Research article

Preparation of Effective Microorganisms Based Compost Using Some Selected Wastes for Improvement of Plants Growth

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Abstract Solid waste disposal is the most pressing problem facing mankind throughout the world. The solid waste management plays a significant role to create a sustainable environment. Some vegetable wastes such as rice husk, cotton husk, coconut husk, pigeon-pea husk and chicken manure were selected for chemical analysis. The effective microorganism (EM) solution was prepared from kitchen vegetable wastes except onion and garlic peels to ferment for two months. The microorganisms that contain in prepared EM solution were studied by using microscopic morphology. The pH of prepared EM solution was measured by using pH meter. The compost was prepared from the vegetable waste materials and prepared EM solution by using aerobic method. The yield percent of compost was determined by calculation method. The yield percent of prepare compost was found to 55%. The mineral contents of compost and soil sample were measured by using EDXRF spectroscopy. The physicochemical properties of vegetable wastes, prepare compost and soil sample were determined. Planting the seedlings of some selected useful vegetables in various ratios of the prepare compost and soil sample. The growth rates of plant rates were found to be effective by the planting experiment.

Keywords physicochemical properties, EM, compost, EDXRF, planting

INTRODUCTION

Compost is organic matter that has been decomposed in a process called composting. This process recycles various organic materials otherwise regarded as waste products and produces a soil conditioner. Compost is rich in nutrients. Compost is decomposed organic material, such as leaves, grass clippings, and kitchen waste. There are two composting types in which the difference is by the nature of the decomposition process; namely as aerobic and anaerobic method. In aerobic composting that oxygen is present, mainly to break the organic matter in the waste into a stable end product such as carbon dioxide, ammonia, water and heat. Anaerobic composting developed an intermediate compound such as methane, organic acid and hydrogen sulphide (Sita et al., 2016).

Composting is a technique which can be used to reduce the amount of organic waste through recycling and the production of soil fertilizers and conditioners. Compost is primarily used as a soil conditioner and not as much as a fertilizer because it contains a high organic content (90-95%) but generally low concentrations of nitrogen, phosphorus, potassium as well as macro and micro nutrients compared to commercial fertilizers (Knight, 1997). 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. There is evidence that EM inoculation to the soil can improve the quality of soil, plant growth and yield (Kengo and Hui-lian, 2000).

The main objectives were to examine the properties of compost from the vegetable waste and investigate the effect on plant growth. The vegetable wastes are very effective in soil nutrient. The principal goal of nature planting is to produce abundant and healthy crops without the use of chemical fertilizers and pesticides and without causing adverse effects on the natural environment.

METHODOLOGY

Sample collection:
The degradable vegetable wastes such as rice husk, cotton husk, coconut husk and pigeon pea husk were collected from Samar village, Kyaukse Township, Mandalay Region. Chicken manure was collected from Taungthamam village, Mandalay Region, Myanmar. Chicken manure was dried under the sunlight. Soil sample was collected from Mandalay University Campus for planting. All selected samples were ground with blender and used for throughout the experiment.

Determination of physicochemical properties of selected wastes:
Some physicochemical properties of selected vegetable wastes and chicken manure were determined (AOAC, 1990).

Preparation of effective microorganism solution:
The kitchen waste materials used for preparation of effective microorganism solution were collected from the home kitchen. The mixture of vegetable wastes from home kitchen (10 kg) was made the small pieces and kept in 10 liters air tight container to ferment for two months. Effective microorganism (EM) solution was prepared by using anaerobic digester method.

Isolation and microscopic morphology of prepare EM solution by using sub-micrometer:
Isolation of microorganism from prepared EM solutions was done at Department of Biotechnology, Mandalay Technology University. The microscopic morphology of microorganism in prepare EM solutions was also studied.

Determination of pH of EM solution:
The pH of EM solution was determined by pH meter (AOAC, 1990).

Preparation of compost by using aerobic digester method:
Compost was prepared by mixing of rice husk (0.25 kg), cotton husk (0.25 kg), coconut husk (0.25 kg), pigeon-pea husk (0.25 kg), chicken manure (0.25 kg) and EM solution 10 liters in container by using aerobic digester method.

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

Determination of mineral contents of compost and planting soil:
The mineral contents of prepared compost and planting soil were measured at department of Chemistry, University of Monywa, by applying EDXRF (Energy Dispersive-X-Ray Fluorescence Spectroscopy).

Determination of pH of prepare compost and planting soil:
The pH of sample was determined by pH meter (AOAC, 1990).

Determination of moisture content of compost and planting soil:
The moisture content was measured by oven dry method (AOAC, 1990).

Determination of ash content of prepare compost and planting soil:
The ash content was measured by oven drying method (AOAC, 1990).

Determination of organic matter:
The sample is ash at 500-600°C by placing a suitable weight (0.5-1.0g) of the sample in a silica crucible and heating it in a muffle furnace for 4-6 h. Loss of weight on ignition can be used as a direct measure of the Organic Matter (MO) (AOAC, 1990).

