The Efficacy of Green Organic Fertilizer on the Growth and Health of Mango Tree (*Mangifera Indica*)

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Abstract. In Malaysia, 98% of garden waste is being dumped in the landfills. Meanwhile, only 2% is being recycled or compost. This is because no specified policy or guidelines focusing on garden waste management, and it often collected separately due to its bulk/large in size caused higher disposal cost. In this study, composting of organic fertilizer (OF) was performed to determine the effectiveness using two types of decomposition medium [leaf mold (LM) and green grass] and to evaluate the growth and health status of the Mango Tree (*Mangifera Indica*). Six different types of soil samples were collected at two-weeks intervals over a three-months period during the composting process. The 6 of tree plots physical monitoring analysis consists of height and diameter of tree and physicochemical parameters tested included pH, total nitrogen (TN), total phosphorus (TP), potassium (K), and heavy metals was performed. Results showed growth and health for plotted tree sample using dripping of OF is more higher and healthy than others. While, N, P and K analysis contents were obviously responsive to the treatments and followed the same trend in wide areas. The result showed highest levels treated with (LM+OF) by dripping automatic system. While, both plot of (LM+OF) manual and both plot (LM) treatments showed significantly the same effectiveness and came second statistically in this regard. In contrast, the lowest values were generally found in plot (control). It was concluded that OF has better effects on plant growth and soil quality with the N, P, and K concentration content. Our results indicate that the residues from the fermentation of organic fertilizers can be widely used.

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1 Introduction

Mango (*Mangifera Indica*) the king of fruits is nutritionally very rich, unique in flavour and smell thus account for approximately half of all tropical fruits produced globally causes from different types of fertilizers used [2-4]. Till today, chemical fertilizers are mostly in use for mango cultivation leads the accumulation of tree growth, healthy and affecting the fruit nutritional value. There is a general agreement that nutrition is the most effective factors affecting tree growth, healthy and fruit quality. However, the high cost of mineral fertilization is a big problem and because of that some previous researchers has come out with new different type of composting to produce organic fertilizers.

Organic fertilizer improves physical, chemical and its biological properties of nearly all soil types; adjusting soil pH and increasing solubility production of the plants [5]. According to Youssef *et al.,* [6], the addition of organic fertilizer (compost) to the soil encouraged proliferation of soil microorganisms, increased microbial population and activity of microbial enzymes. In this context, biofertilizers and liquid organic fertilizers, which are of biological origin, offer themselves as alternative to produce residue free organic for mango tree [7].

In this study, OF that was produced by combination of green grass, salt, water and composted leaf mold that comes from dried leaves were choosen and added to determine its effectiveness towards the growth and health of mango tree. Suitable fertilizer application from combinations of these materials can improve soil quality in terms of physical, chemical, and biological properties [8]. For example, the usage of green grass and leaf mold composting could improve the concentrations of heavy metals as significant to the value as stated that NPK should be in ideal range 0.64% to 1.25% (dry weight basis) for optimized fertilizer [9]. Hence, the positive biological properties could produce the growth and healthy plants.

Good fertilizer management can improve soil quality, but poor fertilizer management can degrade soil physical, chemical, and biological properties [9]. Several factors have been considered to choose Mango Tree as it is abundantly available around Universiti Tun Hussein Onn Malaysia (UTHM) campus. Furthermore, the suitable pH soil ranges value for mango tree is between 5.5 to 8.7 as they can tolerate alkaline conditions [10-11]. According to Zulkepeli *et al.,* [11], findings from previous researchers suggested that the soil condition at UTHM is mainly consists of silty clay and in acidic condition with pH value of 6. Furthermore, according to Liu *et al.,* [12], the pH level of soil is crucial for the growth of mango trees, as it affects microbial activities that associates with nutrient bioavailability.

Recently, the possibility of reutilization of biodegraded wastes as liquid fertilizers to stimulate the plants growth has been proven [13-15]. Thus, it is possible to transfer the raw materials of plants composting to be a OF as a fertilizer source. The positive influence of OF and LM on soil functionality has shown adequate potential and could could act as an alternative for chemical fertilizer and some of the stimulation on the plant's growth has been discussed by Tamara *et al.,* [15]. The main objectives of this study were to determine the effectiveness of organic fertilizer by using two types of decomposing mediums (leaf mold and organic fertilizer) and to evaluate the growth and health of the Mango Tree (*Mangifera Indica*).

