International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume:03, Issue:06 "November-December 2017"

EFFECT OF DIFFERENT FERTILIZER TREATMENTS ON *Eurycoma longifolia* WILDINGS AT NURSERY STAGE

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ABSTRACT

Eurycoma longifolia is a promising herb species due to its pharmacological importance and market demands. Realizing that there is limited information on suitable fertilizer applications, specifically at nursery stage, has led to the initiation of this study. Three types of fertilizer (Coffee, Green and Organic) were tested on 100 wildings of *E. longifolia* at nursery stage. Growth data were taken at initial of the experiment and after three consecutive months. Findings showed no significant difference on the growth performance increment of the wildings (based on height increment data). On the other hand, diameter at collar region showed significant difference at the third month observation by green fertilizer (1.92 mm) and organic fertilizer (1.65 mm). Nevertheless, Organic fertilizer consistently showed the highest increment of height and showed a significant difference on collar diameter increment at the third month observation. Early observation showed that the Organic fertilizer might have performed better in improving the growth performance of *E. longifolia* wildings at the nursery stage.

Keywords: *Eurycoma longifolia*, plant improvement, wildings, fertilizer, nutrients

ISSN: 2455-6939

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1. INTRODUCTION

Eurycoma longifolia, or locally known as "Tongkat Ali" is among the most prominent traditional herbs in Malaysia promising undeniably abounding benefits to people. It belongs to the Simaroubaceae family, characterized with pinnate leaves of green colour growing on branches up to 1 m long and flowers tiny, reddish, unisexual and densely arranged (Keng, 1987).

Quoted from World Health Organization (WHO) which provides clear elucidation of currently popular "traditional medicine" term has defined the latter as "the sum total of the knowledge, skills, and practices grounded from theories, beliefs, and experiences aboriginal to disparate cultures, whether explicable or not, utilized for health maintenance as well as in the prevention, diagnosis, amelioration or remediation of physical and mental illness" (WHO, 2005). Traditionally adopted, indigenous herbal or herb-derived medicines have always been a favourable choice since time immemorial.

Today, apart from having an immense competition of synthetic drug-designing advancement, traditional medicine is constantly captured the global attention as an alternative remedy in recuperating countless diseases. Their natural origin and wide nutraceutical potentials have founded them with a steady stand.

The wide spectrum of pharmacological effects of *E. longifolia* was closely associated with its diverse biologically active compound embedded in its roots, stem, leaves and even bark. Among all, quassinoids which include eurycomanone is conspicuous as the major phytoconstituent of the plant which is effective at inhibiting cell growth in nanomolar and subnanomolar concentrations (Miyake et al., 2009). *E. longifolia* is also an acknowledged folk medicine with aphrodisiac effects enhancing male fertility as well as treating intermittent fever (malaria) in Asia (Rehman, Choe & Yoo, 2016). Consequently, due to its escalating demand, there is a coaxing urge towards the plant breeders in discovering facts of producing the best quality and improved planting materials of *E. longifolia*.

Currently, *E. longifolia* is an important subject matter of research in FRIM due to its many promising benefits. Intense researches on *E. longifolia* have been conducted on many aspects; phytochemistry, genetics and plant pathology. Another important factor is to ensure that the industry have the high quality planting materials of *E. longifolia* in order to meet the market demands. Thus, Plant Improvement Programme of FRIM has started a breeding strategies program on the species which involving the provenance trial research. Genetic materials of *E. longifolia* which consisting of seeds and wildings had been collected throughout Peninsular Malaysia for the study purposes.

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Unfortunately for *E. longifolia* species, limited information available on the common nursery practices specifically referring to the types of fertilizer used, recommended amounts and frequency of application. Therefore, this experiment aims to conduct a comparative study on the best fertilizer from the three commonly used, selected market-available brands which would help improve the growth performance of *E. longifolia* at nursery stage.

2. METHODOLOGY

2.1 Sampling of *E. longifolia* from the wild

Wildings of *E. longifolia* were collected from Forest Reserve Maokil, Johor and brought back to the nursery of FRIM and transferred to 100% of top soil media. Sampling activities were initially conducted for provenances trial of *E. longifolia*. The age of the wildings at the nursery during the experiment is conducted is two years old. However, since the wildings were collected from the forest areas, the exact age is unknown. Criteria took into account prior the selection is based on the wellness of the wildings.

