RESPONSE 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 of Cuddalore district , Tamil Nadu .The soil 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_2O_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 nitrogen uptake in grain (6.09 $g\,pot^{-1}$) and stover (2.268 $g\,pot^{-1}$) , phosphorus uptake of grain (1.060 $g\,pot^{-1}$) and stover (0.615 $g\,pot^{-1}$) , potassium uptake of grain (1.157 $g\,pot^{-1}$) and stover (3.976 $g\,pot^{-1}$) registered due to the application of 100 % RDF + Vermicompost @ 5 $t\,ha^{-1}$ (T_5).

Key words: Maize , Municipal Solid Waste Compost , Vermicompost , Bagasse Ash , Lignite Flyash.

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 world wide. 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 (Shamim Banu and Kanagasabai 2012). Vermicompost maintains a steady mineral balance ,improves nutrient availability for rejuvenating the soil ,in addition of reduction of pathogenic organisms too (Geeta Utekar and Hanamantrao Deshmukh

2016). Lignite Flyash of NLC serves as supplementary source of essential plant nutrients and is also effective in the reclamation of waste degraded land and mine spoil (Saranraj 2015). Bagasse Ash is a good source of micronutrients like Fe, Mn ,Zn and Cu and also high concentration of P and K. (Dotaniya *et al.*2016)

MATERIAL AND METHODS

The pot experiment was conducted in Department of Soil Science and Agricultural Chemistry, Annamalai University, Annamalai Nagar, Cuddalore district , Tamil Nadu. Initial soil was collected from Varagupettai Village of Chidambaram taluk of Cuddalore district ,Tamil Nadu and was sieved through 2mm sieve .Soil was filled in the pot size ( )

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	*Typic Haplusterts*
pH	7.6
EC (dSm^{-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 Flyash @ 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 proedures. The composition of Municipal Solid Waste Compost , Vermicompost, Bagasse Ash and Lignite Flyash 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 Flyash (%)	0.008	0.39	0.48

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 (N,P,K) 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 phosphate 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 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 @ 10 t 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 g pot^{-1} (Table 3) 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 (348.3 g pot^{-1}) (Table 3) was recorded in the treatment (T_9) receiving 100 % RDF and 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.

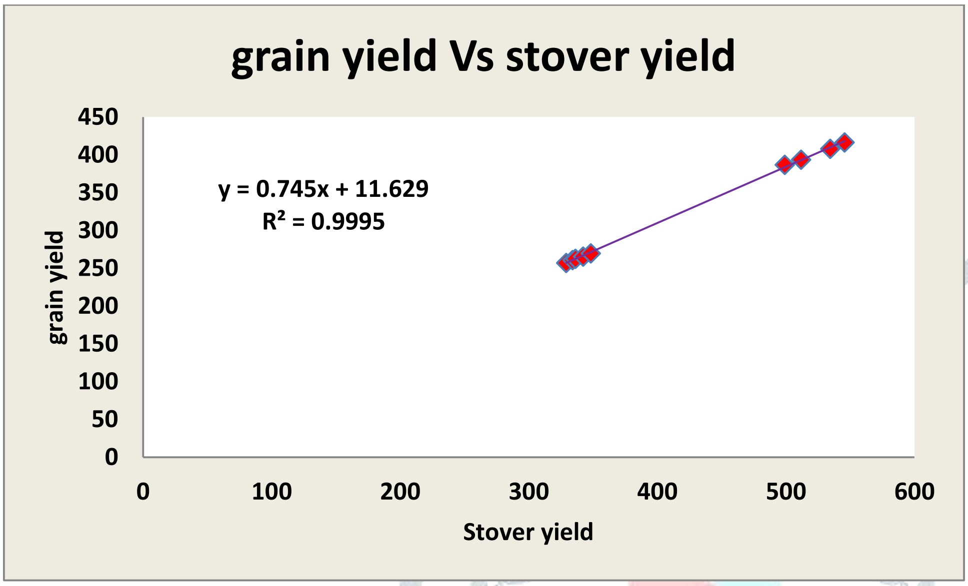

Fig .1.Linear relationship of grain yield with stover yield

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

Treatments	Grain yield ($g\ pot^{-1}$)	Stover yield ($g\ pot^{-1}$)
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 @ 10 t 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.Effect of conventional ,non-conventional organic sources and industrial by-products on NPK uptake in maize grain.

