THE POTENTIAL OF SELECTED BEDDING MATERIALS FOR VERMICOMPOSTING WITH RED WIGGLER WORMS- *EISENIA FETIDA*

BY:

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ABSTRACT

Laboratory experiments were performed to determine the composting potential of *Eisenia fetida* over a period of 70 using different substrates as bedding materials. The study indicates that oil palm leaves, acacia leaves, newspaper and sawdust showed different potentials as bedding materials for vermicomposting. However, proper initial preparation of the bedding material is critical to ensure efficient vermicomposting where precomposting of agricultural wastes is needed to facilitate efficient vermicomposting. The study also indicates that particle size of the bedding material affects the rate of vermicomposting. For household vermicomposting, newspaper is recommended as the bedding material because it is cheap, clean or less messy and very easy to handle. Thus study has shown that kitchen wastes such as left over vegetables and similar wastes can be composted with earthworms and can be converted as valuable garden fertilizer without additional cost.

Introduction

The amount of solid waste produced by Malaysians is about 15,000 tons daily. However, only less then 5% of that is recycled. The other 95% (especially food waste) piles up in dumpsites around the country where valuable plots of land have to be sacrificed for this purpose. Although some steps have been taken by the government to manage solid waste through the recycling programs,

but the activities do not include garden and food waste. This study tried to provide relevant information about alternative bedding materials for vermicomposting which are more readily available to local household and small farmers. With such information it is hoped that vermicomposting could be more easily adopted by the Malaysian society as a beneficial recycling and organic waste management.

Objectives

This study was designed to determine:

1. The rates of worm mortality and reproduction in different bedding materials namely: newspapers, sawdust, oil palm leaves and acacia leaves.
2. The rates of worm growth in different bedding materials namely: newspapers, sawdust, oil palm leaves and acacia leaves.
3. The nutrient content of the compost output from each bedding material.

Materials and Methods

The experimental units of five treatments replicated three times were arranged randomly in a Completely Randomized Design (CRD). Each experimental unit comprised a plastic box measured 30 cm x 30 cm x 30cm, termed as bin, contained the bedding material (treatment), *E. fetida*, moist soil, and egg shell.

The underside of the box was also perforated to drain excess water. A total of 15 experimental units were set up. To each unit, 1.3 kg of soil (Typic

Plinthudult) was added and spread uniformly to form a layer about 0.5 cm thick. The soil was meant to facilitate the burrowing activity of the worms. 10 gm of crushed egg shell was then added to each unit to increase the pH of soil from 5.6 (initial soil pH) to about 7, the favorable pH for *E. fetida*. The treatments consisted of different bedding materials as shown in Table 1 where 1 kg of bedding materials was added to each experimental unit.

Table 1: Vermicomposting Samples with Different Types of Bedding Materials

Bedding Material	Sample No.	No. of Worms/Box
Oil Palm Leaves	A1	59
	A2	59
	A3	59
Newspaper	B1	59
	B2	59
	B3	59
Acacia Leaves	C1	59
	C2	59
	C3	59
Sawdust	D1	59
	D2	59
	D3	59
Control (soil)	E1	59
	E2	59
	E3	59

The worms were fed with 0.5 kg of fresh vegetable each week. The feed was placed at one corner of the bin for the purpose of observing the eating behavior of the worms. Sufficient water was added to each bin to maintain a moisture level of about 70%. Enumeration of *E. fetida* was made and their

weights were taken on the sixth and tenth week of the study period. The products from the decomposition process were sampled and tested for their nutrient contents. The data on the worms' weight, numbers, and the nutrient contents of the composting products were analyzed using the SAS GLM Procedure version 6.5.

Results and Discussions.

1. Change in Population of Worms in Different Bedding Materials

There was a significant increase in worm population for newspaper and sawdust bedding while the control boxes exhibited decreased worm population at week 6. However, at week 10 as can be observed in Table 3, showed a marked decrease in worm population for both newspaper and sawdust.