2 Experimental

2.1 Materials and methods

2.1.1 Leaf Mold and Green Grass Preparation

A series of stages were developed in order to achieve an optimum result using the main ingredients consists of fresh green grass and leaf mold for growth of the mango tree. During this stage, the collection of green grass samples and dried leaves was obtained around Universiti Tun Hussein Onn (UTHM) campus once in every two weeks. The green grass used to produce liquid organic fertilizer, while the dried leaves composted to produce leaf mold. There were several points marked as collecting points throughout this research. The collected waste loaded at the designated compost pile located at Research Building, UTHM. The compost pile designated into two cages at collection sites, walled with wire fence (1x1m). The wire fence was used to allow aeration throughout the composting process. In order to reach the optimal temperatures for the process of degradation to occur, the green grass and dried leaves gathered into a compost heap at least 4 ft x 4 ft x 3 ft in area. The compost pile needs to be constructed at a shaded area to reduce moisture loss. The compost heap of dried leaves and green grass watered once a week to keep it damp and turned every week to allow them to decompose uniformly and keeps the oxygen content evenly distributed in the pile. The quantity of sample was approximately attained up to 5-7 kg in every sampling process. The experiment was conducted at Lake G3 Universiti Tun Hussein Onn Malaysia started from May 2023 to July 2023.

2.1.2 Preparation of Organic Fertilizer

In this study, fermented organic fertilizer was produced consists of combination of fresh green grass and leaf mold in a barrel. The use of organic fertilizers is improving soil acidification, maintaining soil health and achieving organic ecological agriculture [16]. Gathered at their peak and composted correctly, these leaves can reintroduce these nutrients back into the soil [17]. Organic fertilizer was prepared ahead before utilized as fertilizer which need to be fermented about 6 months as shown in Figure 1 and Figure 2. Fermentation take place in a barrel (50 to 100L) in size. A blue barrel is required with a capacity of 50 to 100 liter. The barrel should be half-filled with fresh green grass and topped up with water. In a barrel, two handful of leaf molds and five tablespoon of salt were required in order to activate fermentation process which could be help for growing healthy bacteria in 6 months of fertilization process. These combinations need to stir regularly as to ensure well blended or combined before each usage. Then, the mixture was fermented until it is ready to use.

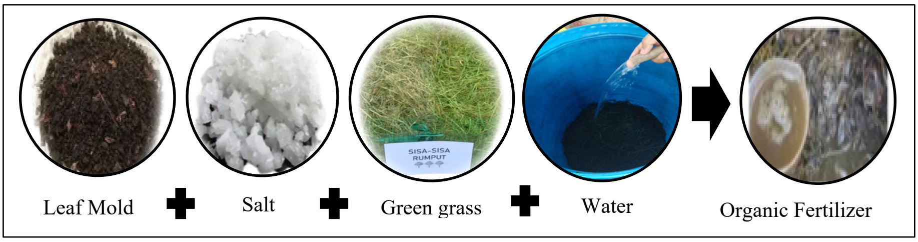


Fig.1. Types of materials prepared for producing organic fertilizer.

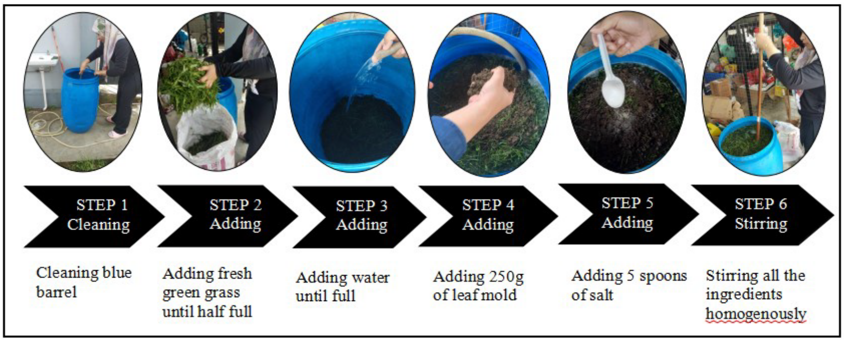


Fig. 2. Preparations of fermented organic fertilizer.

2.1.3 Organic Fertilizer Experimental Set-Up

Two water tanks with a volume of 50 to100 litres will be used as a storage medium for the liquid organic fertilizer. The main storage tank consisted of concentrated organic fertilizer solution placed at 1.5 feet higher than the secondary storage tank consisted of water. The main tank of concentrated organic fertilizer solution flowed to the secondary storage tank through polypipe that installed between the tank. The concentrated fertilizer solution diluted in the secondary storage tank until it meets the criteria for fertilizing the plants. After 6 months of fermentation, 1 litres liquid of organic fertilizer diluted with distilled water which is (1:10) thoroughly as stated by previous studies of [17], distilled water used for the isolation of biosurfactants at a ratio of 1:10 (fermentative sub-strates:water) that would produce a large amount of liquid residue (LR). This is because the fermentative residues often contain specifically high levels of nutrients and various micronutrients in general, so that they should be utilized further rather than discard. According to Liedl *et al.,* [18], stated that since the growth of plants and their quality are mainly a function of the quantity of fertilizer, application of solid fertilizer was not as good as liquid on the effects of plant growth due to the availability of water-soluble nutrients which were easily absorbed by the plants. Recently, the possibility of reutilization of biodegraded wastes as liquid fertilizers to stimulate the plants growth is discussed [19].