Treatments	Nitrogen	Phosphorus	Potassium
	(g pot^{-1})		
T_1 - Control 100 % RDF	3.60	0.524	0.644
T_2- 100 % RDF + Municipal Solid Waste Compost @ 5 t ha^{-1}	5.62	0.945	1.107
T_3-100 % RDF + Municipal Solid Waste Compost @ 10 t ha^{-1}	5.72	0.965	1.130
T_4 -100 % RDF + Vermicompost @ 2.5 t ha^{-1}	5.96	1.035	1.129
T_5 - 100 % RDF + Vermicompost @ 5 t ha^{-1}	6.09	1.060	1.157
T_6 - 100 % RDF + Bagasse Ash @ 5 t ha^{-1}	3.66	0.587	0.675
T_7 - 100 % RDF + Bagasse Ash @ 10 t ha^{-1}	3.68	0.594	0.682
T_8 - 100 % RDF + Lignite Flyash @ 5 t ha^{-1}	3.79	0.578	0.700
T_9 -100 % RDF + Lignite Flyash @ 10 t ha^{-1}	3.85	0.587	0.714
Mean	4.66	0.76	0.88
S.Ed.	0.350	0.071	0.07
CD (p = 0.05)	0.735	0.150	0.16

Table 5.Effect of conventional ,non-conventional organic sources and industrial by-products on NPK uptake in maize stover.

Treatments	Nitrogen	Phosphorus	Potassium
	(g pot^{-1})		
T_1 - Control 100 % RDF	1.287	0.326	2.289
T_2-100 % RDF +Municipal Solid Waste Compost @ 5 t ha^{-1}	2.065	0.554	3.637
T_3-100 % RDF +Municipal Solid Waste Compost@ 10 t ha^{-1}	2.121	0.571	3.734
T_4 100 % RDF + Vermicompost @ 2.5 t ha^{-1}	2.218	0.599	3.891
T_5 -100 % RDF + Vermicompost @ 5 t ha^{-1}	2.268	0.615	3.976
T_6 -100 % RDF + Bagasse Ash @ 5 t ha^{-1}	1.314	0.339	2.360
T_7 -100 % RDF + Bagasse Ash @ 10 t ha^{-1}	1.326	0.343	2.381
T_8 -100 % RDF + Lignite Flyash @ 5 t ha^{-1}	1.376	0.358	2.487

T_9 -100 % RDF + Lignite Flyash @ 10 t ha^{-1}	1.402	0.366	2.533
Mean	1.708	0.452	3.032
S.Ed.	0.128	0.034	0.226
CD (p= 0.05)	0.270	0.072	0.476

The highest nitrogen uptake in grain (6.09 g pot^{-1}) (Table 4) and stover (2.268 g pot^{-1}) (Table 5)was increased due to the application of 100 % RDF and Vermicompost @ 5 t ha^{-1}(T_5) .The integrated treatment recorded higher N uptake than other treatments due to the higher availability of nitrogen from organism at later stages of crop growth and biomass production leading to greater uptake of N. Similar results were noticed by Sadip Hussain *et al.* 2016.

The highest phosphorus uptake of grain (1.060 g pot^{-1}) (Table 4) and stover (0.615 g pot^{-1}) (Table 5) recorded due to application of 100 % RDF and Vermicompost @ 5 t ha^{-1} (T_5).The higher uptake by maize in treatment receiving organics was due to increased availability of P from insoluble P sources due to release of organics acids as well as humic compounds and CO_2,consequent upon the decomposition of organic matter which resulted in more dissolution of organic and insoluble P sources and release of available P into soil solution .The increase in available P led to greater uptake by maize .Vermicompost application increased N and P uptake by the system because applied Vermicompost increased N and P content in grain and stover by providing a balanced nutritional environment inside the plant and higher photosynthetic efficiency which favoured better crop yield .The increased grain and stover yield with higher N and P content together resulted in greater uptake of nutrients (Parastoo Shadab Niazi *et al.* 2017).

The highest potassium uptake of grain (1.157 g pot^{-1}) (Table 4) and stover (3.976 g pot^{-1}) (Table 5) registered due to the application of 100 % RDF and Vermicompost @ 5 t ha^{-1} (T_5).The application of Vermicompost increased K uptake in maize is due to the balanced supply of nutrients to plants at all stages of crop. This is in agreement with the findings of (Eghball *et al.* 1994).

The application of 100 % RDF and Flyash @ 10 t ha^{-1} (T_9) registered potassium grain uptake (0.714 g pot^{-1}) and stover uptake (2.533 g pot^{-1}).The probable root growth ,supply of nutrient and conducive physical environment on account of addition of Flyash would have facilitated better absorption of N,P and K (Lanjewar 1989) .Uptake of N ,P and K by wheat was also increased with increasing Flyash amendment upto 20 % W/W proportion .The present finding was corroborated with Nilesh Mahale *et al.* (2012).

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