Table 2: Change in Population of the Worms at Week 6

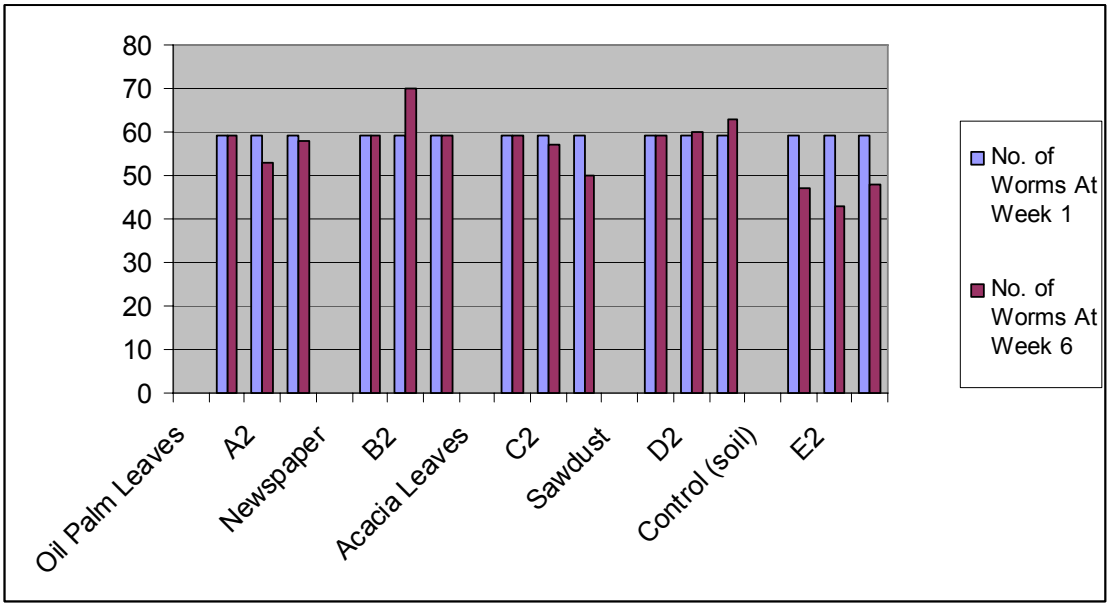
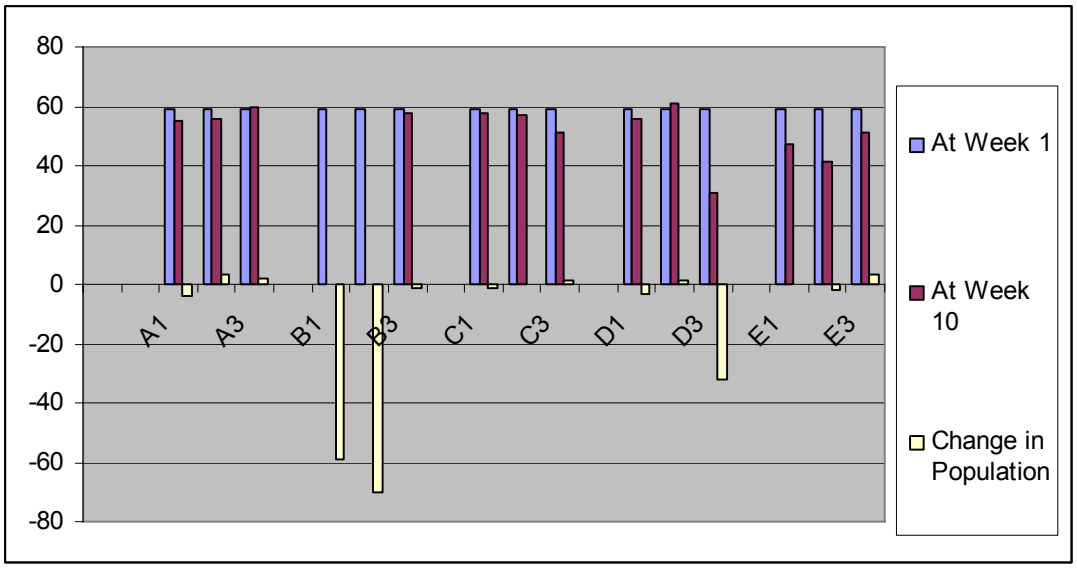


Table 3: Change in Population of Worms at Week 10



2. Worm Growth and Biomass

Worm biomass was observed to decline at week six for most of the vermicomposting boxes (except sample B1, B3 and C1). The control boxes showed the highest rate of weight loss. T-test analysis indicated a significant difference in weight loss between all the treatments (F value of 4.34 at 0.05 degree of confidence). Similar findings was reported by Marsh et. al. (2005).

