COMPARISON OF CHEMICAL COMPOSITION OF COMPOST FERTILIZER PREPARED BY SELECTED FARMERS FROM AMPARA REGION

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ABSTRACT: Farmers in Ampara region depend on massive quantities of synthetic fertilizers.Now there is a tendency to produce and use compost fertilizer in agriculture among several farmers in this region.However their quality is not comparable with the synthetic ones. The following study was undertaken to determine the parameters of the compost prepared by individuals and units operating in this region, in terms of chemical composition andtheir nutrient contentand compare their relative nutrient index value.As an initiative, a total of six representative compost samples from this region were collected during April 2016. pH, EC, moisture content, WHC, NPK values, OC and sand content were analyzed by standard methods. Results revealed that none of the samples collected were satisfying all the standardparameters, may be due to the use of different feed stock as raw material, hence different composition and different time periods allowed for maturity by the different producers. However, one sample (sample no. 5) satisfied most of the standard quality parameters, such as pH of 6.5, EC of 0.476 dS m^{-1}, moisture content of 22%, 59.12% of WHC, 0.5789% of potassium content, 20.03% of OC, 0.8967% of total nitrogen content, a C/N ratio of 22:1 and with a nutrient index of 1.75.Phosphorus and sand content of almost all the samples were deviating from recommended values. Sample number 5 was obtained from a farmer, who has undergone trainings in preparing compost fertilizer. Other samples showed deviation, from the acceptable range of measured parameters mainly due to the usage of improper ratio of feedstock and unhealthy maintenance of conditions throughout the composting period. A vigorous monitoring with periodical analyses of samples is recommended as a continued study.

Keywords: Ampara region;Compost fertilizer; Electrical Conductivity; Water HoldingCapacity; Organic Carbon;Nutrientindex.

1 INTRODUCTION

Since the commencement of green agriculture, people have identified the benefits of applying biological ingredients in the agricultural fields. According to Bastida*et al*. (2010), compost utilization is one such example.Compost can be derived from a number of feedstock including yard trimmings, bio-solids (sewage sludge), wood by-products, animals' manures, crop residues, biodegradable packing, and food scraps. Compost is valued for its organic matter content, and it typically used as a soil amendment to enhance the chemical, physical and biological properties of soil.

Compost can increase the water holding capacity of sandy textured soils. It can also improve structure and water movement through heavier textured soils that are high in silt and clay content. By increasing the organic content of the soil, biological activity can be enhanced. Water and nutrient holding capacity can be improved in some soils.Properties of compost depend on compost feedstock, composting condition and duration. As a result, composts differ in physical and chemical properties and may have different effects on soil properties (Eneji*et al.*, 2001; Kawasaki *et al*., 2008).

In spite of the destructive consequences of chemical fertilizers on both environment and human health, farmers depend on massive quantities of chemical fertilizers for their rapid action, and ease of application. However, there is a tendency to use compost fertilizer in agriculture being increased. There are several compost manufacturing units in Ampara region are operating and the method of preparation, compost feedstock, composting conditions and durations are varying to one another, resulting in different quality of the prepared compost fertilizer. Hence, determining the quality of compost fertilizers is important for better agricultural management practices and accessing the effects of agriculture on environmental quality. Therefore a study was undertaken with the objective to analyze the chemical composition and nutrient content of locally prepared compost fertilizers and compare their nutrient index obtained from some selected (six) farmers from Amparaarea.

2 MATERIALS AND METHODOLOGY

Six compost samples were collected during April, 2016 from individuals and units operating in and aroundAmpararegion. The collected samples were taken to the Faculty of Applied Sciences. Chemical and physical characteristics of compost samples were analyzed at chemistry and earth science laboratories of faculty of applied sciences, South Eastern University while nutrient contents were analyzed at the Horticulture Research and Development Institute, Gannoruwa.

2.1 Sample Preparation

The collected compost samples were numbered from 1 to 6, air-dried in shade, sieved to remove stones, roots, and large organic residues and pass through a 0.1 mm sieve to obtain very fine particles which were then stored in clean polyethylene containers before conducting analyses for chemical and physical characteristics.

1) pH and Electrical Conductivity, EC, (dS/m) were determined for the supernatant solution of 1:5 compost/water ratio (w/v) using a pH meter and conductivity meter respectively(Jackson, 1973).
2) Moisture content in the compost sample was measured by placing a raw compost sample (50.0000 g) in an evaporating disk in a hot air oven for 16 hrs at 105^{o}C. The weight of evaporating disk with dried compost and weight of the beaker with raw compost were recorded.
3) Water holding capacity of compost is the amount of maximum water, which can be held in the saturated compost sample. It is measured as the amount of water taken up by a unit weight of dry sample when immersed in water under standardized conditions (25 ^{0}C, 1 atm). A Whatman filter paper (No.1) was taken into a funnel and it was weighed.The filter paper was moistened (10.0 ml) and excess water was

collected until the last drop falls. The compost sample (5.00 g) was added into the funnel and the weight of the compost sample was measured with the wet filter paper. Water (25.0 ml) was pipetted out and added gradually until the last drop of water drips out of the funnel. The final weight was noted.

