STUDIES ON THE PHYSICAL PROPERTIES OF COIR PITH COMPOST AND TRADITIONAL COMPOST

Lavanya.S[1], Vijitha.N[2], Mahendran. S[2] and Premanandarajah. P[3]

ABSTRACT

The coconut coir pith is a by-product of coconut plantation sector. Though coir pith has a number of beneficial properties, its direct utilization as a manure is restricted owing to its high carbon: nitrogen (C:N) ratio and lignin content. It contains wide C:N ratio of 100-120:1 and 30 % of lignin which does not permit natural decomposition. Hence a study was conducted at the Eastern University, Sri Lanka to convert the raw coir pith to composted coir pith and to investigate its properties to examine its suitability as a manure by comparing traditional compost.

The coir pith compost was prepared by using coir pith, spawn of oyster mushroom (*Pleurotus sajor caju*) and cattle urine. The coir pith was allowed to decompose for a period of 40 days. The samples of coir pith compost were collected and were analyzed for properties such as moisture content, porosity, bulk density, particle density and pH. The results of this study revealed that certain properties of coir pith namely, moisture content and porosity were significantly ($p<0.05$) higher than the traditional compost. Some of the other properties viz., bulk density and particle density were significantly lower than the traditional compost. However, there was no significant difference ($p<0.05$) in the pH between the coir pith compost and traditional compost. Based on the physical properties, it could be concluded that coir pith compost can be used as an effective manure.

Key words: Coir pith compost, physical properties , traditional compost.

INTRODUCTION

Agriculture plays a significant role in Sri Lankan economy. About 17% of the Gross Domestic Product of Sri Lanka is contributed by the agricultural sector. But, the increasing prices of agricultural inputs, especially the fertilizers have decreased the crop production substantially, since most of the farmers are poor. The cost of fertilizers covers approximately 45% to 60% of the total material cost of crop production (Aheeyar, M.M.M. *et al*, 2005). In addition, continuous usage of inorganic fertilizers has resulted in deficiency of micro nutrients, imbalance in the soil physico-chemical properties and unsustainable crop production (Thedchanamoorthy, 1999). Thus, an urgent need is to be evolved to find sustainable and viable alternatives to sustain the crop production.

Using organic fertilizers such as compost might be one of the best solutions for the problems cited. Composts have been used as organic fertilizers. Compost influences the physical, chemical and biological properties of soils. It has nutritional function and serves as a source of nutrients for plant growth, biologically it profoundly affects the activities of microflora and microfaunal organisms and it influencing the physical properties of soil by promoting good soil structure, aeration and retention of moisture (Sriskandavel, 1992). The locally available compost is prepared by using crop residues, animal wastes and municipal wastes. There is a potential to utilize coir pith, which is a by-product of coconut sector, for making compost.

Being a costal area, Batticaloa district has sufficient amount of coconut farms particularly along the costal belt. Cultivation in an area of 20,000 acre produces approximately 97 million nuts annually in this district (Coconut cultivation board, 2009). Apart from utilization of the endosperm for edible purposes and extraction of oil, the outer non-edible fibrous portion of the nuts (husk) is used for extracting coconut fibers or coir. The coir is commercially used for making coir ropes, mats, etc., and the pith which is left out after the extraction of fibers is known as coir pith. Owing to lack of technical know-how, a large quantity of the coir pith is wasted. They are dumped as agricultural waste and get accumulated as heaps of coarse and fine dusts. These agricultural wastes have traditionally been disposed by burning. This burning has caused several

[1] Department of Animal science, Faculty of Agriculture, Eastern University, Sri Lanka. (lavanyah2002@yahoo.com)
[2] Department of Agricultural Biology, Faculty of Agriculture, Eastern University, Sri Lanka.
[3] Department of Agricultural Chemistry, Faculty of Agriculture, Eastern University, Sri Lanka.

environmental problems including carbon deposits and atmospheric warming.

Coir pith has a wide range of C: N ratio of 100-120:1, 30% of lignin and 26% of cellulose, which makes the application of fresh coir pith to fields deleterious to crop growth (Sharma, 2004). The coir pith can be converted to compost with reduced C: N ratio of 24:1 with the help of mushroom fungus. The edible oyster mushroom (*Pleurotus sajor caju*) has a capacity to decompose the lignin present in the coir pith efficiently by producing enzymes like cellulases and lactases (Marimuthu,T. *et al*., 1989) During composting the lignin content is reduced to 4.8% (Sharma, 2004).

The coir pith based compost could be used as one which has the properties of cost effective, time – efficient, simple and having environmentally friendly technology. Even though it has many desirable characters, the physical properties of the coir pith compost have to be studied in order to understand the nature of this material. Plant growth trails are the ultimate indicators of the compost quality. But laboratory testing is commonly done to evaluate the compost. Physical properties like moisture content, bulk density, particle density and porosity are essential to evaluate the compost (Merbout, 2006). This study therefore was conducted with the intention of analyzing the physical properties of the coir pith compost and to compare them with those of the traditional compost.