However, at week ten, the worm biomass seemed to increase significantly for all boxes. T-test analysis revealed significant difference between all treatments in terms of worm weight at week ten (F value of 7.59 at 0.05 degree of confidence). Newspaper treatment showed the highest significant weight gain of 0.63gm (F value of 10.04 at 0.05 degree of confidence). Second, was the sawdust, oil palm leaves and control treatments (0.50gm each) followed by acacia leaves (0.36gm).

Table 4: Worm Weight at Week 6

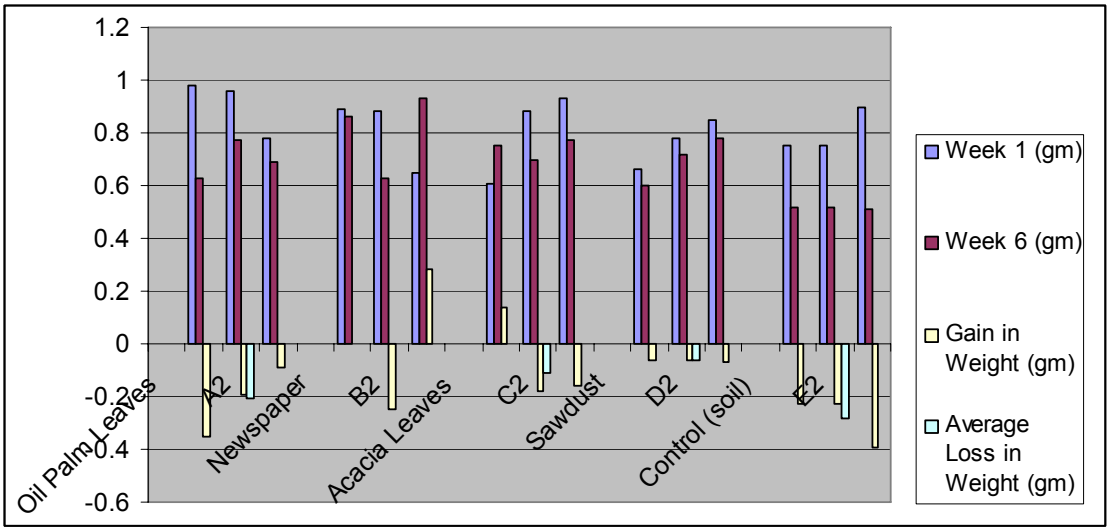
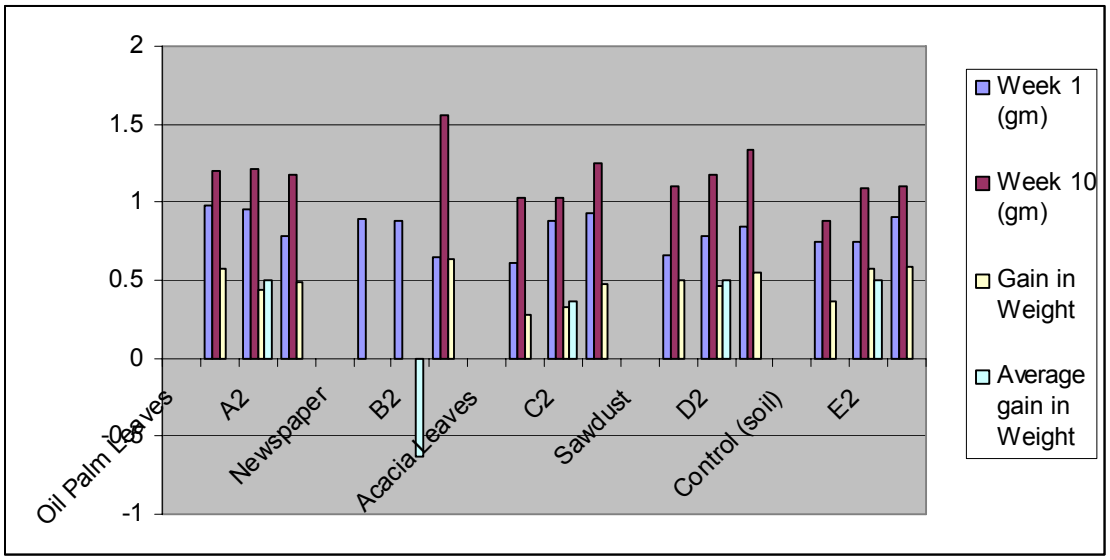


Table 5: Worm Weight at Week 10



3. Nutrient Content and C:N Ratio

There seemed to be no significant difference in the content of K_2O, CaO , MgO and Fe in all samples. However, there seemed to be a significantly higher level of P_2O_4 in the compost output from sawdust (0.23%), and the lowest was

from the control samples (0.10%) with F value of 3.07 at 0.05 degree of confidence. Subsequently, the compost from oil palm and acacia leaves again exhibited a higher level of K_2O (0.23% and 0.26% respectively) as compared to those from newspaper, sawdust and control samples (0.20% each). However, the t-test analysis did not indicate any significant difference in K_2O content between all the treatments.

