International Journal of Environment and Climate Change

Volume 12, Issue 12, Page 1176-1184, 2022; Article no.IJECC.92886
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Nutrients Release in Soils Amended with Different Organic Sources and Industrial by–products: A Laboratory Incubation Study

V. Arulkumar [a++*], S. R. Shri Rangasami [b#], R. Murugaragavan [a†] and D. Venkatakrishnan [c‡]

[a] *Department of Soils and Environment, Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai-625104, India.*
[b] *Rice Research Station, Tamil Nadu Agricultural University, Ambasamudram-627401, India.*
[c] *Department of Soil Science and Agricultural Chemistry, Faculty of Agriculture, Annamalai University, Annamalai Nagar– 608002, India.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2022/v12i121556

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/92886

Original Research Article

Received: 17/10/2022
Accepted: 27/12/2022
Published: 29/12/2022

ABSTRACT

The incubation experiment was carried out to evaluate the best organic sources Such as farm yard manure (FYM), municipal solid waste compost and industrial by – products such as bagasse ash, rice husk and inorganic fertilizers on nutrient release pattern in sandy loam soils of Cuddalore

[++] *Research Scholar (Soil Science);*
[#] *Assistant Professor (Agronomy);*
[†] *Teaching Assistant (Environmental Sciences);*
[‡] *Assistant Professor (SS&AC);*
**Corresponding author: E-mail: arulkumar46@gmail.com;*

District, Tamil Nadu, India. The outcomes showed that pH of the soil was reduced by incubation with organic sources. The application of 100% recommended dose of fertilizer (RDF) + FYM@ 25t ha^{-1}(T_5) outperformed other treatments among organic sources by recording the lowest pH of 7.0 at 90 Days (DAI). The EC of the soil was reduced by the FYM application. Similarly the nitrogen, phosphorus and potassium content of the incubation mixture were significantly increased over the control.

Keywords: Municipal solid waste; farmyard manure; bagasse ash; rice husk ash.

1. INTRODUCTION

Organic sources are traditionally important inputs for maintaining soil fertility and ensuring yield stability. These organic sources supply macronutrients and improve the physical and chemical properties of soil.

2. REVIEW OF LITERATURE

The application of composts and organic amendments influence soil organic matter and nutrients cycling and increase soil nutrients levels.

“Rapid industrialization and population explosion in India has led to the migration of people from village to cities which generate huge quantity municipal solid waste (MSW) daily. The MSW amount is expected to increase significance in the near future as the country strives to attain an industrialized nature status by the year 2020” [1]. “Municipal solid waste (MSW) is largely made up of kitchen and yard waste and their composting has been adopted by many municipalities. Composting of MSW is seen as a method of diverting organic waste materials from landfills while creating a product, at relatively low cost that is suitable for agriculture purpose” [2]. “This trend may be attributed to economic and environment factors such as municipal landfill capacity costs associated with land filling and transportation of materials, adoption of legislation to protect the environment, decrease the use of commercial inorganic fertilizers, increasing the capacity for house hold waste recycling and improved quality of composted products” [3]. “In aerobic composting the bacterial conversion of the organic present in MSW 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 organic manure and it is non-odorous and free of pathogens” [4].

“Integrated nutrient management through FYM, vermicompost, sheep manure by replacing 50 kg N ha^{-1} out of the 200 kg recommended dose ha^{-1} to maize produced similar yield attributes viz., cob length, cob girth, no. of kernel rows cob^{-1}, no. of kernels row^{-1}, no.of kernels cob^{-1}, test weight (g), grain yield (kg ha^{-1}) and stover yield (kg ha^{-1}) as compared to the application of entire nitrogen through inorganic fertilizer. Hence it is evident that 25% of inorganic nitrogen can be substituted by organic manures viz., vermicompost, FYM, sheep manure to obtain on par yield in maize crop” [5].