4) Organic carbon was determined by Loss On Ignition (LOI) method (Schulte and Hopkins, 1996).
5) Total nitrogen was determined by Kjeldahl digestion, distillation and titration procedures as described by Jackson (1958) and Bremner*et al*. (1982).
6) Phosphorus in the compost samples were determined by leaching the compost with 0.002N H_2SO_4 (1 soil : 200 H_2SO_4 suspension, w/v) and shaken for at least 30 minutes and filtered through Whatman filter paper (No. 42) to get a clear solution. The amount of phosphorus in the extract was estimated by chlorostannous reduced phosphomolybdate blue colour method using spectrophotometer at wavelength of 690 nm (Jackson, 1973).
7) Potassium in the compost samples were determined by leaching the compost with 1.0 N ammonium acetate at pH 7.0 (w/v), kept for overnight and then filtered using Whatman filter paper (No. 42) and final volume was made up to 100 ml using distilled water. The potassium in the filtrate was determined using flame photometer (Chapman, 1965).

3 RESULTS AND DISCUSSION

3.1 pH of compost

The measure of pH of compost is an important parameter which helps in identification of chemical nature of the compost (Shalini*et al*., 2003) as it measures hydrogen ion concentration in the compost to indicate acidic and alkaline nature of the compost. The acceptable pH range of the compost is from 6.5 to 8.5 (Mature composts should have neutral or slightly alkaline pH). Sample number 4 had the highest pH value of 7.9 (slightly alkaline) and sample number 6 has the lowest being 6.2.Sample number 6 is slightly acidic and not in acceptable range. Out of the six compost samples, majority was in the pH range of 6.5 to 7.0 and it was 66.66% (Table 1).

Table 1: Measured pH of compost samples

pH values	Number of samples (sample numbers)	%
6.0-6.5	1 (6)	16.67
6.5-7.0	4 (1, 2, 3, 5)	66.66
7.0-7.5	-	-

7.5-8.0	1 (4)	16.67

3.2 Electrical Conductivity (EC)

Conductivity, as the measure of current carrying capacity, gives a clear idea of the soluble salts present in the compost. It plays a major role in the salinity of compost. Lesser the EC value, low will be the salinity value of compost and vice versa. The acceptable EC range of the compost is from 0.5 dS m^{-1} to 3.0 dS m^{-1}. Sample number 4 had the highest EC value of 4.8dS m^{-1} that was not in acceptable range and sample number 6 had the lowest being 0.126 dS m^{-1}. Sample numbers 1, 3 and 6 were lower than the acceptable range and the sample numbers 2 and 5 were within the acceptable range. Out of the six compost samples, majority was in the EC range of 0.0 dS m^{-1} to 1.0 dS m^{-1} and it was 66.66% (Table 2).

Table 2: MeasuredEC values of compost samples

EC values (dS m^{-1})	Number of samples (sample numbers)	%
0.0-1.0	4 (1, 3, 5, 6)	66.66
1.0-2.0	-	-
2.0-3.0	1 (2)	16.67
3.0-4.0	-	-
4.0-5.0	1 (4)	16.67

3.3 Moisture content

It is the water contained in the compost and is a great regulator of physical, chemical and biological activities in the compost. It dissolves salts and make up the compost solution, which is important as a medium for supplying different essential nutrients between the compost solids and the compost solution and, then between compost solution and the plants. The acceptable range of percent of moisture of compost is from 20 to 30. The sample numbers 1 and 2 had slightly high moisture content and other samples were within the acceptable range.

3.4 Water Holding Capacity (WHC)

Water holding capacity is the amount of water that can be retained / held by the compost when all the pores in the compost have been filled with water. Under this condition, compost is saturated with water, accompanied by very poor or no drainage. The acceptable range of the WHC of compost ranges from 20% to 60%. In all the compost samples collected from Ampara region were in the acceptable range.

3.5 Potassium content

Potassium (K) is the third most required element by the plants, which plays a key role in water balance inplants or regulation of osmosis (Singh and Tripathi, 1993). It is the most abundant metal cation in plant cell (2 to 3 % by dry weight).The acceptable percentage range of potassium content of compost is from 0.5 to 3.0. The sample number 1 had low percent of potassium content(0.194 %) than the acceptable range and other samples were in the acceptable range.

