Research article

Physical and Chemical Properties of Compost Made from Agricultural Wastes

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Abstract Compost is a decomposed organic material that can be used to help grow plants and keep soil healthy. The main objectives of this research are to prepare compost from agricultural wastes and study the physical and chemical properties of agricultural wastes and prepared compost. These agricultural wastes are cow dung, rice husk, saw dust, sesame husk and chaff. The physical and chemical properties of agricultural wastes and compost were characterized by pH, moisture, organic matter, calcium, magnesium, sulphur, nitrogen, phosphorus, and potassium. The EM (effective microorganism) solution was prepared by using organic kitchen wastes except onion and garlic peels for mixing in prepared compost. The microscopic morphology of microorganism was also studies for EM solution. The results showed that the prepared compost has pH value 7.29, moisture (20.39%), organic matter (22.89%), calcium (1.96%), magnesium (0.61%), sulphur (0.07%), nitrogen (1.25%), phosphorus (1.62%), potassium (1.56%), iron (1.30%), manganese (0.02%), copper (0.03%), zinc (0.01%) and chloride (1.07%). The yield percent of prepared compost was found to (58.45%) based upon the amount of agricultural wastes. The physical and chemical properties of agricultural wastes and prepared compost were used in soil management in a good way to improve and maintain soil quality, soil fertility, and conserve the environment.

Keywords agricultural wastes, physical and chemical properties, EM solution, compost

INTRODUCTION

Compost means to put together the correct amounts of compostable materials to make a great soil amendment. It is the biological reduction of organic material to humus; it is made from residues of plants and/or animals that are piled, moistened and allowed to decompose, and bacteria, insects and worms in the pile help this break down (Raabe, 2004). Quality control during compost production should ensure adequate chemical and physical properties (Inbar et al., 1993), as well as an adequate degree of stability and maturity (Benito et al., 2003). The beneficial effects on crop production and soil quality reported in literature (Hoitink et al., 1997; Atiyeh et al., 2001) are related to the physical, chemical, and biological properties of the composts (He et al., 1995). Agricultural wastes are defined as the residues from the growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products, and crops. They are the non-product outputs of production and processing of agricultural products that may contain material that can benefit man but whose economic values are less than the cost of collection, transportation, and processing for beneficial use. Their composition will depend on the system and type of agricultural activities and they can be in the form of liquids, slurries, or solids. Agricultural waste otherwise called agro-waste is comprised of animal waste (manure, animal carcasses), food processing waste (only 20% of maize is canned and 80% is waste), crop waste (corn stalks, sugarcane bagasse, drops and culls from fruits and vegetables, pruning) and hazardous and toxic agricultural waste (pesticides,

insecticides and herbicides, etc). Estimates of agricultural waste arising are rare, but they are generally thought of as contributing a significant proportion of the total waste matter in the developed world (Agamuthu, 2009). Effective Microorganisms (EM) are mixed cultures of beneficial naturally occurring organisms that can be applied as inoculants to increase the microbial diversity of soil ecosystem. They consist mainly of the photosynthesizing bacteria, lactic acid bacteria, yeasts, actinomycetes and fermenting fungi. These microorganisms are physiologically compatible with one another and can coexist in liquid culture. There is evidence that EM inoculation to the soil can improve the quality of soil, plant growth and yield (Kengo and Hui-lian, 2000).

Therefore, the present investigation was conducted to study produce a good quality compost from agricultural wastes. The physical and chemical properties of the agricultural wastes and compost were determined by the end of processing period. These properties include pH, moisture, organic matter, calcium, magnesium, sulphur, nitrogen, phosphorus, potassium, iron, manganese, copper, zinc and chloride.

METHODOLOGY

Sample collection: The agricultural waste materials such as cow dung, rice husk, saw dust, sesame husk and chaff were collected for the preparation of compost in June 2018. Cow dung was collected from Myitnge village and rice husk, saw dust, sesame husk and chaff were collected from production of Industrial Zone (I), Pyingyitagon Townships, Mandalay Region, Myanmar. Cow dung samples were dried under the sunlight for 3 months. The rice husk, saw dust, sesame husk and chaff were pounded and sieved with 60 sieve mesh size to get the size of powder.

Preparation of effective microorganism solution: The EM solution was prepared in container all the wastes of the fruits and vegetables from the kitchen except onion and garlic peels were placed in a 10 liters container to ferment for one month. The fermentation time took about one month to obtain effective microorganism (EM) solution.

Preparation of aerobic digester: The plastic container (50.8 cm) was taken. One hole (2.54 cm in diameter) was made at the centre of the base of the container to seep the liquid of the decomposing organic matter from container. Four holes were made around the top of the container, at 38.1 cm from each other. Another four holes were made around the bottom third of the container, at 38.1 cm from each other.