“Organic matter plays an important role in the improvement of soil physical properties such as the promotion of soil aggregation, improved permeability and moisture holding capacity. The recent energy crisis and hike in prices of the inorganic fertilizer, necessitate the use of organic manures and industrial by – products in crop production. Bagasse ash is a type of organic wastes which obtained from sugar industry during the process of sugar production. Basically we use Bagasse also in agriculture as organic fertilizer for crop improvement is now-a-days becoming an established practice. Researches considers bagasse ash as a good source of micro nutrients like, Fe, Mn, Zn and Cu” [6]. “It can also be used as soil additive in agriculture farming having its capacity to supply the plants with small amounts of nutrients” [7].

“Paddy husk ash is a highly available amendment in large quantities. It has reasonable quantities of Ca, Mg, K, Na, and other essential elements including P and very little N. The ash increases the soil pH, thereby increasing available phosphorus, it improves the aeration in the crop root zone and also increases the water holding capacity and level of exchangeable potassium and magnesium” [8]. An incubation experiment was conducted with an objectives of studying the nutrients release pattern from different organic sources, industrial by – products and inorganic fertilizer in sandy loam soils and in addition there is a need for utilizing manures or wastes for supplementing the chemical fertilizer. Keeping the above aspects, incubation experiment were carried out in sandy loam soils of Cuddalore district.

3. MATERIALS AND METHODS

In view of the above, an incubation study was carried out in the Department of Soil Science and Agricultural Chemistry. The experiment was laid out by adopting CRD with three replications. Soils were collected from Vallampadugai of Cuddalore district of Tamil Nadu, and incubated with FYM, Municipal solid waste compost, Rice husk ash and Bagasse ash. The experiment comprised of a treatment combinations involving Municipal solid waste compost, FYM, Rice husk ash and Bagasse ash replicated thrice in *Typic ustifluvent* soil. The soil was sandy loam in texture with low available nitrogen, medium in available phosphorus and potassium status.

Incubation experiment: An incubation experiment was conductedat Dept. of Soil Science and Agricultural Chemistry, Annamalai University, Chidambaram with an objectives of studying the nutrients release pattern from organic sources, industrial by – products and inorganic fertilizer. 200g of 2mm sieved soil samples was filled in 250 ml (depth 9cm diameter 21 cm) plastic containers. The treatment details are given below. Each treatment was replication thrice. The soil was incubated at room temperature for 90 days at field capacity. The design followed was Completely Randomized Design (CRD).

Treatment details of the incubation 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 + Farm Yard Manure @12.5 t ha^{-1}
T_5 - 100 % RDF + Farm Yard Manure @ 25 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 + Bagasse Ash @ 5 t ha^{-1}
T_9 - 100 % RDF + Bagasse Ash @ 10 t ha^{-1}

The soil samples were drawn an 30, 60 and 90th days after incubation and analyzed for pH, EC, organic carbon and available NPK content (Table 1).

4. RESULTS

Soil reaction: The application of conventional, non- conventional organic sources recorded lowest pH value at all three stages of incubation period (Table 2). Among organic sources, application of 100 % RDF + FYM @ 5 t ha^{-1} (T_5) recorded the lowest pH of soil at all three stages of incubation period. The pH values observed with this treatment were 7.0 at 30 DAI, 6.9 at 60 DAI and at 90 DAI. This was followed by the application of FYM @ 25 t ha^{-1} (T_4) recorded pH of 6.9 at 30 DAI. The treatment (T_5) was on par with T_4 100% RDF + FYM@ 12.5t ha^{-1}recorded pH of 7.0 at 60 and 90 DAI. The highest pH at all stages with 100% RDF + Bagasse ash @ 10 t ha^{-1} (T_9) registered 8.6, 8.72, and 8.84, at 30, 60 and 90DAI respectively. “The decrease in pH of the soil amended with FYM might be due to the release of organic acids from the manure” [11].

