8 – 100% RDF + Lignite Flyash @ 5 t ha^{-1}

T_9 – 100% RDF + Lignite Flyash @ 10 t ha^{-1}

At each picking, the fruit yield plant^{-1} was weighed in an electronic balance and the sum of total yield was expressed in g plant^{-1}. The stover yield was obtained in each plant at the time of harvest and the weight was expressed in g plant^{-1}. Soil samples were collected just before the start of the pot experiment and at harvest to determine the various physico-chemical characteristics and nutrient status of soil. The collected soil samples were air dried ground in wooden mallet, passed through 2 mm sieve and stored in polythene bag. The samples were analyzed for pH, EC, organic carbon, available NPK. The post-harvest soil samples were analyzed for organic and available NPK. The chemical properties of soil were determined as follows: pH, EC (1:2:5 soil: water), organic carbon (Walkley and Black, 1934); available N by alkaline $KMnO_4$ method (Subbiah and Asija, 1956); available P by Olsen method (Olsen *et al.,* 1954); available K by flame photometer using ammonium acetate, available Ca and Mg by versenate titration using ammonium acetate extract. Statistical analysis of the experimental data was done by Agres and Agdata software for comparison of treatments in the soil amended with composts and industrial by-products.

Results and Discussion

Physico-chemical properties of experimental soil

The composite soils at 0-15 cm collected from Killai were analyzed for the various physico-chemical properties (Table 2). The textural composition of soil was sandy. The experimental soil of Killai comes under the taxonomical classification Typic Udisamments. The cation exchange capacity was 8.2 [cmol (p+) kg-1]. The soil pH was 7.83 with EC of 0.22 dS m^{-1}. The organic carbon content was 2.8 g kg^{-1}. The available nitrogen, phosphorus and potassium content of the soil were 257, 10.2 and 117 kg ha^{-1} respectively recording low status in soil fertility.

Fruit yield per plant

The data on the effect of conventional, non-conventional organic sources and industrial by-products were presented in Table 3. The highest fruit yield plant^{-1} was registered in the application of 100 % RDF + Vermicompost @ 5 t ha^{-1} (T_5) registered a fruit yield of 934.2 g plant-1 followed by treatment (T_4) 100 % RDF + vermicompost @ 2.5 t ha^{-1} registered

Table 1. Composition of composts and industrial by-products

Properties	Values
Coarse sand (%)	69.75
Fine sand (%)	21.95
Silt (%)	5.00
Clay (%)	2.5
Textural class	Sandy soil
Taxonomic classification	Typic Udisamments
Bulk density (mg m^{-3})	1.57
Particle density (mg m^{-3})	2.65
Pore space (%)	40.08
Soil colour	10 YR 5/2 – dry soil
	10 YR 2/1 wet soil
Soil pH	7.83
EC (dS m^{-1})	0.22
CEC [c mol (p^+) kg^{-1}]	8.2
Exchangeable Ca [c mol (p^+) kg^{-1}]	3.1
Exchangeable Mg [c mol (p^+) kg^{-1}]	2.3
Alkaline $KMnO_4$-N (kg ha^{-1})	257
Olsen-P (kg ha^{-1})	10.2
NH_4OAC-K (kg ha^{-1})	117

a fruit yield of 916.3 g $plant^{-1}$. The probable reason for increased fruit yield $plant^{-1}$ might be due to the optimum growing environment, better utilization of inorganic nitrogen due to presence of vermicompost municipal solid waste compost thereby enhancing synthesis of growth hormones viz., IAA, cytokinin, auxins etc. The phytohormoes stimulate fruit growth and induce changes in fruit morphology, which in turn improve the assimilation of nutrients and water, more photosynthesis and enhanced food accumulation in edible parts. Similar observation has been made by Mona Abdul Mounty *et al.* (2006).

Stover yield per plant

The data on stover yield is furnished in Table 3. The highest stover yield 417.5 g $plant^{-1}$ was recorded in plants applied with 100 % RDF + Vermicompost @ 5 t ha^{-1} (T_5) followed by 100 % RDF + Vermicompost @ 2.5 t ha^{-1} (T_4) which registered 403.7 g $plant^{-1}$. The significant increase in stover yield under these fertility levels appears to be on account of their influence on yield attributes and indirectly increase the plant growth. This may be due to the effect of both vermicompost and municipal solid waste compost application.

Post-harvest available nutrient status

Soil nitrogen

The highest soil available N was observed with application of 100 % RDF + vermicompost @ 5 t ha^{-1} (T_5) recorded 148 mg kg^{-1} and were statistically comparable with application of 100 % RDF + vermicompost @ 2.5 t ha^{-1} (T_4) recorded soil available N registered 146 mg kg^{-1} and application of 100 % RDF + Municipal Solid Waste Compost registered 145.5 mg kg^{-1} (Table 4).It might be attributed to the release of nitrogen to the soil because of congenial environment for soil organism involved in nitrogen transformation. Balaji (1994) found that application of organic increase N content in soil. The increased N availability with applied conventional, non-conventional organic sources might be due to the increased decomposition of conventional, non-conventional organic sources under favourable soil environment and due to reduced volatilization, leaching and denitrifying losses. The conventional, non-conventional organic sources treated soils act as harbour of number of microorganisms that are associated with fast decomposition and mineralization of organic materials in soil and thus the availability of N greatly increased (Clarson *et al.,* 1984).

