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UTILIZATION OF COMPOSTS AND INDUSTRIAL BY-PRODUCTS FOR YIELD AND QUALITY OF MAIZE

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Abstract

Pot experiment was conducted in Department of Soil Science and Agricultural Chemistry, Annamalai University, Cuddalore district , Tamil Nadu .The soil of Varagupettai was classified as *Typic Haplusterts* having clay loam texture .The available nutrient status was low in N ,high in P and medium in K.The treatments considered of 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 + Bagasse Ash @ 5 $t\,ha^{-1}$,T_7 - 100 % RDF + Bagasse Ash @ 10 $t\,ha^{-1}$,T_8 - 100 % RDF + Lignite Flyash @ 5 $t\,ha^{-1}$,T_9 - 100 % RDF + Lignite Flyash @ 10 $t\,ha^{-1}$. All the pots were applied with recommended dose of fertilizers 135:62.5 :50 of N: P_2 O_5: K_2O $Kg\,ha^{-1}$. The highest grain yield of 416.8 $g\,pot^{-1}$ and stover yield of 545.9 $g pot^{-1}$was obtained with treatment T_5 receiving 100 % RDF + Vermicompost @ 5 $t\,ha^{-1}$ .The highest post harvest available nitrogen (153.1 $mg\,kg^{-1}$) and soil available P (22.3 $mg\,kg^{-1}$) was maximum in T_5 receiving 100 % RDF with Vermicompost @ 5 $t\,ha^{-1}$ .The post harvest available Potassium (121.7 $mg\,kg^{-1}$) recorded higher in the treatment T_3 which received 100 % RDF with Municipal solid waste compost @ 10 $t\,ha^{-1}$.

Key words: Maize, Municipal Solid Waste Compost, Vermicompost, Bagasse Ash and Lignite Fly ash.

1. Introduction

Maize (*Zea mays* L.) known as queen of cereals, also called corn is one of the most important cereal crops of the world. Maize ranks as the major grain crop worldwide. In India maize cultivation is taken up in an area of 8.69 million hectares with an annual production of 21.81 million tonnes (Agriculture statistics at a glance 2016). Composting is the controlled biological process to turning organic waste into soil conditioner. Waste minimization is a methodology used to achieve waste reduction, primarily through reduction at source, but also including recycling and reuse of material. In nature, organic matter such as wood, paper, animal waste and plant material is decomposed by bacteria.

Vermicompost maintains a steady mineral balance, improves nutrient availability for rejuvenating the soil, in addition of reduction of pathogenic organisms too. Lignite Fly ash of NLC serves as supplementary source of essential plant nutrients and is also effective in the reclamation of waste degraded land and mine spoil. Bagasse Ash is a good source of micronutrients like Fe, Mn, Zn and Cu and also high concentration of P and K.

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2. Material and Methods

The pot experiment was conducted in Department of Soil Science and Agricultural Chemistry, Annamalai University, Cuddalore district, Tamil Nadu. Soil properties are given in Table - 1.

Table - 1: Initial soil properties of pot experiment

Properties	value
Clay (%)	38.7
Silt (%)	15.7
Fine sand (%)	32.4
Coarse sand (%)	13.2
Textural classification	Clay loam
Taxonomical classification	*TypicHaplusterts*
pH	7.6
EC ($d\ Sm^{-1}$)	0.31
CEC ($cmol(p^{+})kg^{-1}$)	22.1
Organic carbon (%)	0.45 (low)
Available nitrogen ($kg\ ha^{-1}$)	235.2 (low)
Available phosphorus ($kg\ ha^{-1}$)	38 (high)
Available potassium ($kg\ ha^{-1}$)	226.4 (medium)

The experiment was laid out in a Completely Randomized design(CRD) in the year of 2017.The treatments includes 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 + Bagasse Ash @ 5 $t\ ha^{-1}$,T_7 - 100 % RDF + Bagasse Ash @ 10 $t\ ha^{-1}$,T_8 - 100 % RDF + Lignite Flyash @ 5 $t\ ha^{-1}$,T_9 - 100 % RDF + Lignite Fly ash @ 10 $t\ ha^{-1}$. All pots received recommended dose of inorganic fertilizers. The grain harvested from each pot experiment was weighed and expressed at$g\ pot^{-1}$. The post harvest soil samples were collected from each pot experiment and sieved through 2 mm sieve were used for analysis by following the standard procedures. The composition of Municipal Solid Waste Compost, Vermicompost, Bagasse Ash and Lignite Fly ash are furnished in Table - 2.