Electrical conductivity (EC): The application of conventional organic sources significantly contributed for the reduction of EC in soil (Table 3). The electrical conductivity (EC) of the soil significantly reduced to the tune of 1.30 dS m^{-1} at 90 DAI with application of 100% RDF + FYM @ 25 t ha^{-1}(T_5) compared with control (T_1) of 1.35 dSm^{-1}. The lowest EC was found with the addition of 100% RDF + FYM @ 25 t ha^{-1} (T_5) recorded 1.41, 1.35, 1.30 dSm^{-1} at 30, 60 and 90 DAI respectively. This treatment however maintained on par with 100% RDF + FYM @ 12.5 t ha^{-1} (T_4) registered 1.25, 1.30, and 1.31 dSm^{-1} at 30, 60, and 90 DAI respectively. This was followed T_3 100% RDF + Municipal solid waste compost @ 10 t ha^{-1} registered 1.29, 1.30 and 1.31 dSm^{-1} at 30, 60 and 90 DAI respectively. The highest EC at all stages of incubation experiment was recorded with 100% RDF + Bagasse ash @ 10 t ha treatment (T_9) recorded 1.55 dSm^{-1} at 30 DAI and 1.66 dSm^{-1} at 60 DAI and 1.64 dSm^{-1} at 90 DAI. “Moreover the FYM used in this study contained relatively more organic N and P, which produced amino acid and phosphoric acids upon decomposition and hence result in lowering both soil pH and EC” [12].

Soil Organic Carbon: All the treatments significantly contributed for increasing the organic carbon content of the soil, an essential factor for soil fertility and productivity improved (Table 4).

Though all the treatments were efficient in increasing the organic carbon status, the influence of FYM was found superior followed by municipal solid waste compost. Application of 100% RDF + FYM @ 25 t ha^{-1} (T_5) recorded significantly highest organic carbon of 2.31, 2.32 and 2.32 g kg^{-1} at 30, 60 and 90 DAI respectively. This was on par with treatment (T_4) registered 2.27, 2.31, 2.31g kg^{-1} at 30, 60 and 90 DAI respectively. This was followed by the treatment T_3 and T_2 throughout the incubation period. Treatment T_6 (100% RDF + RHA @ 5 t ha^{-1}) recorded lowest organic carbon content of 2.06 g kg^{-1} at 30, 60 and 90 DAI. The organic carbon content was increased by the addition of organic manures in the soil [13].

Table 1. Methods of analysis of organic manures and industrial by- products

S. No.	Parameters	Method	Reference
A. Municipal solid waste compost, farm yard manures			
1	Total nitrogen	Micro – Kjeldahl method (Diacid extraction H_2SO_4:$HClO_4$ in 9:4 ratio)	Humphries [9]
2	Total phosphorus	Vanado molybdate yellow method (Triple acid extraction, HNO_3,H_2SO_4 in 9:2:1 ratio)	Jackson [10]
3	Total potassium	Flame photometry (Triple – acid extract)	Jackson [10]
B. Bagasse ash and Rise-husk ash			
4	pH	Potentiometry (1:10 soil : water suspension)	Jackson [10]
5	Electrical conductivity	Conductometry (1:10 soil : water suspension)	Jackson [10]

Table 2. Effect of organic sources and industrial by- products on soil pH in incubation experiment

Treatments	Soil reaction (pH)		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% NPK	7.2	7.1	7.1
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	7.5	7.5	7.5
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	7.5	7.5	7.4
T_4 – 100% RDF + Farm yard manure @ 12.5 t ha-^{1}	7.1	7.0	7.0
T_5 – 100% RDF + Farm yard manure @ 25 t ha-^{1}	7.0	6.9	6.9
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha-^{1}	7.7	7.8	7.9
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha-^{1}	7.8	7.9	7.9
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	8.3	8.6	8.7
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	8.5	8.7	8.8
Mean	7.68	7.73	7.75
S.Ed	0.50	0.50	0.09
CD (p=0.05)	1.05	1.06	0.20

Table 3. Effect of conventional, non – conventional organic sources and industrial by – products on soil electrical conductivity (EC) in incubation experiment

Treatments	Electrical conductivity (dSm^{-1})		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% NPK	1.35	1.31	1.31
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	1.30	1.31	1.31
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	1.29	1.30	1.31
T_4 – 100% RDF + Farm yard manure @ 12.5 t ha-^{1}	1.25	1.30	1.31
T_5 – 100% RDF + Farm yard manure @ 25 t ha-^{1}	1.41	1.35	1.30
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha-^{1}	1.39	1.45	1.41
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha-^{1}	1.40	1.40	1.45
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	1.55	1.56	1.60
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	1.55	1.66	1.64
Mean	1.39	1.41	1.41
S.Ed	0.09	0.09	0.09
CD (p=0.05)	0.19	0.19	0.19

Nitrogen: The influence of various organic sources, and industrial by – products in increasing the fertility of soil by the way of increased availability of nitrogen at all the stages of incubation study was well evidenced in the present investigation (Table 5).