The dilution process executed manually. When the fertilizer solution is already diluted, the solution then can be used as fertilizer to the plant trees by opening the stop corks. The flow of dilution of organic fertilizer is remain 24h only. In order to eliminate any residue or contaminants in the solution, a disc fertigation water filter installed before the dilute solution flows to the plant trees. The diluted solution flowed through the microtube and drip by using the fertigation dripper installed at the end of the microtube to the trees. Figure 3 has shown the illustration of proposed organic fertilizer design system, Figure 4 shown orthographic drawing of the proposed design while Figure 5 shown fertigation organic fertilizer system design.

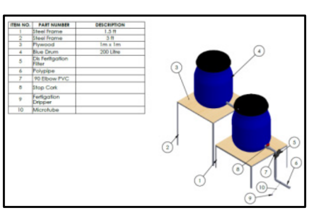


Fig. 3. Illustration of proposed organic fertilizer design system.

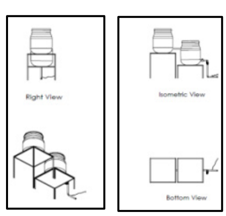


Fig. 4. Orthographic drawing of Organic fertilizer.

Fig. 5. Fertigation of organic fertilizer.

2.1.4 Type of Tree Sample Identification

Monitoring and plotting tree growth for several mango tree has been identified as the sampel or reactors in this study. All devoted trees received the different horticultural practices (control, leaf mold, organic fertilizer) adopted in the region's Mango Tree. Each reactor respresented two types of tree. Complete randomized block design with six replications (each replicate was represented by a single tree) was used for arranging the following treatments:

A1: Control, no fertilizers at all
B1: 250g Leaf mold + 1L OF (Manual)
C1: 250g Leaf mold
D1: 250g Leaf mold + 1L OF + 10L Distilled water (Automatic)
B2: 250g Leaf mold + 1L OF (Manual)
C2: 250g Leaf mold

Taking into consideration that, 250g Lead mold = 2 handfuls adult.

2.1.5 Tree Plots Physical Monitoring Analysis

In terms of growth parameter, once every two weeks, one litre of OF was watered to the plotted tree. Parameters were also recorded and observed. Detection and monitoring were conducted to identify the type of ecosystem damage that occurred to the selected tree. Parameters namely as diameter of stem and height of tree were measured using rope tape. The procedure of monitoring parameters were conducted by using USDA Forest Health Monitoring as well as method by Observation procedure Mcroberts R. E. [19-20]. The observed signs and symptoms were used to record any damage and catastrophic assessment. The damage type as shown in Table 1 was recorded by using a numerical code, which denotes from damage type 01 till 12. The severity damage level was coded by using data from the recorded damage type provided in the Forest Health Monitoring Field Methods Guide [21].

Table 1. The code and damage type codification based on Environmental Monitoring and Assessment Program (EMAP).

No	Damage Type	Saverity level (10%-99%)	Code
1.	Cancer/gall	20%	1
2.	Konk/decay further	Nil*	2
3.	Open wound	20%	3
4.	Exudation (gumosis and resinosis)	20%	4
5.	Broken branches less than 0.91cm	Nil*	11
6.	Brum in root and bole	Nil*	12
7.	Broken root and dieback less than 0.91cm	20%	13
8.	Crown dieback	1%	21
9.	Broken and die branch	20%	22
10.	Brum in crown	20%	23
11.	Leaf damage	20%	24
12.	Leaf discolourization	30%	25

If multiple damage was occurred in the same location, only the most severe damage recorded. The number of damages recorded to each tree was three types of heavy damage. Furthermore, coding the damage to the parts of the tree is carried out by codification according to the standards of the Environmental Monitoring and Assessment Program (EMAP) [20].

2.1.6 Organic fertilizers, soil, leaf mold sampling analysis

Soil sampling was collected every two week and 500g of soil sample was taken from a depth of 30cm prior and 15cm distance from the stem of tree using soil sampler probe. Each sample was divided into 6 plastic bag with different type of soil sample, 1 sample of 250g of lead mold and 1L sample of organic fertilizers. Sample was anaylsed at the Analytical Laboratory.

