INDIGENEOUS MICROORGANISM AND RED WIGGLER WORM (*EISENIA FETIDA*) AS COMPOSTING AGENTS FOR PRUNED OIL PALM LEAVES

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ABSTRACT

The study was conducted to compare the rates of composting of oil palm leaves through vermicomposting and Indigenous Microorganism (IMO). Three treatments with three replications were made, which consist of oil palm leaves with worms, oil palm leaves with IMO, and oil palm leaves without composting agent serve as control. Each replication was treated with 3kg of worm and 3kg of IMO. Data was collected within a period of 12 weeks. Results revealed that composting with worm proceeded at a faster rate with greater volume as compared to those treated with IMO and the control boxes. Generally, there were no significant differences in compost quality among the three treatments, with the exception of phosphorus content which was observed to be slightly higher in the worm-composted materials.

Key words*: Vermicomposting, Indegeneous microorganisms(IMO), composting agent.*

Introduction

Malaysia has the most mature oil palm industry in the world, and overall development of the country is moving very rapidly (Corley and Tinker, 2003). Oil palm plantation is focusing on producing the oil based products and biofuel and every single day, the plantations conduct pruning to maintain the oil palm growth and development. The leaves will usually be dumped or shredded into pieces for livestock feed especially for cattle and goats.

Considering that the oil palm plantation of Malaysia is expected to dump thousands of tonnes of leaves everyday whereby the number of leaves produced annually by a plantation increases to between 30 and 40 at 2-4 years of ages (Corley and Tinker, 2003), there is a need for serious efforts on how to manage this agricultural waste which will in turn benefit the plantation and reduce costs.

Lately, tiger worm (*Eisenia fetida*) has been widely used by farmers to recycle their wastes into very useful compost. Previous studies conducted by the Department of Agriculture, University Putra Malaysia and University Sains Malaysia have focused on various aspects of composting. Most of these studies emphasized on the variations of organic compostable materials particularly agricultural waste. Subsequently, the role of specific indigenous microorganism has been recognized to be among some of the factors which influence the rate of composting. However, there is still insufficient information about variable use of composting agents which is best suited to the needs of the plantation industry particularly the oil palm plantations in the country.

Understanding the fundamentals of composting enables operators to manipulate the process in order to maximize the rate of decomposition of the organic material and meet other environmental or quality specifications. The aim of this study is to investigate and compare the rate between vermicomposting and IMO composting using oil palm leaves as the bedding material. The findings from this study provide valuable information about the most efficient composting agent using oil palm leaves as the composting media. Such information could facilitate the expansion of the idea of recycling oil palm plantation wastes especially the pruned leaves. On the other hand, this study also supports the effort to enhance environmental awareness through recycling whereby plantation waste can be converted into usable manure for the crops.

Materials and Methods

A laboratory experiment was carried out to compare the efficiency of two different composting agents using the same bedding material (pre-composted oil palm leaves). The experimental units of three treatments were replicated three times and arranged randomly in Complete Randomized Design (CRD). Each experimental unit comprised a concrete pool measuring 143 cm x 143 cm x 30 cm, and contained the bedding material (oil palm leaves), *E. fetida* and IMO. The treatments consisted of different composting agents designated as follows:

Treatment 1: Worms (vermicomposting) + oil palm leaves

Treatment 2: IMO + oil palm leaves

Treatment 3: Control (oil palm leaves)

**The oil palm leaves were pre-composted for about two weeks before the study was conducted. The partition was watered once in two days using the sprinkler for about fifteen minutes. Sufficient water was added to each concrete box to maintain the moisture level of about 70%.

Changes in volume of bedding material were taken every week for three months by measuring the decrease in depth of the oil palm leaves in each composting unit. Temperature readings of each individual composting unit were recorded each week. The products from the composition process were sampled and tested for their nutrient contents. The data on compost weight of each treatment and the nutrient contents of composting products were analyzed using the SPSS Version 16.

Results

The results are discussed based on the rate of composting, volume of compost output and compost quality.

Rate of Composting

The data taken were analyzed to determine the general monthly rate of composting and the different rates of composting for each of the treatments. In general, there seemed to be a significant difference in the monthly composting rate for all treatments. The mean values for the amount of compost generated indicated that the composting rate was highest during the second and third months (December and January) at about 0.3 m^3/month. However, the rate of composting dropped in the fourth month (February) at an average of 0.006 m^3/month (Figure 1).