The nitrogen content of soil failed to differ significantly among the treatments. The highest nitrogen content in the soil was recorded with T_5 (100% RDF + FYM @ 25 t ha^{-1}) recorded maximum N content of 87.0, 88.3, and 89.1 mg kg^{-1} at 30, 60 and 90 DAI respectively. The control (T_1) maintained the lowest soil N content of 83.9, 85.0, and 85.9 mg kg^{-1} at 30, 60 and 90 DAI respectively. "The increased N availability with applied conventional and non – conventional organic sources might be due to the increased decomposition of conventional and non – conventional organic sources under favourable soil enrichment and due to reduced volatilization, leaching and denitrifying losses. It might be due to the decomposition of organic matter leads to mineralization of organically found nitrogen" [14].

Phosphorus: The positive influence of organic sources and industrial by – products did not significantly influence on soil available P was observed in the present incubation experiment (Table 6). The highest available P in soil was recorded with $T_{5,}$ (100% RDF + FYM@ 25 t ha^{-1}) recorded was 11.5 mg kg^{-1} at 30 DAI, 11.7 mg kg^{-1} at 60 DAI and 11.8 mg ka^{-1} at 90 DAI with this treatment(T_5). The treatment (T_1) control recorded the lowest P content of 10.7, 10.8 and 11.0 mg kg^{-1} at 30, 60 and 90 DAI respectively. The application of FYM enhanced phosphorus availability, [15] reported that organics were superior in improving available P.

Table 4. Effect of organic sources and industrial by – products on soil organic carbon in incubation experiment

Treatment	Soil Organic Carbon (g kg^{-1})		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% RDF	2.1	2.17	2.21
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	2.26	2.30	2.31
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	2.31	2.32	2.32
T_4 – 100% RDF + Farm yard manure @ 12.5 t ha^{-1}	2.27	2.31	2.31
T_5 – 100% RDF + Farm yard manure @ 25 t ha^{-1}	2.31	2.32	2.32
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha^{-1}	2.06	2.06	2.06
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha^{-1}	2.06	2.07	2.07
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	2.16	2.07	2.07
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	2.16	2.07	2.07
Mean	1.39	1.39	2.19
S.Ed	0.09	0.09	0.14
CD (p=0.05)	0.20	0.20	0.31

Table 5. Effect of organic sources and industrial by – products on Nitrogen in incubation experiment

Treatment	Soil N (mg kg^{-1})		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% RDF	83.9	85.0	85.9
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	85.06	86.0	87.0
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	85.3	86.3	87.3
T_4 – 100% RDF + Farm yard manure @ 12.5 t ha^{-1}	86.1	88.1	89.0
T_5 – 100% RDF + Farm yard manure @ 25 t ha^{-1}	87.0	88.3	89.1
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha^{-1}	84.7	85.0	85.7
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha^{-1}	85.0	85.3	86.1
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	83.7	85.1	86.0
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	84.0	85.2	86.1
Mean	85.03	86.09	86.97
S.Ed	5.56	5.63	5.66
CD (p=0.05)	NS	NS	NS

Table 6. Effect of organic sources and industrial by – products on Phosphorus in incubation experiment

Treatment	Soil P (mg kg^{-1})		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% RDF	10.7	10.8	11.0
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	10.8	11.1	11.1
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	11.0	11.1	11.2
T_4 – 100% RDF + Farm yard manure (FYM) @ 12.5 t ha^{-1}	11.3	11.5	11.7
T_5 – 100% RDF + Farm yard manure (FYM) @ 25 t ha^{-1}	11.5	11.7	11.8
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha^{-1}	10.8	10.8	11.0
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha^{-1}	10.8	10.8	11.0
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	10.8	10.8	10.9
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	10.8	10.9	10.9
Mean	11.00	11.11	11.18
S.Ed	0.71	0.72	0.73
CD (p=0.05)	NS	NS	NS