Parameters chemical analysis are including pH, total nitrogen (TN), total phosphorus (TP), potassium (P), and heavy metal measurement were conducted once in two weeks for OF, LM and soil sample. Changes in pH was determined immediately after transportation into the laboratory and measured by using a ph meter using a method described by [20]. TN was analysed by DR6000 UV-VIS spectrophotometer, HACH Method 10072 Persulfate Digestion Method and the samples was determined by the modified Micro-Kjedahl method [21]. While TP content was tested by atomic absorption spectrometry and inductively coupled plasma atomic emission spectrometry (ICP-AES), respectively, following nitric acid/hy- drogen peroxide microwave digestion [22]. As for potassium and heavy metal, the samples were extracted by nitric acid digestion and analysed by Atomic Absorption Spectrometer (AAS) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Each sampling was replicated three times to ensure there is no bias result achieved during experiment.

3 Results and discussion

3.1 Characteristics of fertilizers

Table 2 below indicated the pH, N, P, K and heavy metals values for the different types of fertilizers consist of LM and fermented OF. For LM and OF, pH value indicated the initial is 3.91 and 4.64 respectively which is acidic. The reason why pH is acidic may be the formation of NH4 + by the ammoniation of nitrogen and the pH of OF itself [22]. In addition, from the previous studies, the organic anions of OF released are adsorbed on the surface of iron and aluminum hydroxide, and the exchanged and dissociated OH ions neutralizes some acidic substances [22].

The N, P, K of LM and OF plots experienced a significant value as it stated the total N,P,K content of the finished compost in this study were in acceptable to ideal ranges: 0.64-1.25% (dry weight basis). As stated by Pregl [23], typical total nitrogen levels of finished compost range from 0.5% to 2.5%. This is influenced by surplus of phosphate in fertilizers to avoid overdosing of P, by balancing the P and N input. Besides, an excessive K uptake may be problematic due to antagonisms with magnesium, resulting in nutrient imbalances with negative consequences for growth and quality (e.g. digestibility) [23]. Thus, also the amount of K relative to N and P is important for optimized fertilization.

While, for the heavy metals, the result shows range between 0-0.6 (mg/l). The ranges of Cd, Cr, Cu, Pb, Ni, Zn, As, Ba concentrations for LM were 0, 0.3, 0.3, 0.6, 0.1, 0, 0.2 and 0 mg/l respectively and for OF were 0, 0.3, 0.1, 0.08, 0.02, 0.6, 0.05, 0.05 mg/l respectively. Among the 8 heavy metals, the concentrations values followed the order for LM were Pb>Cr> Cu>As>Ni>Cd, Zn, Ba and for OF were Zn>Ba>Cu>Pb>As>Cr>Ni>Cd. This result indicated that for LM, Pb has the highest content in LM fertilizer samples, with the value contents of 0.6 mg/l and Cd, Zn, Ba were the least where the value is 0 mg/l. While for OF fertilizers samples, the highest content was Zn which indicated 0.6 mg/l and the least value of content was Cd that only 0 mg/l. From this survey, it will be seen that Pb and Zn were present at high concentrations in fertilizer samples in this study. From the previous researchers, the highest concentration of heavy metals influenced by different raw materials compost and fertilizers processes itself [24]. So, it is important to establish appropriate organic fertilizer quality criteria, decrease the transfer of heavy metals from fertilizers correctly. Thus, according to Neela *et al.,* [25], the concentrations of all elements in fertilizers samples are within tolerable limits.

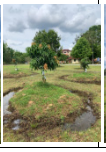
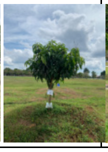
Table 2. Chemical analysis for fertilizers.

Parameters	**May**		**June**		**July**	
	Type of fertilizers		**Type of fertilizers**		**Type of fertilizers**	
	(OF)	**(LM)**	**(OF)**	**(LM)**	**(OF)**	**(LM)**
pH value	6.10	4.30	5.20	4.38	4.64	3.91
TN (%)	3.87	2.10	1.84	0.67	0.64	0.84
TP (%)	4.30	3.30	2.50	2.80	0.66	0.73
K (%)	0.93	4.10	0.88	2.20	0.75	1.25
Heavy metals (mg/l)						
Cd	0.00	0.00	0.00	0.00	0.00	0.00
Cr	0.11	0.23	0.04	0.33	0.03	0.30
Cu	0.08	0.00	0.16	0.30	0.10	0.30
Pb	0.10	0.90	0.30	0.50	0.08	0.60
Ni	0.00	0.00	0.00	0.12	0.02	0.10
Zn	0.00	0.11	0.68	0.00	0.60	0.00
As	0.00	0.11	0.00	0.04	0.05	0.20
Ba	0.30	0.00	0.00	0.00	0.50	0.00

3.2 Physical tree growth measurements

In this regard, number of height of tree (cm) and diameter of stem (cm) and severity level code were investigated growth parameters in response to the differential mineral, organic and bio-organic fertilizer treatments. Data obtained from May to July 2023 are presented in Table 3. Herein, the differential investigated treatments showed obviously a considerable variation in this respect. Worth to mention, highest subjected to D1 followed by B1, B2, C1 and C2 treatments all significantly showed the second in this concern during this experiment. On the contrary, the least values of physical tree recorded usually in concomitant to A1.