2.2 Experimental design: Completely Randomized Design (CRD)

The experiment was laid in a Completely Randomized Design (CRD), there were 5 wildings per fertilizer treatment (one control and three different fertilizers treatment) and replicated by five times, making a total of 100 wildings tested. The experiment was taken place at FRIM's nursery with 100% exposure to sunlight and automated watering for two times per day (morning = 8.30am and evening = 4.30pm).

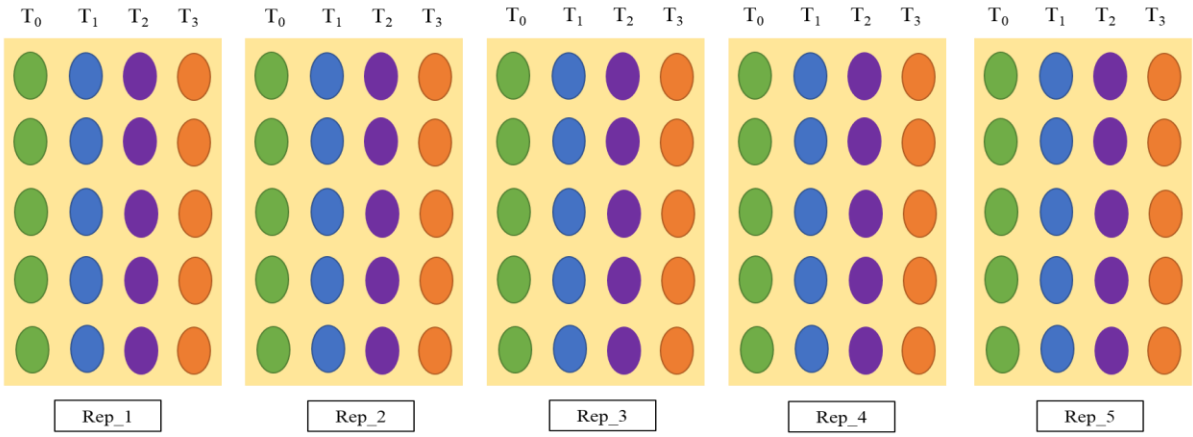

Figure 1: Illustration of the fertilizer trial of *E. longifolia'* wildings at the nursery

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2.3 Fertilizer Applications

There were three different fertilizer treatments tested in the experiment with one control treatment, where there was no fertilizer applied. The first treatment is with N:P:K (8:8:8) or commercially known as Coffee fertilizer, the second treatment is with N:P:K:S (15:15:15:15) or commercially known as Green fertilizer, and the third treatment is with Organic fertilizer. Organic fertilizer used in this study was made from vegetables, fruits and coffee wastes with an even ratio of N:P:K. However, the nutrients ratio was not disclosed by the manufacturer.

The fertilizers were applied with the recommended amount at nursery stage (based on the plant's height) according to the brand applied – 5g for both Coffee and Green fertilizers and 10g for Organic fertilizer. Fertilizer application was carried out once per month.

Table 1: The selected fertilizer used in the experiment

Fertilizer treatments	Indicator
Control	T_0
N:P:K (8:8:8)	T_1
N:P:K:S (15:15:15:15)	T_2
Organic fertilizer	T_3

N = Nitrogen, P = phosphorus, K = Potassium, S = Sulphur

2.4 Data collection

Data collection is done at the initial phase in which after transferring the wildings into the polybags followed by three consecutive measurements of a one-month interval . Data collected included the height of the plants measured with centimetre ruler (cm) and also diameter at collar region measured with Vernier calliper in millimetre (mm).

2.5 Statistical Analysis

Data were analysed using SPSS Statistics Software ® using Analysis of Variances (ANOVA) and Tukey post-hoc test. The increment of height (cm) and increment of collar diameter (mm) were calculated and taken into the assessment.

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Figure 2: (1) Samples of *E. longifolia* from the wild were potted in polybags (8X8 inches); (2) The experiment was laid in CRD experimental design; (3) Each fertilizer treatment was labelled; (4) The diameter at collar region is measured using Vernier caliper; Figure 5: 5.00 g of Coffee fertilizer is weighed; (6) 10.00 g of Organic fertilizer is weighed; (7) Applications of fertilizers; and (8) The height of the wildings were measured using centimeter ruler.