Table 7. Effect organic sources and industrial by – products on Potassium in incubation experiment

Treatment	Soil K (mg kg^{-1})		
	30 DAI	**60 DAI**	**90 DAI**
T_1 – control – 100% RDF	94.0	94.1	95.0
T_2 – 100% RDF + Municipal solid waste compost @ 5 t ha^{-1}	91.8	94.3	95.3
T_3 – 100% RDF + Municipal solid waste compost @ 10 t ha^{-1}	94.2	94.7	95.0
T_4 – 100% RDF + Farm yard manure (FYM) @ 12.5 t ha^{-1}	94.4	94.8	95.9
T_5 – 100% RDF + Farm yard manure (FYM) @ 25 t ha^{-1}	94.5	95.0	96.1
T_6 – 100% RDF + Rice Husk Ash @ 5 t ha^{-1}	118.0	120.0	121.1
T_7 – 100% RDF + Rice Husk Ash @ 10 t ha^{-1}	118.3	120.1	121.9
T_8 – 100% RDF + Bagasse Ash @ 5 t ha^{-1}	120.0	121.3	122.9
T_9 – 100% RDF + Bagasse Ash @ 10 t ha^{-1}	120.3	121.9	123.3
Mean	105.11	106.29	107.80
S.Ed	5.88	6.99	7.21
CD (p=0.05)	12.35	14.0	15.16

Potassium: Application of organic sources, industrial by – products significantly increased the available K content of the soil (Table 7). The highest amount of available K was noticed with the application of 100% RDF + Bagasse ash @ 10 t ha^{-1} (T_9). It registered 120.3, 121.9 and 123.3 mg kg^{-1} of K at 30, 60 and 90 DAI respectively. This was followed by the application of 100% RDF + Bagasse ash @ 5 t ha^{-1} (T_9) which recorded 120.0, 121.3 and 74.53 mg kg^{-1} of K at 30, 60 and 90 DAI respectively. The control (T_1) recorded the lowest K content of 94.0, 94.1, and 95.0 mg kg^{-1}at 30, 60 and 90 DAI respectively. The increase in available potassium content in bagasse ash application might be due to the release of potassium present in bagasse ash. Similar results were also made by Nkana et al. [16].

5. DISCUSSION

pH and EC: It is evident that greater crop nutrition depends on the chemical qualities of the soil being improved. The chemical characteristics of soil were greatly improved by the use of all organic sources and industrial waste products in the incubation experiment. In the incubation experiment, the traditional organic sources significantly decreased the electrical conductivity and soil reaction (pH) of the alluvial soil. The initial soil pH of 7.6 and EC of 1.3 dSm^{-1}. Due to the application of 100% RDF + FYM@ 25t ha^{-1} (T_5), a reduction in soil pH value of 6.9 at 90 DAI was noticed. The EC value observed with the treatment (T_5) recorded lowest EC value of dSm^{-1}1.30 at 90 DAI. “The favourable reduction in pH and EC could be attributed to the prolonged decomposition of added organic sources. Decline in soil pH can have positive impacts on availability of nutrients such as phosphorus, zinc, iron and manganese". [17], "the reduction in soil pH was mainly due to release of organic acids in the soil upon decomposition of organics. The decrease in pH of the soil amended with FYM might be due to the release of organic acids from the manure" [11].

"The decrease in soil EC with the application of FYM is unusual as FYM contains nutrients which normally increase the soil EC. A possible reason for this phenomenon could be that active absorption of nutrients by plants has occurred during the growing period, leaving behind few nutrients in the soil as EC was measured after crop harvest. Moreover the FYM used in this study contained relatively more organic N and P, which produced amino acid and phosphoric acids upon decomposition and hence result in lowering both soil pH and EC" [12].