Table 3. Analysis physical tree growth measurements.

Physical monitoring	**Month**	**A1**	**B1**	**B2**	**C1**	**C2**	**D1**	**D2**
Height of tree (cm)	May	143.8	141.2	132.7	135.5	135.4	154.1	161.8
Diameter of stem (cm)		15.3	13.6	11.1	12.4	12.9	14.3	13.3
Height of tree (cm)	June	159.6	154.2	142.2	148.8	140.4	164.1	155.7
Diameter of stem (cm)		18.4	19.1	16.1	17.3	17.8	18.2	22.2
Height of tree (cm)	July	165.5	164.1	158.4	159.9	148.6	171.5	176.5
Diameter of stem (cm)		22.0	23.5	20.2	22.4	21.4	23.9	26.9
Code		1, 13, 24, 25	24, 25	24, 25	22, 24, 25	22, 24, 25	21	21
Photo of tree								

3.3 Analysis of soil samples

Table 4 below indicated the analysis of soil samples starting from May to July: A1, B1, B2, C1, C2 and D1. The parameters were included to analysed the soil samples: pH value, a total nitrogen (TN), total phosphorus (TP), potassium (P), and heavy metal. From this result, it can observed that D1 indicated the best performance of chemical analysis among them followed by B1 and B2 then C1 and C2. In contrast, the lowest values of the above parameters were generally determined in A1. From this chemical analysis, it shows the use of OF and LM has a good impact on plants in terms of growth and health.

Table 4. Analysis of soil samples.

Month	Parameters	Soil sample					
		A1	**B1**	**B2**	**C1**	**C2**	**D1**
May	pH value	4.13	4.21	4.26	4.68	4.68	5.68
	TN (%)	0.31	0.49	0.50	0.44	0.44	0.69
	TP (%)	0.58	0.37	0.23	0.86	0.24	0.16
	K (%)	0.32	0.16	0.20	0.23	0.22	0.40
	Cd	0.20	0.00	0.00	0.00	0.02	0.00
	Cr	0.80	0.40	0.30	0.40	0.40	0.30
	Cu	0.60	0.30	0.30	0.20	0.90	0.20
	Pb	0.60	0.60	0.50	0.20	0.00	0.30
	Ni	0.20	0.60	0.10	0.04	0.10	0.10
	Zn	0.00	0.00	0.00	0.00	0.00	0.00
	As	0.40	0.30	0.60	0.30	0.50	0.40
	Ba	0.40	0.30	0.50	0.20	0.00	0.30
June	pH value	4.34	3.94	5.54	4.79	5.47	6.47
	TN (%)	0.31	0.20	0.50	0.51	0.55	0.14
	TP (%)	0.38	0.47	0.47	0.70	0.39	0.74
	K (%)	0.24	0.25	0.14	0.30	0.17	0.12
	Cd	0.05	0.00	0.00	0.00	0.00	0.00
	Cr	0.90	0.40	0.30	0.40	0.40	0.50
	Cu	0.40	0.30	0.10	0.20	0.20	0.20
	Pb	1.00	0.50	0.90	0.50	0.70	0.70
	Ni	0.20	0.09	0.00	0.08	0.08	0.10
	Zn	0.00	0.80	0.70	0.00	0.00	0.00
	As	0.80	0.50	0.50	0.40	0.40	0.50
	Ba	0.00	0.40	0.70	0.40	0.60	0.50
July	pH value	4.69	3.89	5.10	5.39	5.41	6.80
	TN (%)	0.83	0.13	0.94	0.10	0.10	0.52
	TP (%)	0.38	0.57	0.49	0.60	0.60	0.66
	K (%)	0.18	0.18	0.17	0.17	0.17	0.17
	Cd	0.00	0.00	0.00	0.00	0.00	0.00
	Cr	0.30	0.40	0.30	0.70	0.30	0.20
	Cu	0.20	0.40	0.10	0.30	0.10	0.10
	Pb	0.50	0.60	0.50	0.90	0.40	0.30
	Ni	0.10	0.10	0.10	0.10	0.10	0.04
	Zn	0.70	0.90	0.40	0.90	0.50	0.30
	As	0.30	0.40	0.20	0.60	0.20	0.20
	Ba	0.00	0.00	0.50	0.80	0.40	0.30