3. RESULTS AND DISCUSSION

Initial height and diameter at collar region indicated that *Eurycoma longifolia'* wildings in control treatment (T0) had significantly better growth ($p < 0.05$) as compared to wildings tested in the other three fertilizer treatments which were N:P:K fertilizer (T1), N:P:K:S fertilizer (T2) and Organic fertilizer (T3) (Table 2). Initial height recorded for T0 was 35.452a ± 1.739 (cm ± SE), followed by T1 = 24.072b ± 1.295 (cm ± SE), T3 = 23.832b ± 1.722 (cm ± SE) and T2 =21.384b ± 1.517 (cm ± SE) (Table 3). Initial collar diameter recorded for T0 = 9.256a ± 0.511 (mm ± SE), followed by T1 = 5.222b ± 0.342 (mm ± SE), T3 = 4.475b ± 0.391 (mm ± SE) and T2 = 4.471b ± 0.272 (mm ± SE) (Table 4).

It has to be admitted that there were variations when the samples used in the study were originated from the wild whereby the exact age of the wildings collected was unknown. Therefore, in this study, the increment of height and collar diameter were calculated and taken into account as an indicator of the effect of different fertilizers on the growth performance of *E. longifolia'* wildings.

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Early observations showed that different fertilizers treatments did not significantly ($p > 0.05$) affect the increment of height for three consecutive months after the fertilizers application (Table 2). However, there were variations of the effect of the fertilizer treatments on the diameter at collar region data. After the first month, control treatment (T 0) showed significantly higher increment with 2.202a ± 0.413 (mm ± SE) (Table 6) as compared to other fertilizers treatments. The increment of collar diameter was not significant ($p = 0.097$) after the second months but showed significant difference after the third months ($p < 0.005$) (Table 2). After the third months of observation, increment for collar diameter recorded the highest by T2 = 1.918a ± 0.389 (mm ± SE) and T3 =1.651a ± 0.149 (mm ± SE), followed by T1 = 1.301ab ± 0.136 (mm ± SE) and T0 = 0.657b ± 0.136 (mm ± SE) (Table 6).

Table 2: Analysis of Variance (ANOVA)

		Sum of Squares	df	Mean Square	F	Sig.
Initial Height	Between Groups	2973.207	3	991.069	15.904	.000
	Within Groups	5982.441	96	62.317		
	Total	8955.648	99			
Height after the first month	Between Groups	2046.638	3	682.213	8.771	.000
	Within Groups	7466.742	96	77.779		
	Total	9513.380	99			
Height after the second month	Between Groups	2193.625	3	731.208	8.077	.000
	Within Groups	8690.381	96	90.525		
	Total	10884.006	99			
Height after the third month	Between Groups	1635.252	3	545.084	4.681	.004
	Within Groups	11179.765	96	116.456		
	Total	12815.016	99			
Initial Collar diameter	Between Groups	377.368	3	125.789	33.271	.000
	Within Groups	362.947	96	3.781		
	Total	740.315	99			
Collar diameter after	Between Groups	545.744	3	181.915	33.094	.000

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the first month	Within Groups	527.706	96	5.497		
	Total	1073.450	99			
Collar diameter after the second month	Between Groups	507.940	3	169.313	32.903	.000
	Within Groups	494.005	96	5.146		
	Total	1001.945	99			
Collar diameter after the third month	Between Groups	269.252	3	89.751	19.062	.000
	Within Groups	452.009	96	4.708		
	Total	721.261	99			
Height increment (1)	Between Groups	21.619	3	7.206	1.881	.139
	Within Groups	314.218	82	3.832		
	Total	335.837	85			
Height increment (2)	Between Groups	16.421	3	5.474	1.012	.393
	Within Groups	389.440	72	5.409		
	Total	405.860	75			
Height increment (3)	Between Groups	9.082	3	3.027	.230	.875
	Within Groups	1080.459	82	13.176		
	Total	1089.541	85			
Collar diameter increment (1)	Between Groups	25.182	3	8.394	7.093	.000
	Within Groups	88.755	75	1.183		
	Total	113.937	78			
Collar diameter increment (2)	Between Groups	1.866	3	.622	2.216	.097
	Within Groups	14.872	53	.281		
	Total	16.738	56			
Collar diameter increment (3)	Between Groups	16.248	3	5.416	5.423	.002
	Within Groups	78.889	79	.999		
	Total	95.137	82			