Table - 2: NPK content of materials

Materials	N	P	K
Municipal Solid Waste Compost (%)	1.13	2.92	0.53
Vermicompost (%)	1.59	3.43	0.027
Bagasse Ash (%)	0.014	0.0052	0.024
Lignite Fly ash (%)	0.008	0.39	0.48

3. Results and Discussion

Grain yield varied from 257.3 to 416.8 $g\ pot^{-1}$ (Table - 3). Among the treatments, The highest grain yield of 416.8 $g\ pot^{-1}$ was obtained with treatment T_5 receiving 100 % RDF + Vermicompost @ 5 $t\ ha^{-1}$. The highest yield in maize plants exposed to particular concentration of vermicompost may be due to the influence of combined effect of various ingredients of vermicompost such as macro (NPK) nutrients ,plant growth hormones (indole acetic acid, indole butyric acid, naphthalene acetic acid and gibberellic acid), vitamins (vitamin A ,B_1 ,B_2 ,B_3, C and E). Similar results were observed by Prabha 2006 and Ramasamy 2009.The analysis of physico –chemical parameters showed that though nutritional availability is rich in vermicompost, the plant utilizable quantity differed from one concentration of vermicompost to the other .The higher availability of nutrients especially nitrogen and phosphorus in Vermicompost and improved soil physical, chemical and biological properties might have contributed to higher yield (More 1994).The possible for increasing grain yield might be due to increase in ear length,100 grain weight with the same treatment (T_5) including the effect of humic acid on soil physico-chemical properties of soil and providing a medium for absorption of plant nutrients and improved conditions for soil microorganisms. Similar results were observed by Karki*et al.* (2005). Among the industrial by-products the application of 100 % RDF + Flyash @ 10t ha^{-1} (T_9) registered 270 g pot^{-1}.This is due to the supply of nutrients ,conducive physical environment leading to better aeration ,increase in soil moisture holding capacity ,root activity and nutrient absorption and the consequent complementary effect in flyash have resulted in higher grain yield (Matte and Kene 1995).

The highest stover yield of 545.9 gpot^{-1} was recorded in application of vermicompost @ 5 t ha^{-1} (T_5). The significant increase in stover yield under these fertility levels appears to be on account of their influence on yield attributes and indirectly in a increase in plant growth. This may be due to the effect of both vermicompost and Municipal Solid Waste Compost application. (Ashish Shivran *et al.* 2015). The potassium plays a major role in growth as it is involved in assimilation transport and storage tissue development. Similar results were observed by Bhanu Prakash *et al.* (2007) .Among the industrial by-products.the highest stover yield for Flyash (348.3g pot^{-1}) was recorded in the treatment (T_9) receiving 100 % RDF + Flyash @ 10 t ha^{-1} could be beneficial in improving the soil quality and there by leaching to better availability to nutrients (Chandrakar *et al.* 2015).

Table - 3: Effect of conventional, non-conventional organic sources and industrial by-products on grain yield and stover yield

Treatments	Grain yield	Stover yield
	(gpot^{-1})	
T_1 - Control 100 % RDF	257.3	329.3
T_2 - 100 % RDF + Municipal Solid Waste Compost @ 5 t ha^{-1}	386.9	499.1
T_3 - 100 % RDF + Municipal Solid Waste Compost @ 10t ha^{-1}	393.8	512.0
T_4 - 100 % RDF + Vermicompost @ 2.5 t ha^{-1}	408.1	534.6
T_5 - 100 % RDF + Vermicompost @ 5 t ha^{-1}	416.8	545.9
T_6 - 100 % RDF + Bagasse Ash @ 5 t ha^{-1}	261.0	334.1
T_7 - 100 % RDF + Bagasse Ash @ 10 t ha^{-1}	262.8	336.4
T_8 - 100 % RDF + Lignite Flyash @ 5 t ha^{-1}	265.5	342.4
T_9 - 100 % RDF + Lignite Flyash @ 10 t ha^{-1}	270.0	348.3
Mean	324.7	420.2
S.Ed	16.11	20.89
CD (p = 0.05)	33.86	43.89