3.3.1 pH value

Figure 6 shows that, the pH value for D1 is more neutral compare than the other reactors. This is influenced by the fermentation of organic fertilizers towards the soil. Many studies have shown that the addition of fermentation residues could significantly improve the soil pH and increase the soil nutrients content [25]. While, the pH value for the reactors A1, B1, C1, B2 and C2 were recorded between 4-5.5 which categorized as acidic. According to Neela *et al.,* [25], pH value was important in evaluating the microbial environment. This is also supported by Karnchanawong *et al.,* [26] that, action of microbes can be found in the variation of pH especially in acidic range during composting and the best for competent biological decomposition of organic waste also depends on pH. During 3 months of fertilization on D1, pH values were recorded between 5.6-6.8. Early stage of month, the acidic conditions may be influenced by the formation of organic acids and the production of carbon dioxide due to the decomposition of organic substances [26]. pH value may affect the rate of biodegradation due to the rise and fall of the pH value. According to Hla *et al.,* [26], stated that the pH value for compost material should not too acidic or too basic and the suitable pH ranges between 6 to 8 for better biodegradation. However, at the end of the fertilization, pH value for D1 reactors was within 6-6.8 and this indicated the pH value was achieved to suitable pH for the fertilization process.

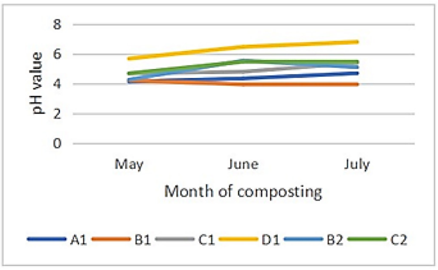


Fig. 6. pH value of soil sample by month in the reactor.

3.3.2 Total Nitrogen

In this study, the concentration of total nitrogen all the reactors demonstrate different value with composting time. As shown in Figure 7, it was recorded that, D1 contain high nitrogen with 0.7% early month of stage, but the end of the fertilization, D1 indicated low nitrogen with 0.5%. Compare with other previous researcher, concentration of total nitrogen, obtained is a quite low for this type of compost. This might be due to ammonia volatilization and elevated temperature during composting process [26]. The concentration of total nitrogen, that retrieved from previous researchers varied from 1.00 to2.45%. In this study, lower total nitrogen was recorded, however the results are similar recorded by Hla *et al.,* [26] which is between 0.03 to 0.07%. While for the other reactors shows the middle value of nitrogen at the early fertilization stages which indicates around 0.5% but the end of study, different value nitrogen indicated respectively with range between 0.5%-0.9%. Overall, total nitrogen recorded range between 0.5-1% for all the reactors.

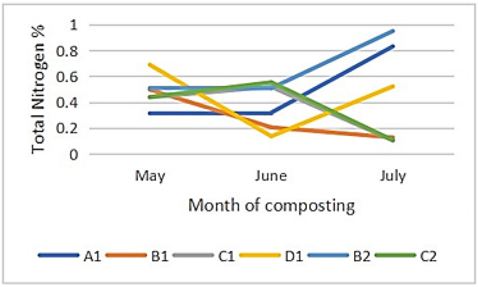


Fig. 7. Total Nitrogen of soil sample by month in the reactor.

3.3.3 Total Phosphorous

Figure 8 shows values of phosphorus along 3 month of fertilization process. D1 shows the increment from early stage of month of fertilization until the 2nd month and dropping to the July. While B1, B2 and C2 demonstrated the increment from the early July until the end of September. From the previous studies, this is also discussed that the increasing of phosphorous may be due to decreases of water solubility with humification so that phosphorous solubility during the decomposition was subjected to further immobilization factor [27]. A1 and C1 shows the decreasing of phosphorous from May until July. Overall, the figure demonstrate the concentration of total phosphorous for all the reactors demonstrate decrease value with composting time.

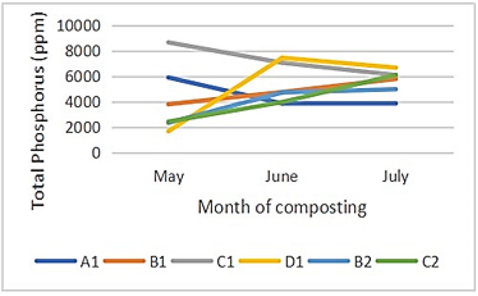


Fig. 8. Total Phosphorous of soil sample by month in the reactor.

3.3.4 Potassium

Potassium is a beneficial element in composting. The K concentration works to increase the size, shape, colour and taste of plant growth [27]. Besides, K can improve photosynthesis and improve the protein synthesis [27]. Based on Figure 9, the highest K concentration was D1 with 3545 ppm during the 1st month of composting. Then, the graph shows the K concentration in D1 decreases dramatically for the 2nd month before increasing considerably for the 3rd month of composting. The decrease in K value might occur due to the type of decomposing medium used such as leaf mold and green organic fertilizers [27]. The raw materials may affect the value of K to increase due to absorption of moisture content maintaining structural integrity and porosity [28]. The increase in K is also influenced by microbes' activity. However, the values of potassium were observed decrease at the end of composting process. At the end of the decomposition process, the value measured was obtained for all reactors is around 1700-2000 ppm.