Preparation of compost by using aerobic method: Compost was prepared by mixing of cow dung (0.25 kg), rice husk (0.25 kg), saw dust (0.25 kg), sesame husk (0.25 kg), chaff (0.25 kg) and EM (10 L) solution in container (50.8 cm).

Turning over for compost under aerobic condition: During decomposition, the waste products were turned over regularly, in order that it remains well aerate and all the materials were converted into compost. The first turning over was done after two weeks. The second turning overtook that after one week. Then, each turning over was done after one week. During the process, water was sprinkled over the container, if necessary. After one month, decomposition was complete because the waste materials were changed into an unrecognizable crumbly dark mass. However, some stalks do not decomposed completely and can still be seen.

Analysis of physical and chemical composition of agricultural wastes and compost: The agricultural wastes and compost were air dried and physical and chemical properties were determined based upon the total weight of selected materials used (FAO, 2008).

Determination of pH of agricultural wastes and compost: Cow dung (5 g), rice husk (5 g), saw dust(5 g), sesame hush (5 g), chaff (5 g) and prepare compost (5 g) were weighed accurately and placed into a each beaker and 100 mL of distilled water was added into each beaker (the ratio of sample to water was 1:4). It was shaken and heated for 30 minutes. It was cooled and filtered. The filtered was determined by digital pH meter.

Determination of moisture contents of agricultural wastes and compost: With the oven-drying method, the loss of water on heating agricultural wastes and compost at 105°C in a silica crucible and heating it in a temperature control oven for 5 hours.

Determination of total sulphur contents of agricultural wastes and compost: 2-5 mL of aliquot was taken into 50 mL volumetric flask. 5 mL of 50% acetic acid, 2 mL of 0.25% Gum Acacia and 1 mL of ortho-phosphoric acid was added into the flask. It was shaken for 1 min. 0.2 g of $BaCl_2$ crystal was added and shaken for 1 min. Make the volume up to 50 mL with distilled water. Measure the turbidity intensity at 440 nm.

Determination of total nitrogen by using Kjeldahl method: 0.5 g of each sample was put into 600 mL digestion tube and 1 g of catalyst was added. It was heated gently unit frothing ceases. The flask was removed from the heater and cool, distilled water was added and transfer to the suitable volumetric flask. Accurately 20-25 mL of 2% Boric Acid was placed in the receiving conical flask. 2-3 drops of methyl red indicator was added. Water was add enough to cover the end of the condenser outlet tube. 5 mL of aliquot pipette into the distillation tube and 5 mL of 40% NaOH was added and the ammonia was distilled for about 4 minutes. The receiving flask was removed and rinsed the outlet tube into the receiving flask with a small amount of distilled water. Excess acid was titrated with 0.02 NH_2SO_4. Determine the blank a reagent in the same manner.

Determination of total phosphorus by using Molybivanado phosphoric acid method: Pipette 5-25 mL of aliquot depending on P content in a 50 mL volumetric flask and add 5 mL of Barton's Reagent and dilute to 50 mL with distilled water. After 1 hour, measure with spectrophotometer at 420 nm.

Determination of potassium, calcium and magnesium by using atomic absorption spectroscopic method: Potassium, calcium and magnesium content of agricultural wastes and compost were determined by Atomic Absorption Spectroscopic Method (AAS), at Department of Agriculture (Land Use), Ministry of Agriculture and Irrigation, Mandalay.

Determination of organic matter in agricultural wastes and compost: Loss of weight on ignition can be used as a direct measure of the Organic Matter (OM). The sample is ashed at 500-600°C by placing a suitable weight (0.5-1.0 g) of the sample in a silica crucible and heating it in a muffle furnace for 4-6 hours.

Determination of yield percent of compost: The compost was dried and the yield percent was determined based upon the total weight of selected materials used.

Isolation of microorganism from EM solution by using sub-micrometer: Isolation of microorganism from EM solution was done at Department of Biotechnology, Mandalay Technology University (MTU). The microscopic morphology of microorganism was also studied for EM solution (Krieg, 1984).

RESULTS AND DISCUSSION

Physical and Chemical Properties of Agricultural Wastes

Physical and chemical properties of agricultural wastes used for composting were measured. The results are shown in Table 1. According to these results the pH value of rice husk is greater than others. The pH value is directly affects plant growth. Calcium, potassium and moisture were highest values in cow dung. Sesame husk has highest phosphorus, sulphur, nitrogen amount and higher organic matter. Nitrogen, phosphorus and potassium are essential minerals for agriculture. The mixture of the richest sources, such as sesame husk, saw dust, chaff, cow dung and rice husk were combined and made the compost which used for agriculture. The agricultural wastes improve the overall health of soil and produce healthy various plants. The physical and chemical properties of prepared compost were rechecked in agricultural wastes and the results are described in Table 2.