Table - 4: Influence of composts and industrial by products on post harvest available Nitrogen, Phosphorus and Potassium

Treatments	Post harvest available N ($mg\ kg^{-1}$)	Post harvest available P ($mg\ kg^{-1}$)	Post harvest available K ($mg\ kg^{-1}$)
T_1	111.1	17.5	112.5
T_2	139.1	19.7	121.5
T_3	148.1	20.9	121.7
T_4	152.9	22.1	120.1
T_5	153.1	22.3	120.5
T_6	111.6	17.6	112.4
T_7	111.7	17.7	112.6
T_8	111.2	17.8	112.8
T_9	111.3	17.9	112.9
Mean	127.7	19.2	116.4
S.Ed	3.15	0.47	2.84
CD (p = 0.05)	6.63	1.00	5.98

The data on post- harvest soil, NPK presented in Table 4.The soil available N (153.1 $mg\ kg^{-1}$) and soil available P (22.3 $mg\ kg^{-1}$) status was higher due to application of 100 % RDF with Vermicompost @ 5 $t\ ha^{-1}$ (T_5).The post harvest available K (121.7 $mg\ kg^{-1}$) recorded higher in the treatment T_3 which received 100 % RDF with Municipal solid waste compost @ 10 $t\ ha^{-1}$. Among the different treatments soil application of 100 % RDF+ Vermicompost @ 5 $t\ ha^{-1}$ (T_5) recorded higher nitrogen (153.1 $mg\ kg^{-1}$) in soil compared to municipal solid waste compost treated soil. This is may be due to mineralization of added Vermicompost which helped in increasing the available nitrogen status of soil. The increased organic matter due to organics acts as a source of carbon for growth and multiplication of nitrogen fixing microbes in soil. The higher availability of nitrogen in municipal solid waste compost treatment could be attributed to its rapid rate of mineralization. These findings are in accordance with the findings of Yolou *et al.* (2015). The application of 100 % RDF + Vermicompost @ 5$t\ ha^{-1}$ recorded highest value of 22.3 $mg\ kg^{-1}$ .The organic acids released from Vermicompost solubilize fixed form of Fe and Al complexes through organic anions and hydroxy acids liberated during organic matter decay .The organic acids released from Vermicompost and additional supply of P through organics along with inorganic phosphorus lead to increased phosphorus content in soil (Bindiya *et al.* 2012). The application of 100 % RDF + Municipal Solid Waste Compost @ 10 $t\ ha^{-1}$ (T_3) recorded value of 20.9 $mg\ kg^{-1}$ .The greater available P in municipal solid waste compost treatment could be attributed to its higher content as evident from its composition. The application of municipal solid waste compost to soil increased the available P of post harvest soil (Ranjbar *et al.*, 2016). The application of 100 % RDF + Municipal solid waste compost @10 $t\ ha^{-1}$(T_3) registered highest value of 121.7 $mg\ kg^{-1}$. The higher potassium in soil involving municipal solid waste compost and inorganic sources was might be due to addition of increase amount of K through these sources .The increased potassium content in soil when soil was treated with municipal solid waste compost. Similar results were observed by Eida *et al.* (2008).

Among industrial by-products the application of 100 % RDF + Flyash @ 10 $\mathrm{t\,ha^{-1}}$ (T_9) recorded highest value of 112.9 $\mathrm{mg\,kg^{-1}}$ .This is due to a marginal increase in the concentration of potassium in Flyash amended soil was observed by Ashish Tejasvi and Sudhir Kumar (2012).

4. Conclusion

The present study revealed that application of 100 % RDF with Vermicompost @ 5 $\mathrm{t\,ha^{-1}}$ (T_5) is the best .The post harvest available K were maximum in the treatment MSWC @ 10 $\mathrm{t\,ha^{-1}}$ along with 100 % RDF.

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