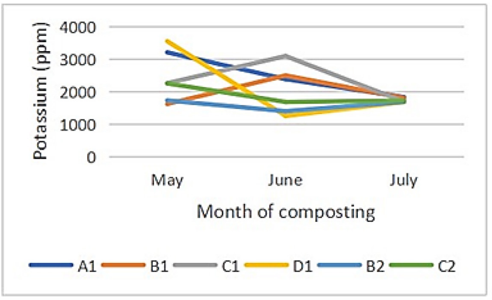


Fig. 9. Potassium of soil sample by month in the reactor.

3.3.5 Heavy Metal

Compost usually contains heavy metal based on their initial raw materials. In this study, heavy metals such as copper, cadmium, arsenic, nickel and lead concentration were measured in all reactor and found as stated in Table 4 above. The value is in accordance with the usage of a small amount of is essential for plant growth and vice versa [28-29]. The concentration of heavy metal where all type of soil were less than 4 ppm. Compared to several commercial organic amendments, the concentrations of heavy metals were much lower, thus it was feasible and safe for the application green organic fertilizers in field [30].

4 Conclusion

In this study, green organic fertilizers as composting method was conducted as one of the feasible alternative method for reducing chemical fertilizers generated at Lake G3 Universiti Tun Hussein Onn Malaysia (UTHM). The results obtained proved that the physical monitoring of height and diameter of stem that using OF can improve growth and healthy of tree. Indeed, the efficacy of green organic fertilizers could also prove acceptable value of nitrogen, phosphorous and potassium (NPK) and the heavy metal were found to be in desirable limits. Therefore, the organic fertilizer could be acceptable used as fertilizers for the tree.

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References

1. Rymbai, H., Patel, C. R., Chaudhry, K. N., Ahlawat, T. R. and Patel, N. L. 2015. *Performance of 'Alphonso'as a source of pollen for its hybrids 'Sonpari'and 'Neelphonso'as female parents in mango*. Indian J. Hort., **72**: 157-61.

2. Anees, M., Tahir, F. M., Shahzad, J. and Mahmood, N. 2011. *Effect of foliar application of micronutrients on the quality of mango (Mangifera indica L.) cv. Dusehri fruit*. Mycopath., **9**: 25-28.
3. W. J. Lim, A. Y. Yusof, N. L. Chin, and A. Yahya, *"Food waste handling in Malaysia and comparison with other Asian countries,"* International Food Res. J, **1–6** (2016).
4. Tan, L. Min, *"Production of Fertilizer using Food Wastes of Vegetables and Fruits"* (Bachelor of Science with Honours, Plant Res. Science and Manag, 2015).
5. H. A. Hamid, L. P. Qi, H. Harun, F.H. Ahmad, M. S. Muhammad, and N. Hamidon, *"Development of Organic Fertilizer from Food Waste by Composting in UTHM Campus Pagoh"* (J. of Applied Chemistry and Natural Res., 2019), **1**, 1, pp. 1–6.
6. Youssef, A.H., A.H. El-Fouly, M.S. Youssef and S.A. Mohamadien, 2001. *Effect of using organic and chemical fertilizers in fertigation system on yield and fruit quality of potato plants. Resent Technologies in Agriculture.* Proc. of the 2nd Congress, **9 (1)**: 79-94.
7. Abou Hussein, S.D., L. EL-Oksha, T. EL-Shorbagy and A.M. Gomaa, 2002. *Effect of cattle manure, biofertilizers and reducing mineral fertilizer on nutrient content and yield of potato plant.* Egypt. J. Hort., **29 (1)**: 99-115.
8. Hasan, M.A., M. Manna, P. Dutta, K. Bhattacharya, S. Mandal, H. Banerjee, S. K. Ray and S. Jha, 2013. *Foliar nutrient content in mango as influenced by organic and inorganic nutrients and their correlative relationship with yield and quality*. Acta Horticulturae, **992**: 201-206.
9. Gathala MK, Kanthaliya PC, Verma A, Chahar MS (2007). *Effect of integrated nutrient management on soil properties and humus fractions in the long-term fertilizer experiments.* Journal of the Indian Society of Soil Science, **55**:360-363.
10. Bally, Ian SE. *"Mangifera indica (mango)."* Species profiles for pacific island agroforestry (2006): 1-25.
11. Zulkepeli, Zati Amani, and Zaihasra Abu Talib. *"A GIS-Based Approach For Data Management in Universiti Tun Hussein Onn Malaysia (UTHM), Batu Pahat, Johor, Malaysia."* Recent Trends in Civil Engineering and Built Environment 3.**1** (2022): 281-289.
12. Liu, G., Mylavarapu, R., Hanlon, E. and Lee, W. C. (2020) *'Soil pH Management for Optimum Commercial Fruit Production in Florida'*, UF/IFAS Extension, **(4)**, pp. 1–6.
13. Reyes-Torres, M., Oviedo-Ocaña, E. R., Dominguez, I., Komilis, D. and Sánchez, A. (2018) *'A systematic review on the composting of green waste: Feedstock quality and optimization strategies',* Waste Management. Elsevier Ltd, **77,** pp. 486–499. doi: 10.1016/j.wasman.2018.04.037.
14. Khan, M. and Ahmed, N. (2021) *'Sustainable Management of Mango Nutrition for Better Yield and Quality',* Cercetari Agronomice in Moldova, **53(4)**, pp. 473–501.
15. Tamara, V.R., G.K. Nadezhda and A.M. Natalya, 2005. *Influence of soil application of biological and mineral fertilizers on the growth, yield and fruit biochemical components of 'charavnitsa' apple and on some agrochemical soil characteristics.* Acta Scientiarum Polonorum, Hortorum Cultus, **4**: 59-67.
16. Kassem, H.A. and H.A. Marzouk, 2002. *Effect of Organic and / or mineral nitrogen fertilization on the nutritional status, yield and fruit quality of Flame seedless grapevines grown in calcareous soils.* J. Advan. Agric. Res., **7(1)**: 118-126.
17. Cayuela, J. A. (2008). *Vis/NIR soluble solids prediction in intact oranges (Citrus sinensis L.) cv.* Valencia Late by reflectance. Postharvest Biology and Technology, **47(1),** 75-80.