Estimation of available nitrogen by using alkaline permanganate method:
The amount of nitrogen released by alkaline permanganate solution was estimated by distillation procedure. The distillate was collected in known amount of standard acid and the excess acid was titrated against standard alkali solution by using methyl red as an indicator. The nitrogen so estimated is designated as available nitrogen (Subbiah and Asija, 1956).

Determination of available phosphorus by using Olsen's method:
2.5 g of sample was taken in a conical flask and 1.0 g of carbon black was added. 50 mL of 0.5 M $NaHCO_3$ solution was added to the flask and shaken for half an hour. It was filtered through the filter paper. 5 mL of filtrate was pipette out into a 25 mL volumetric flask. 5 mL of molybdate reagent was added and washed down the steam of the flask and mixed. 1 mL of dilute stannous chloride solution was added and made up to 25 mL with distilled water. The contents were mixed thoroughly. After ten minutes the color intensity was read in the spectrophotometer by using read filter (or 700 nm). The value (mg of phosphorus) was read from the standard curve (Olsen et al., 1954).

Determination of potassium by using atomic absorption spectroscopic method:
The potassium content of prepare compost and planting soil were determined by Atomic Absorption Spectrophotometer at Department of Agriculture (Fishman and Downs 1966).

Planting:
The roselle, nannan, pumpkin, lady's finger, cow pea and mustard were seedlings in pots. After 20^{th} days, all the seedlings of the same size were selected and planted in planting experiment. The three plant-based filter were used in the different ratio of compost and soil sample. In the first plant-based filter, no fertilizer was used. In the second plant-based filter, 1:10 of prepare compost and soil sample were mixed. In the third plant-based filter, 1: 5 prepare compost and soil sample were mixed. All plant-based filter was regularly watered. The duration from the time of selected plants to the end of the study period was 60 days. The growth rate of the plants was measured from selected plants from each plant-based filter and average values were recorded. The plant growth was measured at every ten days during this research work.

RESULTS AND DISCUSSION

The Results of Physicochemical Properties of Vegetable Wastes

The results of physicochemical properties of vegetable wastes are shown in Table 1. According to Table 1, the pH values of samples were lie between 6 and 8. It values showed the slightly alkaline condition. The organic matter content of cotton husk was found to be higher than the other samples. Thus, all selected samples contain suitable inorganic matter such as N, P and K contents found to be suitable amount respectively (Dharmakeerthi et al., 2007).

Isolation of Microorganism and Bacterial Identification from Prepare EM Solution

The results of isolation of microorganism and bacterial identification from prepare EM Solution were describe in Table 2.

Table 1 Physicochemical properties of vegetable wastes

Sample description	Unit	Chicken manure	Rice husk	Coconut hush	Cotton husk	Pigeon pea husk
pH	-	7.12	7.43	7.62	6.62	7.21
Moisture	%	21.60	12.93	8.45	6.24	10.18
Organic Matter	%	41.02	79.36	88.12	89.97	20.50
Available N	%	2.66	0.41	0.31	3.36	2.15
Available P	%	0.52	0.02	0.01	0.48	0.28
Available K	%	1.12	0.93	0.16	0.51	1.25

Table 2 Cultural and microscopic morphology of isolated bacteria

Sample name	Colony morphology				Microscopic morphology		
	Size (mm)	Color	Elevation	Shape	Size (um)	Gram' reaction	Shape
EM1	1	Yellow (opque)	raised	round	1-2 × 2-4	+	Small Rod
EM2	3- 4	White (opque)	flat	Irregular	1-2 × 2-4	+	Rod (spore)
EM3	3- 4	White (opque)	raised	Irregular	2-3 × 3-4	+	Rod (spore)
EM4	4-6	White (opque)	raised	round	2-3 × 3-4	+	Rod (spore)

According to cultural and microscopic morphology, four bacterial strains were observed in liquid of EM solutions with different conditions. Four bacterial strains (EM 1, EM 2, EM 3, EM 4) from prepare EM samples were isolated on Nutrient media. According to the cultural and microscopic morphology, EM 1 predicted that positive gram stain bacterial from the family of *Pseudomonadaceae*, and EM 2, 3 and 4 could be assumed that positive gram stain bacterial from the family of *Bacillaceae* (Khan et al., 2018).

The pH of Prepare Effective Microorganism Solution

The pH value of prepared effective microorganism solution was found to be 4.29. The value is towards slightly acidic and to neutralized selected vegetable wastes (Khan *et al.,* 2018).

The Yield Percent of Prepared Compost

The yield percent of prepare compost was found to be 55%.

Table 3 Relative abundance (%) of elemental composition of prepared compost and planting soil

Element	Symbol	Prepare compost (%)	Planting soil (%)
Silicon	Si	40.413	56.573
Calcium	Ca	26.922	4.410
Iron	Fe	5.143	11.110
Potassium	K	22.596	5.546
Sulfur	S	2.997	2.225
Titanium	Ti	0.933	1.127

Mineral Content of Prepared Compost and Planting Soil

The relative abundance (%) of elemental composition of prepared compost and soil were shown in Table 3. The elemental analysis indicated that the amount of silicon was highest value in prepare compost and planting soil. The calcium content in prepare compost was higher than planting soil. The sulphur content of prepare composed and planting soil was nearly equal. The other mineral contents were found to be small amount in prepare compost and planting soil (Pravina et al., 2013).