Table 1 Physical and chemical properties of agricultural wastes used for composting

Parameter	Sesame husk	Saw dust	Chaff	Cow dung	Rice husk
pH	6.62	6.95	7.14	7.23	7.43
Moisture (%)	6.24	9.61	12.19	22.80	12.93
Organic matter (%)	89.97	91.18	23.49	51.03	79.36
Total Ca (%)	1.07	0.52	0.23	9.70	0.19
Total Mg (%)	0.15	0.07	0.11	0.57	0.12
Total S (%)	57.10	16.90	2.50	38.60	31.50
Total N (%)	3.36	0.19	0.09	2.18	0.41
Total P (%)	0.48	0.01	0.01	0.41	0.02
Total K (%)	0.51	0.06	1.01	1.15	0.93

Table 2 Physical and chemical properties of compost

Parameter	Results
pH	7.29
Moisture (%)	20.39
Organic matter (%)	22.89
Total Ca (%)	1.96
Total Mg (%)	0.62
Total S (%)	0.07
Total N (%)	1.25
Total P (%)	1.62
Total K (%)	1.56
Total Fe (%)	1.30
Total Mn (%)	0.02
Total Cu (%)	0.03
Total Zn (%)	0.01
Total Cl (%)	1.07

In accordance with the comparisons of physical and chemical properties of crude wastes and prepared compost, sulphur and nitrogen content are significantly decreased in compost which may be produced of gas in combination period. The organic matter is also reduced in prepared compost which is decomposed of agricultural wastes, cow dung and EM solution in moist aerobic conditions.

Yield Percent of Compost

Yield percent of compost was obtained 58.45% on based upon the total weight of material in aerobic condition.

Table 3 Cultural and Microscopic Morphology of Isolated Bacteria

Colony Morphology					Microscopic Morphology			Family
Sample name	Size (mm)	Color	Elevation	Shape	Size (µm)	Gram' reaction	Shape	
EM 1	2	White (Transparent)	Flat	Irregular	2-2.5× 5-6	+	Rod, spore	*Bacillaceae*
EM 2	3	White (Opaque)	Raised	Irregular	1.5-2× 3-4	+	Rod, spore	
EM 3	2	White (Transparent)	Raised	Irregular	1-1.5× 5-7	+	Rod, spore	

The Isolation of Microorganism from EM Solution

The microorganisms were isolated from prepare effective microorganisms solution. These microorganisms were used accelerator on composting process. EM cultures have been used effectively to inoculate both farm wastes as well as hasten the treatment process. EM enhances soil fertility and promotes grow ripening in crops. The isolated bacteria were shown in Table 3.

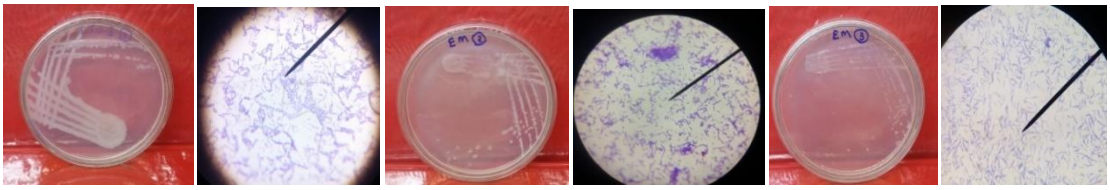

Fig. 1 Cultural and microscopic morphology of isolated bacteria

Three bacterial isolates (EM 1, EM 2, EM 3,) from sample EM were isolated on Nutrient media. According to the cultural and microscopic morphology, all three bacterial isolates on *Bacillaceae* shows in Fig. 1. *Bacillaceae* is mainly due to their ability to form resistant endospores. It is believed to be the key factor determining the ecology of these bacteria. They also perform fundamental roles in soil ecology and in plant health and growth stimulation.

CONCLUSION

According to physical and chemical properties of compost which should be used as organic fertilizer. As a result of analysis data of prepared compost showed that suitable for plant growth and health. In addition, waste products and compost were observed to be suitable for agricultural used. According to cultural and microscopic morphology, two aerobic bacterial strains were observed in liquid of EM solutions with different conditions. The compost should be used widely in agriculture because of their low cost, good fertility of the soil and supplying more trace elements. It provides many essential nutrients for plant growth and therefore is often used as fertilizer. Therefore, prepared compost has great potential for applications and as a source of plants nutrients.

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