18. Liedl, B. E., Bombardiere, J., & Chatfield, J. M. (2006). *Fertilizer potential of liquid and solid effluent from thermophilic anaerobic digestion of poultry waste.* Water Science and Technology, **53(8),** 69-79.
19. McRoberts, R. E., Bechtold, W. A., Patterson, P. L., Scott, C. T., & Reams, G. A. (2005). *The enhanced Forest Inventory and Analysis program of the USDA Forest Service: Historical perspective and announcement of statistical documentation.* Journal of Forestry, **103(6),** 304-308.
20. Tallent-Halsell, N. G. (1994). *Forest health monitoring: Field methods guide* (No. PB-95-190419/XAB; EPA-620/R-94/027). Environmental Protection Agency, Las Vegas, NV (United States). Environmental Monitoring Systems Lab.
21. Whittier, T. R., & Paulsen, S. G. (1992). *The surface waters component of the Environmental Monitoring and Assessment Program (EMAP): an overview.* Journal of Aquatic Ecosystem Health, **1,** 119-126.
22. H. Dahshan, A.M.M. Abd-Elall, M.A. Abd-El-Kader and A.M. Megahed, *Field-scale management and evaluation of recycled cattle manure solids from livestock in Nile Delta ecosystem.* African J. of Agricultural Research, **8(23),** 2829-2836, (2013).
23. Pregl, F. (1968). *Quantitative organic microanalysis. In Source Book in Chemistry, 1900–1950* (pp. 6-8). Harvard University Press.
24. Sah, R. N. and Miller, R. O. 1992. *Spontaneous reaction for acid dissolution of biological tissues in closed vessels.* Anal. Chem., 64: 230–233.
25. Neela, S., & Fanta, S. W. (2019). *Review on nutritional composition of orange-fleshed sweet potato and its role in management of vitamin A deficiency.* Food science & nutrition, 7(6), 1920-1945.
26. Karnchanawong, S., Mongkontep, T.,and Praphunsri, K.,. *Effect of green waste pretreatment by sodium hydroxide and biomass fly ash on composting process.* Journal Cleaner Production, **146,** (2017), pp.14–19.
27. Hla, S. S. and Roberts, D. (2015) *'Characterisation of chemical composition and energy content of green waste and municipal solid waste from Greater Brisbane, Australia',* Waste Management**. Elsevier Ltd, 41,**
28. Brennan, A., Jiménez, E. M., Puschenreiter, M., Alburquerque, J. A., & Switzer, C. (2014). *Effects of biochar amendment on root traits and contaminant availability of maize plants in a copper and arsenic impacted soil.* Plant and soil, 379, 351-360.
29. Masters DG, Thompson AN (2016) *Grazing crops: implications for reproducing sheep.* Anim Prod Sci 56:655–668.
30. Clemens, M. A., Radelet, S., Bhavnani, R. R., & Bazzi, S. (2012). *Counting chickens when they hatch: Timing and the effects of aid on growth.* The Economic Journal, **122(561),** 590-617.