Table 6: Average Nutrient Content of Compost Output using different Bedding Materials

Bedding Materials	N(%)	P_2O_5(%)	K_2O(%)	CaO(%)	MgO(%)	Fe(%)
Oil Palm Leaves	0.30	0.17	0.23	2.40	0.10	0.67
Newspaper	0.20	0.20	0.20	3.30	0.10	0.67
Acacia leaves	0.33	0.20	0.26	3.20	0.10	0.70
Sawdust	0.20	0.23	0.20	3.30	0.10	0.70
Control	0.10	0.10	0.20	2.50	0.10	0.67

3. C:N Ratio

The results obtained from the analysis for all the samples showed very high C: N ratio and very high percentage of organic matter. 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 is 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 the 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. This is true for all bedding materials used in this study where the C:N ratio were well above desired level of 30:1. The initial C: N ratio of oil palm leaves was about 58-60:1, newspaper was 170:1, Acacia was 40:1, and sawdust was 500:1.

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.

Applehof (1982), states 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.

Conclusions

Based on the data collected, the results showed that newspaper and sawdust were able to support the growth of the earthworms during the first 6 weeks. This may de due to their ability to retain moisture and provide big surface

area for the earthworms to burrow and feed. The treatments with sawdust and newspaper showed some increase in population of the worms and the highest weight gain of the earthworms. This shows that newspaper and sawdust as bedding materials can sustain the lives of the worms provided the right environmental requirements are present.

Oil palm leaves exhibited some potential as bedding materials. With proper environmental conditions such as the right temperature, moisture and handling, these materials can provide excellent bedding materials for vermicomposting of agricultural wastes.

Bedding materials made from acacia exhibited the least sustainability of the worms where the worm mortality was quite high at the 6th week and were not able to pick up at week ten.

Recommendations

Based on the findings of this study, several recommendations are made for further research in the field of local vermicomposting especially of agricultural and household wastes.

1. Detailed study of the potential of acacia leaves as bedding materials should be pursued with regards to the pre-composting period and the right mixture with other substrate so as to provide a smaller C:N ratio to facilitate efficient vermicomposting. Composting of acacia leaves is important since this tree is widely used in ornamental landscapes and their leaf litter can be made use of and turned into organic fertilizer instead of burning which could cause environmental hazards such as the haze.

2. For oil palm plantations, not only the empty fruit bunches can be composted. The leaves can also be converted to valuable organic fertilizers instead of leaving them to rot on their own or burning them. Proper pre-composting and shredding of the fallen oil palm fronds can be used in vermicomposting. This can help the farm owner especially the smallholders to ease the burden of buying fertilizers for their crop.
3. The use of sawdust in vermicomposting can be further studied so that appropriate mixing and conditiong of this substrate can be fully exploited.

Bibliography

Applehof, Mary. 1982. Worms Eat My Garbage. Flower Press, Kalamazoo, Michigan USA.

Gajalakshmi, S., Ramasamy, E.V. and Abbasi, S.A. 2002. High-rate composting –vermicomposting of water hyacinth (Eichhornia crassipes, Mart. Solms). *Bioresource Technology*. Vol 83. pp. 235-239.

Marsh, Lori. et al. 2005**.** Suitability of aquaculture effluent solids mixed with cardboard as a feedstock for vermicomposting**.** *Bioresource Technology***.** 96: pp413-418**.**

Ndegwa, P.M., Thompson, S.A. and Das, K.C. 2000. Effects of stocking density and feeding rate on vermicomposting of biosolids. *Bioresource Technology*. Vol.71, Issue 1 Jan. pp 5-12.

Tripathi, G. and Bhardwaj, P. 2004. Decomposition of Kitchen waste amended with cow manure using an epigeic species (*Eisenia fetida*) and an anecic species (*Lampito mauritii*). *Bioresource Technology*. Vol. 92, issue 2. pp215-218.