Results of Physicochemical Properties of Prepared Compost and Planting Soil

The results of physicochemical properties of prepared compost and planting soil were showed in Table 4. The pH value of prepare compost and planting soil was nearly equal and the ash content of prepare compost was higher than planting soil. The moisture content of planting soil was decreased compare to the prepare compost (Clark et al., 1998).

Table 4 pH, moisture and ash value of prepared compost and planting soil

Sample	pH	Moisture (%)	Ash (%)
Planting soil	8.81	2.24	10
Prepared compost	8.76	12.19	45

The available nitrogen value of prepared compost and planting soil were described in Table 5. According to the results from the determination of available nitrogen content of prepare compost was higher than planting soil. The phosphorus and potassium contents in prepare compost were higher than planting soil (Clark et al., 1998).

Table 5 Available nitrogen, phosphorus and potassium value of prepared compost and planting soil

Chemical properties	Prepared compost (% by dry mass)	Planting soil (% by dry mass)
Available Nitrogen	2.08	0.12
Available Phosphorus	1.32	0.46
Available Potassium	1.02	0.44

Planting

Duration from the time of roselle, nannan, pumpkin, lady's finger, cow pea and mustard were to the end of the study period was 60 days. The plants growth was measured at every 10 days during this research work and average values were record.

Table 6 The growth rate of Roselle

Day	Roselle		
	Blank	1:10	1:5
10	4.11	4.40	4.81
20	6.14	6.43	6.84
30	8.17	8.46	8.87
40	10.21	10.50	10.91
50	12.23	12.52	12.93
60	14.25	14.54	14.95

Table 7 The growth rate of Nannan

Day	Nannan		
	Blank	1:10	1:5
10	2.11	2.4	2.81
20	3.12	3.41	3.82
30	4.13	4.42	4.83
40	5.18	5.47	4.88
50	6.20	6.49	6.90
60	7.22	7.51	7.92

Table 8 The growth rate of Pumpkin

Day	Pumpkin		
	Blank	1:10	1:5
10	8.10	8.39	8.80
20	10.12	10.41	10.82
30	12.13	12.42	10.83
40	14.14	14.43	14.84
50	16.18	16.47	16.88
60	18.21	18.50	18.91

Table 9 The growth rate of Lady's finger

Day	Lady's finger		
	Blank	1:10	1:5
10	8.10	8.39	8.80
20	10.11	10.40	10.81
30	12.13	12.42	12.83
40	14.15	14.44	14.85
50	16.18	16.47	16.88
60	18.20	18.49	18.90

Table 10 The growth rate of Mustard

Day	Mustard		
	Blank	1:10	1:5
10	4.15	4.44	4.85
20	6.16	6.45	6.86
30	8.18	8.47	8.88
40	10.20	10.49	10.90
50	12.21	12.50	12.91
60	14.22	14.51	14.92

Table 11 The growth rate of Cow pea

Day	Cow pea		
	Blank	1:10	1:5
10	8.11	8.40	8.81
20	10.13	10.42	8.83
30	12.14	12.43	12.84
40	14.16	14.45	14.86
50	16.17	16.46	16.87
60	18.20	18.49	18.90

In this planting experiment contains three conditions. The first condition is blank, the second condition is 1:10 ratio and the third condition is 1:5 ratio of prepare compost and planting soil. According to these results, the third condition was found in the best growth rates of planting because its uses the most amount in prepare compost.

CONCLUSION

This experiment was done in an effort to solid wastes management by investigating homemade composting with effective microorganism solution. From this analysis, vegetable waste materials were used in evaluation provided a better environment for EM to grow produce quality compost. The degradable vegetable wastes, cow dung and EM play a significant role in stabilizing the mixture and accelerate the composting process. The pH value of EM was found to be 4.29 and it is slightly acidic condition. According to microorganism morphology, four types of bacterial strains were observed in EM solution. All are gram positive bacteria. The observed bacteria are degraded the vegetable waste materials and creates the suitable environment conditions for decomposition of organic materials used. The elemental analysis indicated that silicon was found to be the highest amount in prepared compost and planting soil. Since silicon generates the resistance in many plants to disease and pests, it may contribute to reduce the rate of application of pesticides and fungicides. The physicochemical properties of vegetable wastes and prepare compost were lie within the limiting range and it is suitable for planting. The selected useful vegetables were treated with different ratio of prepared compost and planting soil. The highest amount of prepare compost used in planting is most growth rates in all selected plants. Thus, the prepared compost was low cost, easily available and supporting the improvement of growth rates of plants. According to the results of experimental work, compost from kitchen waste product could be employed as an alternative, eco-friendly and low cost for supporting of plants growing.

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