Soil phosphorus

The application of 100 % RDF + Vermicompost @ 5 t ha^{-1} (T_5) proved most efficient in improving the P status of soil registered 7.15 mg kg^{-1} and were on par with application of 100 % RDF + Vermicompost @ 25.5 t ha^{-1} (T_4) registered of soil available P (6.73 mg kg^{-1})

Table 2. Physico-chemical properties of experimental soil

Composts and industrial by-products	Total N (%)	Total P (%)	Total K (%)
Municipal solid waste compost	0.63	0.16	0.46
Vermicompost	1.82	0.76	1.64
Lignite Fly ash	0.00029	–	0.0042
Rice husk ash	–	0.09	0.92

The vermicompost, municipal solid waste, rice husk ash contained 0.76, 0.16 and 0.09 total P respectively. During the process of decomposition of mineralization, the ‘P’ released from conventional, non-conventional organic sources and industrial by-products greatly contributed to its availability and this might expressed the superiority of municipal solid waste compost and vermicompost in increasing the phosphorus availability in soil. The production of organic acids released during the process of decomposition might have solubilized the insoluble from of P to soluble fraction (Singh Parihar et al., 2003). The experiment soil showed low available ‘P’ status of 10.2 kg ha^{-1}. The coastal soil is variable depending on the nature of parent material and physico-chemical properties of soil. In the present investigation, the profound influence of all conventional and non-conventional organic sources in increasing Olsen-P in coastal soil was well documented. The use of organic manures is beneficial for P management of coastal soils as they improve the physical condition and increase the availability of soil phosphorus (Bandyopadhyay and Rao, 2001). Manures are always much more effective than soluble inorganic P fertilizer in increasing the available P in soil (Rajkumar, 2011).

Soil potassium

The highest soil K availability of 77.48 mg kg^{-1} was recorded with (T_9) application of 100 % RDF + Lignite Flyash @ 10 t ha^{-1} which was comparable with (T_8) application of 100 % RDF + Lignite Flyash @ 5 t ha^{-1} recorded 75.58 mg kg^{-1} of soil K availability

Table 3. Effect of conventional, non-conventional organic sources and industrial by products on brinjal fruit yield plant^{-1} and stover yield plant^{-1}

Treatments	Fruit yield (g plant^{-1})	Stover yield (g plant^{-1})
T_1 – Control 100% RDF	815.3	230.0
T_2 – 100% RDF + Municipal Solid Waste Compost @ 5 t ha^{-1}	884.6	360.2
T_3 – 100% RDF + Municipal Solid Waste Compost @ 10 t ha^{-1}	908.6	385.3
T_4 – 100% RDF + Vermicompost @ 2.5 t ha^{-1}	916.3	403.7
T_5 – 100% RDF + Vermicompost @ 5 t ha^{-1}	934.2	417.5
T_6 – 100% RDF + Rice husk ash @ 5 t ha^{-1}	835.6	301.7
T_7 – 100% RDF + Rice husk Ash @ 10 t ha^{-1}	862.3	330.5
T_8 – 100% RDF + Lignite Flyash @ 5 t ha^{-1}	826.6	250.8
T_9 – 100% RDF + Lignite Flyash @ 10 t ha^{-1}	831.3	280.5
Mean	868.3	328.9
SEd	2.3	8.2
CD (P=0.05)	4.9	17.3

Generally, the coastal soils contain adequate amount of available potassium. The increase in K concentration in soil due to application of conventional, non-conventional organic sources and industrial by-products was well evidenced in the present investigation. Among treatments, application of 100 % RDF + Lignite Flyash @ 10 t ha^{-1} (T_9) recorded. The addition of lignite fly ash increased the available potassium content markedly in soil. It might be due to the higher K_2O content of flyash (8.3 %) compared to other organic sources. Application of both organic and inorganic fertilizers brought changes in soil properties and also influenced the availability of native nutrients.

Table 4. Effect of conventional, non-conventional organic sources and industrial by products on NPK contents of soil

Treatments	N	P	K
	(mg kg^{-1})		
T_1 – Control 100% RDF	131.0	5.20	60.42
T_2 – 100% RDF + Municipal Solid Waste Compost @ 5 t ha^{-1}	134.5	6.38	70.04
T_3 – 100% RDF + Municipal Solid Waste Compost @ 10 t ha^{-1}	145.5	6.50	72.98
T_4 – 100% RDF + Vermicompost @ 2.5 t ha^{-1}	146.0	6.73	73.14
T_5 – 100% RDF + Vermicompost @ 5 t ha^{-1}	148.0	7.15	74.13
T_6 – 100% RDF + Rice husk ash @ 5 t ha^{-1}	131.5	5.63	67.92
T_7 – 100% RDF + Rice husk Ash @ 10 t ha^{-1}	132.0	5.68	68.16
T_8 – 100% RDF + Lignite Flyash @ 5 t ha^{-1}	130.5	5.28	75.58
T_9 – 100% RDF + Lignite Flyash @ 10 t ha^{-1}	132.0	5.38	77.48
Mean	136.7	5.94	71.09
SEd	3.1	0.1	1.4
CD (P=0.05)	6.4	0.2	2.9