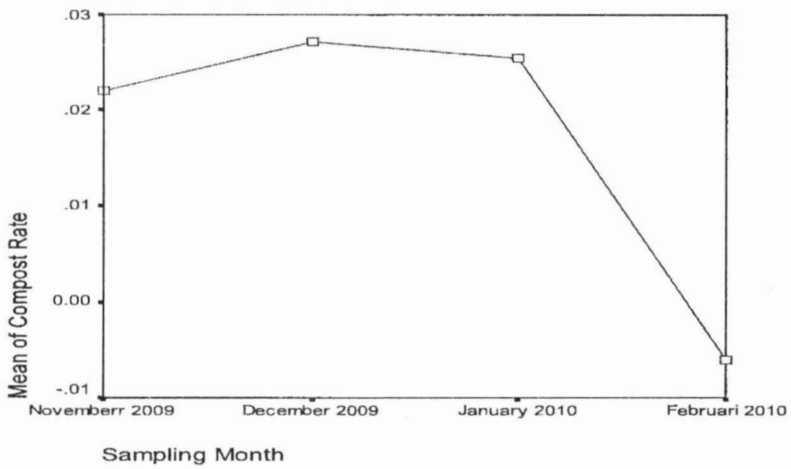

Figure 1: Composting Rate per Month.

The composting rate according to treatments did not show any significant difference. Although the substrates treated with worms seemed to exhibit a slightly higher rate of composition compared to those treated with IMO and the control (Figure 2), result from ANOVA showed that there was no significant difference among the treatments ($P>0.05$) (Table 1).

Table 1: Analysis of variance of composting rate between treatments.

	Sum of Squares	df	Mean Square	F	Sig.
Between Treatments	.000	2	.000	.351	.707
Within replication	.011	33	.000		
Total	.011	35			

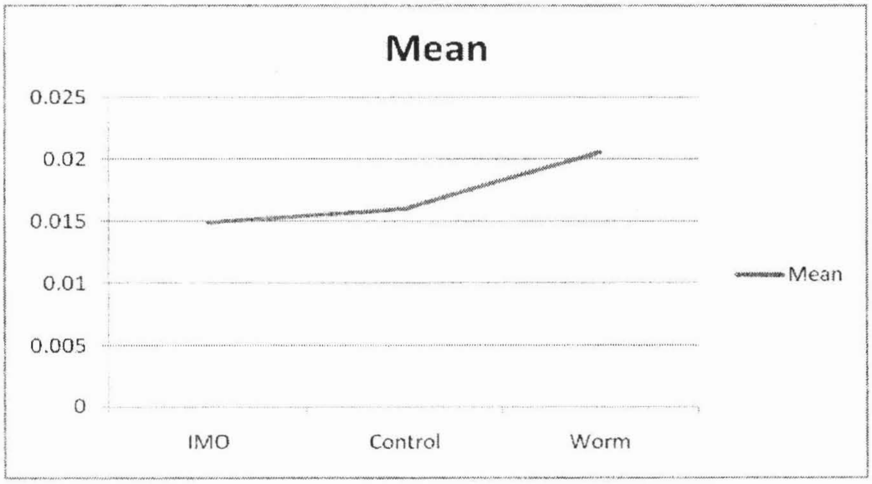

Figure 2: Composting Rate According to Treatments

Volume of Compost Output

Weekly measurements of the decrease in volume of the respective substrates were taken to determine the average volume of compost output for all treatments. Result showed that, substrates treated with worms significantly gave the greatest decrease in volume. This indicated that, this treatment gave the highest volume of compost output compound to other treatments. The compost output from substrates treated with worms gave (0.3 m^3) 55% of the original volume, followed by those treated with IMO (0.23 m^3 - 42% of original volume) and the least was from the control (0.2 m^3 - 36% of original volume) (Figure 3).

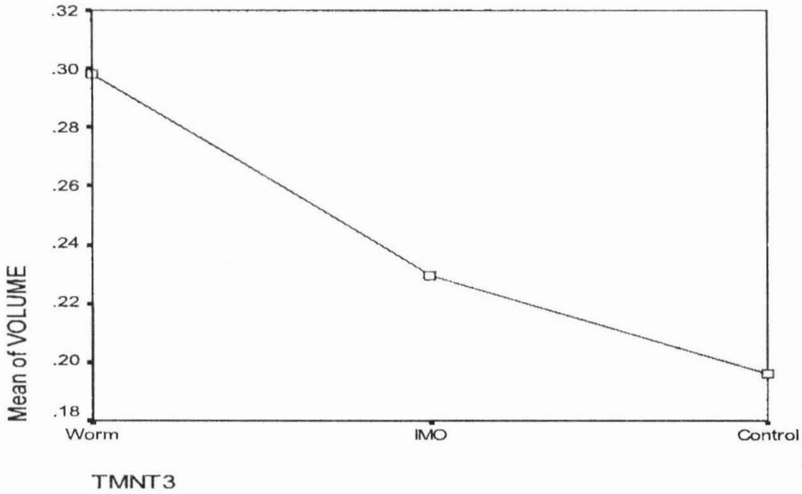

Figure 3: Volume of Compost Output among Treatments

Compost Quality between Treatments

The third objective of the study was to determine the nutrient content of the compost output. Each of the treatment samples was analyzed for nutrient contents (N, P, K, Mg). Based on the preliminary results there were no significant difference in nutrient contents from all of the samples irrespective of treatments. However, results from analysis of variance (ANOVA) showed significant difference ($P<0.05$) in the content of phosphorus in the compost treated with worms compared to compost treated with IMO and the control (Table 2). The content of other nutrients were more or less the same in all treatments. This may be due to the common substrate that have been used in all the treatments is oil palm leaves.