Soil Organic Carbon: The organic carbon content of the experimental soil was 2.5g kg^{-1} and rated low. The organic carbon content of the incubation soil was greatly influenced by the added organic sources. The increase in organic carbon content of soil was in the range of 2.26 to 2.32g kg^{-1} in the incubation experiment with organic sources. Among treatments 100% RDF + FYM @ 25t ha^{-1}(T_5) excelled all the treatments by recording 2.31, 2.32 and 2.32g kg^{-1}at 30, 60, 90 DAI respectively. The increase in soil organic carbon among organic sources was due to addition of carbon sources through FYM [18], The organic carbon content was increased by the addition of organic manures in the soil [13].

Nitrogen: In the incubation experiments, the availability of N increased with the application of organic sources. In the incubation experiment application of 100% RDF + FYM@ 25t ha^{-1}(T_5) registered highest N availability value of 89.1 mg kg^{-1}. "The increased N availability with applied organic sources might be due to the increased decomposition of organic sources under favourable soil enrichment and due to reduced volatilization, leaching and denitrifying losses. It might be due to the decomposition of organic matter leads to mineralization of organically found nitrogen" [14].

Phosphorus: The increased Olsen – P content due to application of organic sources and industrial by – products was well evidenced in the incubation experiment. The experimental soil exhibited medium status of available phosphorus. The increased availability of phosphorus due to application of organic sources and industrial by – products were in the range of 10.7 to 11.5mg kg^{-1} at 30DAI, 10.8 to 11.7mg kg^{-1} at 60DAI and 10.9 to 11.8mg kg^{-1} at 90DAI. Generally the content of the added inputs is the most important factor for phosphorus mineralization in the soil [19]. In the incubation studies Municipal solid waste compost, FYM, Rice husk ash and Bagasse ash were used as sources for supplementing P nutrition. The FYM, Municipal solid waste compost, Rice husk ash contained 0.42, 0.16, 0.09% total P respectively. The application of FYM enhanced phosphorus availability, [15] reported that "organics were superior in improving available P. It might be due solubilizing effect of organic acids on organic phosphorus and organic anions retard the fixation of P in by complexing with organic ligands and chelation of P fixing cations like Ca, Mg, Fe, Al, Zn, Mn and Cu". Phosphorus complex with humic and fulvic acid increase the availability of phosphorus to the plants. Similar findings were also reported by Hemalatha and Chellamuthu [20].

Potassium: Application of organic sources and industrial by – products showed on improvement in the K content of soil. In incubation experiment, the highest K availability was observed with the application of 100% RDF + Bagasse ash @ 10 t ha^{-1}(T_9) which registered 123.3mg kg^{-1}. The other industrial by – products viz., Rice husk ash, Bagasse ash, organic sources viz, FYM, Municipal solid waste compost also improved the K status of soil. The organic sources increased the K availability could be ascribed to the variation in the amounts of total K added through organic sources this rates and around of mineralization [21]. The release of potassium present in bagasse ash may be responsible for the increase in available potassium content in bagasse ash applications. Nkana et al. obtained similar results [16].