This is in line with the findings of Kumarajit Singh *et al.* (2005). The other industrial by-products *viz.,* rice husk ash, organic sources *viz.,* vermicompost, municipal solid waste compost also improved the K status of soil. The conventional and non-conventional organic sources increased the K availability could be ascribed to the variation in the amounts of total K added through organic sources their rate and amount of mineralization (Yadvinder Singh *et al.,* 2005). The increase in available potassium content with Lignite Flyash application might be due to release of potassium present in Lignite Flyash. Similar results were also made by Ramasubramoniam and Chandrasekaran (2001).

References

Balaji, S.K. 1994. Effect of vermicompost on growth and flower yield of China after (*Callistephus chinensis*). *M.Sc. Thesis,* Dharwad.

Bandyopadhyay, B.K. and Rao, D.L.N. 2001. Integrated plant nutrient management in saline soil. *Journal of Indian Society of Coastal Agriculture Research,* **19:** 35-38.

Clarson, D., Ramaswamy, P.P. and Sree Ramulu, U.S. 1984. Influence of amendments in rice in a sodic soil. *Madras Agricultural Journal,* **71(10):** 681-684.

Horticulture Statistics at a Glance. 2017. pdf-Indian Environment Portal.

Jackson, M.L. 1973. Soil chemical analysis Prentice Hall India, Pvt. Ltd., New Delhi.

Kumarajit Singh, R., Herojit, K., Singh, A., Athokpam, Zobiana, C. and Gopiman Singh, M. 2005. Integrated management of *Azolla*, vermicompost and urea on yield and nutrient uptake of rice and soil fertility. *Journal of Indian Society of Soil Science,* **53(1):** 107-110.

Mihai, L., Viorelonitre, Flaria, A.T., Dorin, E.M., and Badiu. 2014. The potential use of vermicompost on orchards. *Bulletin UAVSM Horticulture,* **7(1):** 56-58.

Mona, M.M., Asmaa, R. Mahmoud, M., Demki, E. and Fatma, Rizk, A. 2006. Yield and fruit quality of eggplant as affected by organic and mineral fertilizers application. *Research Journal of Agriculture Biological Science,* **7:** 196-202.

Mufeed, S., Kateel, A., Gauhor, M. and Trivedi, R.C. 2008. Municipal solid waste management in Indian cities – A review. *Waste Management Review,* **28:** 459-467.

Olsen, S.R., Cole, C.V., Watanable, F.S. and Dean, A.L. 1954. Estimation of available phosphorus in soil by extraction with sodium bicarbonate. USDA, 939.

Prabhu, M., Rameshkumar, A., Balasubramanian, V., Jagadeesan, R. and Ponnuswami, V. 2010. Vermicompost and vegetable production. *The Asian Journal of Horticulture,* **4(2):** 541-544.

Rajkumar, K. 2011. Study on the effect of nutrient management on yield and quality of maize. M.Sc. (Ag.) Thesis, Annamalai University, Annamalainagar.

Ramasubramoniam, S. and Chandrasekaran, A. 2001. Effect of Fly ash on physico-chemical properties of laterite soils of Kanyakumari district, Annamalai University, Annamalainagar, Tamil Nadu, India, 118-124.

Shamim Banu, S. and Kangasabai, S.K. 2012. Solid waste management in Tamil Nadu: An over view. *International Journal of Business Management Economics and Information Technology,* **4(1):** 91-95.

Singh Parihar, A.K., Singh, J., Rana, B.S. and Govind, S. 2003. Effect of nitrogen source on yield and N uptake by rice in a sodic soil. *Annals of Plant and Soil Research,* **5:** 232-233.

Subbiah, B.V. and Asija, C.L. 1956. A rapid procedure for the estimation of available nitrogen in soils. *Current Science,* **25:** 259-260.

Thind, H.S., Yadvinder, S., Bijay, S., Varinder Pal, S., Sandeep, S., Monika, V. and Gobinder, S. 2012. Land application of rice husk ash, bagasse ash and Fly ash. Effect on crop productivity and nutrient uptake in rice-wheat system on alkaline loamy sand. *Field Crops Research,* **135:** 137-144.

Vimal, C.P. and Nandita, S. 2010. Impact of Fly ash incorporation in soil system. *Agriculture Ecosystem and Environment,* **136:** 16-27.

Walkley, A. and Black, C.A. 1934. An examination of the wet acid methods for determining soil organic matter and proposed modification of the chromic acid titration method. *Soil Science,* **37:** 29-38.

Yadvinder, S., Pannu, R.P.S., Bijay, S. and Khind, C.S. 2005. Leaching of potassium from organic manures, crop residues and inorganic fertilizers in two soils under flooded and upland moisture regimes. *Journal of Indian Society of Soil Science,* **53:** 207-213.