3.6 Phosphorus content

Phosphorus is the second most important macronutrient available in the biological systems, which constitutes more than 1% of the dry organic weight. It is also a second most limiting factor often affecting plant growth, which exists in the compost in both organic and inorganic forms. The acceptable percentage range of phosphorus content of compost is from 0.5 to 4.0. The sample numbers 1, 2, 4, 5, and 6 had low percent of phosphorus content and the sample number 3 was in the acceptable range.

3.7 Organic Carbon (OC) content

Carbon of compost is quite resistant to further decomposition; thus compost may be useful to increase carbon sequestration in soils (Whalen *et al*., 2008). The acceptable percentage range of organic carbon of compost is from 20 to 35. The sample numbers 1, 2, 3 and 6 had low percent of organic carbon and the sample numbers 4 and 5 were in the acceptable range.

3.8 Total nitrogen content

The quantity and form of nitrogen present in compost is important in shaping the material's quality.Plants take up nitrogen generally as nitrates under aerobic conditions and as ammonium ions during anaerobic conditions. Nitrogen is most often the limiting nutrient for the plant growth. The acceptable percentage range of total nitrogen of compost is from 0.5 to 3.0. The sample numbers 1, 3 and 6 had low percent of total nitrogen and the sample numbers 2, 4 and 5 were in the acceptable range.

3.9 C/N ratio

The ratio of the carbon to nitrogen (percent of dry weight) is a key indicator of the compost's suitability as a growth medium. The ratio of available C to N is a critical parameter for biodegradation, and optimal composting occurs with a C/N ratio between 20:1 and 30:1 (Rynk*et al*., 1992).The sample number 1 had higherC/N ratio and the sample number 4had lower C/N ratio than the acceptable range. Sample numbers 2, 3, 5 and 6 were in the acceptable range.

3.10 Sand content

The recommended sand percentage should be below 10%. But all the compost samples collected were having sand percentage above 10%.

3.11 Nutrient index

To evaluate the compost fertility status in compost samples, nutrient index with respect to organic carbon, phosphorus, potassium and total nitrogen were calculated based on the specific rating chart (Table 3) and criteria to calculate nutrient index (Table 4) respectively.

Table 3: Rating chart for compost test values and their nutrient indices

1.Organic carbon (OC)			
Range (%)	Low	Medium	High
	Below 0.5	0.5-3.0	Above 3.0
Nutrient index	I	II	III
2.Total nitrogen			
Range (%)	Low	Medium	High
	Below 0.5	0.5-3.0	Above 3.0
Nutrient index	I	II	III
3.Phosphorus			
Range (%)	Low	Medium	High
	Below 0.5	0.5-4.0	Above 4.0
Nutrient index	I	II	III
4.Potassium			
Range (%)	Low	Medium	High
	Below 0.5	0.5-3.0	Above 3.0
Nutrient index	I	II	III

The nutrient index in the compost was evaluated for the compost samples analyzed using the following formula:

$$Nutrient\ index = \frac{(1 \times No.of\ samples\ in\ low\ and\ high\ catogaries) + (2 \times No.of\ samples\ in\ medium\ catogary)}{Total\ number\ of\ samples}$$

Table 4: Nutrient index with range and remarks

Nutrient index	Range	Remarks (OC, N, P,K)
I	Below 1.50	Low
II	1.50-1.75	Medium
III	Above 1.75	High

Table 5: Nutrient index values and remarks for the compost samples

Sample number	Nutrient index	Remark
1	1.00	Low
2	1.50	Medium
3	1.50	Medium
4	1.75	High
5	1.75	High
6	1.25	Low

It is possible to classify nutrient status of the collected compost samples and classify nutrient level (i.e., low, medium or high) based on a rating chart using the results and nutrient index. Based on the criteria given in Table 4 and 5, the compost samples 2 and 3 had medium nutrient level and the sample numbers 1 and 6 had low nutrient level. The sample numbers 4 and 5 had the high nutrient level with a nutrient index 1.75. But C/N ratio of sample No.4 (19:1) isnot in the acceptable range.

4 CONCLUSIONS

Results revealed that none of the samples collected were satisfying all the standard parameters, may be due to the use of different feed stock as raw material, hence different composition and different time periods allowed for maturity by the different producers. However, one sample (sample no. 5) satisfied most of the standard quality parameters, such as pH of 6.5, EC of 0.476 dS m^{-1}, moisture content of 22%, 59.12% of WHC, 0.5789% of potassium content, 20.03% of OC, 0.8967% of total nitrogen content, a C/N ratio of 22:1 and high nutrient level with a nutrient index of 1.75. Phosphorus and sand content of almost all the samples were deviating from recommended values. Sample number 5 was obtained from a farmer, who has undergone trainings in preparing compost fertilizer. Other samples showed deviation, from the acceptable range of measured parameters mainly due to the usage of improper ratio of feedstock and unhealthy maintenance of conditions throughout the composting period. A vigorous monitoring with periodical analyses of samples is recommended as a continued study.

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