MATERIALS AND METHODS

Production of coir pith compost

A shaded place was selected to prepare the compost heap. A pit having a depth of 15 cm was made in an area of 1.5m x 1m and a polyethylene sheet appropriate to this size was spread. A quantity of 10 kg of collected coir pith was spread over the polyethylene sheet. Oyster Mushroom spawn (30 g) was uniformly applied over the coir pith. A second layer of 10 Kg of coir pith was spread over the first one and cattle urine was sprinkled uniformly on the second layer. This sandwich process of one layer of coir pith and mushroom spawn followed by another layer of coir pith and cattle urine was repeated to a height of one meter (Figure 1). The heap was moistened by sprinkling water. The heap was allowed to decompose for a period of 40 days (Damodaran *et al.,* 2004).

Determination of physical properties of composts

The physical properties of the coir pith compost and traditional compost were analyzed according to Muthuvel and Udayasooriam (1988). The moisture content of composts was determined by drying a known quantity of composts sample in an electric oven at 110°C for overnight and finding out the loss in weight. Bulk density, particle density and pore space were determined from the apparent and true volumes of the compost measured by adding a known quantity of water (50 ml) to a measuring cylinder containing a weighed quantity (10 g) of compost. The pH of the composts was determined by using an electronic pH meter.

Analysis of data

The collected data were statistically analyzed using Analysis of Variance to determine the significance if any at the treatment level. The difference between treatments was compared by Duncan's Multiple Range Test.

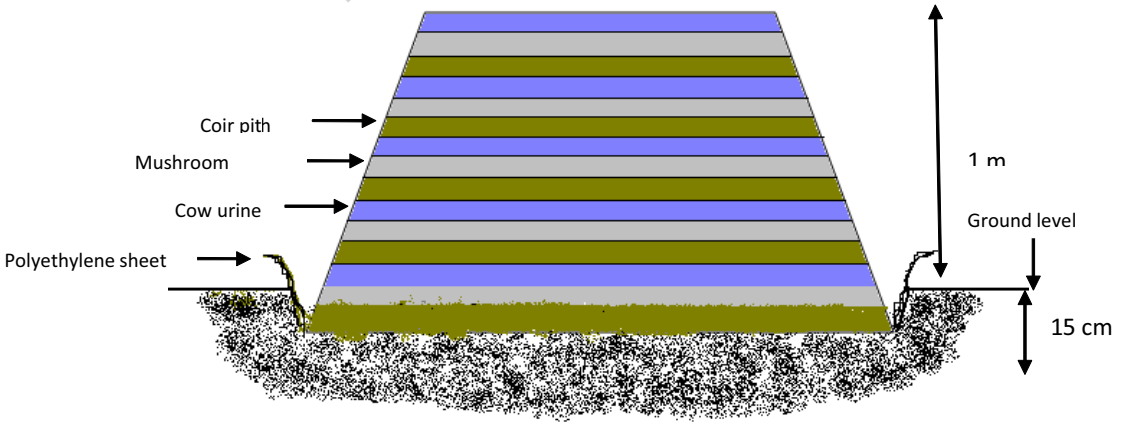

Figure 1: Diagrammatic representation of the manner in which the coir pith compost was prepared

RESULTS AND DISCUSSION

The analysis revealed that there were significant differences ($P<0.05$) between treatments in the moisture content, pore space, bulk density and particle density of coir pith compost and traditional compost. However, there was no significant difference in the pH of the coir pith compost and traditional compost (Table 1). Certain properties of coir pith namely, moisture content and pore space were significantly higher ($P<0.05$) than those of the traditional compost. Some of the other properties viz., bulk density and particle density were significantly lower ($P<0.05$) than those of the traditional compost.

Table 1: The physical properties of coir pith and traditional composts

Physical properties	Coir pith compost	Traditional compost
Moisture content (%)	86.96[a]	16.28[b]
Porosity	0.55[a]	0.45[b]
Bulk density (gcm^{-3})	0.34[b]	0.53[a]
Particle density (gcm^{-3})	0.74[b]	1.11[a]
pH	6.25[a]	7.02[a]

*Values in the same row followed by the same letter do not differ significantly ($P<0.05$).

Moisture content

Coir pith compost contains significantly higher ($P<0.05$) amount of moisture content than the traditional compost (Figure 2).