Table 2: Nutrient Content of Compost Output

Treatment	Organic Matter (%)	Total N	Total C	C/N Ratio	Total K_2O	Total P_2O_5	Total Mg	Ca
Control	80.7	1.9	46.8	24.6:1	0.3	0.11	0.2	1.1
IMO	77.0	1.6	44.6	28:1	0.2	0.10	0.18	1.0
Worms	78.9	1.9	45.8	24:1	0.3	0.13*	0.2	1.1

N= Nitrogen, C= Carbon, C/N= Carbon: Nitrogen, K_2O= Potassium oxide, P_2O_5= Phosporus pentoxide Mg= Magnesium, Ca= Calcium. *= significant difference at $P<0.05$

C/N Ratio

The ratio of available carbon to nitrogen is a very important relationship in the process of decomposition. Decomposition of organic matter is brought about by living organisms that use the carbon as a source of energy and nitrogen for building cell structure. In the actual sense, more carbon than nitrogen is needed. The results from the study showed that C: N ratio and the percentage of the organic matter were quite high. This indicates that very little decomposition of the bedding materials had taken place.

It has been commonly established in literature that the ideal initial C: N ratio of organic wastes should be between 21 to 30 for rapid composting (Anon, 2005). Ndegwa and Thomson (2000), in support of this statement, found that a C: N ratio of 25 is optimal for *Eisenia fetida* growth. If the excess carbon is too great, decomposition decreases when the nitrogen is used up and some of the organisms die.

Discussion

In this study, the results showed that the C: N ratio and the percentage of organic matter were very high. This may be due to the high initial C: N ratio of oil palm leaves (58-60 : 1). It also needs more time for the decomposition to take place. As have been reported by other researchers, enhanced organic matter decomposition in the presence of earthworm results in lowering of the C: N ratio (Fosgate and Babb, 1972; Kale et. al., 1982; Edwards, 1988; Talashilkar et. al., 1999). Researchers (Anon. 2005) have reported that composting time will increase considerably with increases in C: N ratio above the range of 30 to 40. The findings by Tripathi and Bhardwaj (2004) supports the above report where, the process of composting was observed to be complete after 150 days or approximately 21 weeks. In this study, the last data was collected quite early, that is at 70 days or 10 weeks. Nonetheless, to reduce the vermicomposting period, Gajalakshmi et. al. (2002) demonstrated that precomposting of organic wastes makes it more easily utilizable by the worms hence accelerating the vermicomposting period.

The size or surface area of the bedding material is another factor to be considered in vermicomposting. In this study, the bedding materials were not properly shredded into very small pieces that could provide adequate surface area for the earthworm to work on. As mentioned by Applehof (1982), the size of the substrate or feedstock in vermicomposting affects the composting output potential. The smaller the food scraps the faster the worms will digest them. Smaller materials have more surface area available for microbial activity. Therefore, by reducing the particle size of the substrate will increase the rate of the decomposition and composting process by the earthworms.

Decomposition of organic matter by IMO should take place in about three weeks. However in this experiment, samples treated with IMO did not seem to perform as expected. The researchers believe that this might be due to several reasons. Firstly, all treatments were watered daily to keep the temperature low for vermicomposting. This however hindered the microbial activities of the IMO. By reducing the temperature, microbial activities slowed down, hence explaining the low compost output in the IMO treatment.

Conclusions

The overall findings of this research have shown that worm composting rate was the highest compared to IMO composting. The rainy season in December to January with the average temperature of 28° seemed to provide an ideal situation for the worm activities. IMO composting was not as efficient as indicated by a minimal increase in temperature in the treated samples. Active microorganism biodegradation of organic wastes should normally be accompanied by an increase in temperature up to 40°C. Therefore, it could be concluded that, IMO composting and vermicomposting should be carried out in different environmental conditions because each has its own specific environmental preferences which are different from each other.

Based on the above situation it could also be concluded that the volume of the compost output from vermicomposting was highest, followed by IMO composting and the control with (55%) > (42%) > (36%) respectively but no significant difference was observed in the compost quality among all the treatments except the Phosphorus content which was higher in vermicompost compared to IMO compost and control.

Recommendations

The researchers would like to make several recommendations for further research in the area of agricultural composting using both techniques tested in this study:

1. Further study on the ideal stocking rates per specified volume of organic waste should be carried out so that appropriate recommendations could be made for its efficient application by farmers.
2. Separate environmental requirements for each technique should be considered if a more meaningful comparison were to be made.

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