6. CONCLUSION

The results of the current study indicate that addition of different organic manures and industrial waste to the soil decreases its pH and electrical conductivity (EC), but increases its SOC, nitrogen, phosphorus, and potassium content with the time of incubation. The potential sustainability of a system is significantly influenced by the amount of organic matter in the soil. An important factor in providing plants with the nutrients they need is soil organic matter (especially nitrogen, sulphur and phosphorus). Additionally, organic matter binds contaminants, increases soil buffering capacity, and helps to improve soil structure. To increase the quality and tilth of the soil as well as to supply nutrients for plant growth, organic fertilisers are utilized. They supply nutrients necessary for plant growth and general health, such as nitrogen, phosphorus, and potassium.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Sharma S, Shah KV. Generation and disposal of solid waste in Hoshangabad. In: Book of proceedings of the second international congress of chemistry and environment. Indore, India. 2005;749-51.
2. Wolkowski RP. Nitrogen Management Consideration for land spreading Municipal Solid Waste Compost. J Environ Qual. 2003;32(5):1844-50.
3. Hansel TG, Bhander T, Christensen Bruun S, Jensen L. Life cycling Modeling of Environmental Impacts of Application of Processed Organic Municipal Solid Waste on Agricultural land (EASTE WASTE). Waste Manag Res. 2006;124:154-66.
4. Sharholy M, Ahamed K, Mahmood G, Trieeli RC. Municipal Solid Waste management in Indian cites. A review. Waste Manag Res. 2008;28:249-467.
5. Madhukar Rao P, GECH. Vidya Sagar, K. Suresh, G. Padmaja and S. Narender Reddy. Effect of Organic and Inorganic Sources of Nitrogen on Yield Attributes and Yield of Maize Under Sandy Loam Soil Conditions In Northren Telangana Zone. The J. Res. PJTSAU. 2021;49(4): 65-73.
6. Anguissola S, Silva S, Botteschi G. Effect of fly ash on the availability of Zn, Cu, Ni and Cd to chi-cory. Agric Ecosyst Environ. 1999;72:159-63.
7. Carlson CL, Adriano DC. Environmental impacts of coal combustion on residues. J Environ Qual. 1993;22:227-47.
8. AICOAF. Application of rice husk charcoal, Food and Fertilizer Technology Center for the Asian and Pacific region leaflet for Agriculture: practical. Technologies 4. 2001.
9. Humphries EC. Mineral components and ash analysis. In: modern methods of plant analysis. Springer – Vering, Berlin. 1956;1:486-502.
10. Jackson ML. Soil chemical analysis. Prentice – hall of Indian Pvt. Ltd. New Delhi; 1973.
11. N JS, H SA, K ND, N C, N BS, P TS et al. Effect of farm yard manure and press mud on fertility status of alkaline soil under maize – wheat cropping sequence. Afr J Agric Res. 2015;10(24):2421-31.
12. Zahir S, Haq I, Rehman A, Khan A, Afzal M. Soil amendments and seed priming influence, nutrients uptake, soil properties, yield and yield components of wheat (*Triticum aestivum* L.) in alkali soils, Soil Science and Plant Nutrients. 2013;59(2):262-70.
13. Thamaraiselvi T, Brindha S, Kaviyarasi NS, Annadurai B, Gangwar SK. Effect of organic amendments on the bio chemical transformations under different soil conditions. Int J Adv Biol Res. 2012;2:171-3.
14. Singh D, Balyan DS, Rana MK. Effect of integrated nutrient management on growth, yield and economics of okra (*Abelmoschus esculentusas* (L.) Moonch). Haryana J Hortic Sci. 1998;26(3-4):254-7.
15. Narwal RP, Gupta AP, Antil RS. Efficiency of triple super phosphate and mussoorie rock phosphate mixture incubated with sulfitation process pressmud. J Indian Soc Soil Sci. 1990;38(1):51-5.
16. Nkana JC, Demeyer A, Verloo MG. Effect of wood ash application on soil solution chemistry of tropical acid soils: incubation study. Bioresour Technol. 2002;85(3): 323-5.
17. Singh Brar B, Singh J, Singh G, Kaur G. Effect of long term application of inorganic and organic fertilizer on soil organic carbon and physical properties in maize – wheat rotation. Agronomy. 2015;5:200-38.
18. Kaur T, Brar BS, Dhillon N. Soil organic matter dynamics as effected by long – term use of organic and inorganic fertilizers under maize – wheat cropping system, nutr. Cycl. Agro Ecosyst. 2008;81:59-69.
19. Hundal HS, Thind SS. Release of phosphorus in flooded soil amended with green manure. J Indian Soc Soil Sci. 1993;41:782-3.
20. Hemalatha S, Chellamuthu S. Impacts of long-term fertilization on soil nutritional

quality under finger millet: maize cropping sequence. J Environ Res Dev. 2013:104-6.
21. Yadvinder Singh P, RPS, Singh B, Khind CS. Leaching of potassium from organic manures, crop residues and inorganic fertilizer in two soils under flooded and upland moisture regimes. J Indian Soc Soil Sci. 2005;53:207-13.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/92886