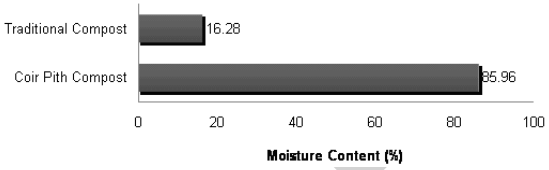

Figure 2: Moisture contents of coir pith compost and traditional compost

The major constituent of coir pith compost has the ability to absorb and retain high amount of moisture. Coir pith is a fluffy, light, spongy material with increased water-holding capacity (Ghosh, 2006). This might be the reason for high moisture content in the coir pith compost. Water holding capacity of the soil can be improved by adding coir pith compost. Sriskandavel (1992), stated that water holding capacity of the soil was increased in direct proportion to the amount of coir pith incorporated. High soil moisture content was noticed due to incorporation of coir pith compost (Anabayan and Palaniappan, 1991).

The high water holding capacity of soil leads to greater water availability to plants. Thus, under drought condition plants can survive longer. Water is held in soil under a force in capillaries due to surface tension. Energy is required for plant to absorb water from soil pores. Less energy is needed to remove water at high moisture content than when a soil is dry (Epstein, 1997). During the *Yala* season, most of the crop production is affected by water scarcity in the Batticaloa district. Use of coir pith compost to crop cultivation would be one of the remedies to minimize water scarcity problem. Use of coir pith compost to crop cultivation will also help to reduce the salinity problems. High water holding capacity of the coir pith compost thus reduces the frequency of irrigation. By applying less amount of water, growers add less salt to their soil. Further, the farmer spends less cost for irrigation.

Pore space

The coir pith compost has significantly higher ($P<0.05$) pore space than the traditional compost (Figure 3).

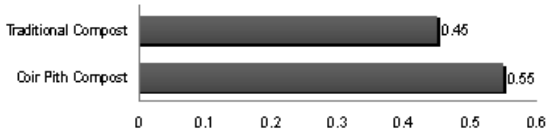

Figure 3: Pore spaces of coir pith compost and traditional compost

Pore space in compost consists of that portion of the compost volume not occupied by solids, either mineral or organic. Pores in compost are the result of irregular shapes of primary particles and their aggregation (Gupta, 2003). The coir pith compost has recorded a higher pore space than traditional compost. The particle size of the coir pith compost approximately 2 mm. However, the particle size of traditional compost is less than 2 mm. This may be the reason for higher pore space in the coir pith compost than the traditional compost. Pore space of the compost may influence the aeration and water movement when it is incorporated into the soil. Since the coir pith compost has higher pore space than the traditional compost, it increases the porosity of the soil when it is added to it. Soils which have low porosity could be improved by the addition of coir pith compost.

Bulk density and particle density

The coir pith compost has significantly lower ($P<0.05$) bulk and particle densities than the traditional compost (Figure 4 and Figure 5).

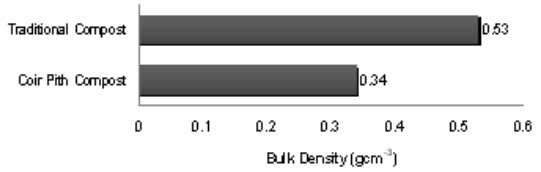

Figure 4: Bulk densities of coir pith compost and traditional compost

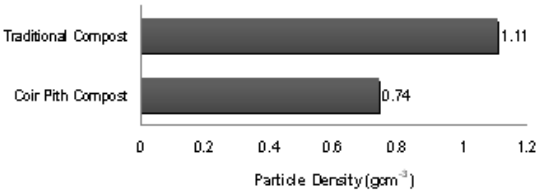

Figure 5: Particle densities of coir pith compost and traditional compost

Bulk density is the weight per unit volume of a soil or compost mass including the pore space. Particle density is the density of the solid soil or compost particles only. Thus, bulk density is an indication of soil compactness (Donahue *et al*., 1983). The coir pith compost has lower bulk density than the traditional compost. The coir pith compost consists particle of light in weight and it has higher pore space than the traditional compost. This might be the reason for lower densities of coir pith compost than traditional compost. The higher the bulk density, the more difficult it is for plant roots to proliferate. Consequently, the potential for plants to extract water and nutrients is reduced (Epstein, 1997). Soils with low bulk density have a high pore space, are less tightly packed and have a greater potential to store water and allow roots to grow readily. Use of coir pith compost will reduce the bulk density of soil, improving potential root growth, drainage and infiltration.

pH

The analysis of pH of coir pith compost and traditional compost revealed that there was no significant difference ($P<0.05$) between the pH of both composts. The average pH of coir pith compost was 6.25 whereas; the average pH of the traditional compost was 7.02. Therefore, the incorporation of these composts to the soil will not change the pH of the soil. Soil pH influences plant growth by its effects on the activities of beneficial microorganisms.

CONCLUSION

The coir pith compost has comparatively better physical properties than the traditional compost. Further, the coir pith compost reduces the environmental pollution. This is a time saving method of composting too. Based on these physical properties the coir pith compost could be served as better organic manure compared to traditional compost. Further investigations are needed to test the chemical properties of the coir pith compost.

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