**Significant different at $p < 0.05$*

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Even though, ANOVA test showed no significant difference of the height increment among the fertilizer treatments, T3 (organic fertilizer) constantly showed the highest height increment throughout the three consecutive months; first month = 3.392a ± 0.420 (cm ± SE), second month = 2.621a ± 0.554 (cm ± SE) and third month = 5.126a ± 0.567 (cm ± SE) (Figure 3). The increment of collar diameter of T3 also showed highly significant difference after the third month (Figure 4). On the other hand, the rank of initial height is as follows; T0 > T1 > T3 > T2 (T3 ranked the third). However, after the first, second and third month of fertilizer treatment, the rank of height is as follows; T0 > T3 > T1 > T2 (T3 ranked the second) which indicated that the growth performances of E. longifolia' wildings in T3 treatment have shown an improvement.

Organic fertilizer used in this study is easily purchased at plant nurseries. The fertilizer was made based on the mixture of vegetable s, fruits and coffee wastes. The manufacturer only mentioned that the N:P:K ratio is even, without disclosing the information of the ratio in figure. For further information of the organic fertilizer used in the study, chemical composition test is recommended to be carried out.

Table 3: Height (cm) of *E. longifolia* wildings based different fertilizer treatments

Fertilizer treatments	Initial height (cm) ± SE	Height (cm) ± SE after the first month	Height (cm) ± SE after the second month	Height (cm) ± SE after the third month
T_0	35.452a ± 1.739	36.096a ± 1.717	38.0a ± 1.964	40.596a ± 2.063
T_1	24.072b ± 1.295	26.488b ± 1.475	28.996b ± 1.691	32.648ab ± 2.167
T_2	21.384b ± 1.517	24.2b ± 1.757	25.284b ± 1.814	29.528c ± 2.244
T_3	23.832b ± 1.722	27.224b ± 2.057	29.036b ± 2.115	33.652ab ± 2.154

**Mean with the same alphabet showed no significant difference at 0.05*

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Table 4: Collar diameter (mm) of *E. longifolia* wildings based different fertilizer treatments

Fertilizer treatments	Initial collar diameter (mm) ± SE	Collar diameter (mm) ± SE after first month	Collar diameter (mm) ± SE after second month	Collar diameter (mm) ± SE after third month
T_0	9.256a ± 0.511	10.797a ± 0.669	10.755a ± 0.605	10.56a ± 0.391
T_1	5.222b ± 0.342	5.742b ± 0.392	5.718b ± 0.353	6.849b ± 0.411
T_2	4.471b ± 0.272	5.065b ± 0.347	5.318b ± 0.390	6.385b ± 0.418
T_3	4.475b ± 0.391	5.485b ± 0.397	5.651b ± 0.423	7.302b ± 0.507

**Mean with the same alphabet showed no significant different at 0.05*

Table 5: Increment of height (cm) after the consecutive months of different fertilizer treatments

Fertilizer treatments	Height (cm) ± SE increment (1)	Height (cm) ± SE increment (2)	Height (cm) ± SE increment (3)
T_0	1.886a ± 0.415	2.69a ± 0.408	4.4a ± 1.071
T_1	2.626a ± 0.460	3.215a ± 0.621	4.309a ± 0.719
T_2	2.942a ± 0.355	1.882a ± 0.524	4.744a ± 0.806
T_3	3.392a ± 0.420	2.621a ± 0.554	5.126a ± 0.567

**Mean with the same alphabet showed no significant different at 0.05*

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Table 6: Increment of collar diameter (mm) after the consecutive months of different fertilizer treatments

Fertilizer treatments	Collar diameter (mm) ± SE increment (1)	Collar diameter (mm) ± SE increment (2)	Collar diameter (mm) ± SE increment (3)
T_0	2.202a ± 0.413	0.977a ± 0.193	0.657b ± 0.136
T_1	0.842b ± 0.101	0.502a ± 0.114	1.301ab ± 0.136
T_2	0.934b ± 0.093	0.672a ± 0.103	1.918a ± 0.389
T_3	0.933b ± 0.198	0.559a ± 0.136	1.651a ± 0.149

**Mean with the same alphabet showed no significant different at 0.05*

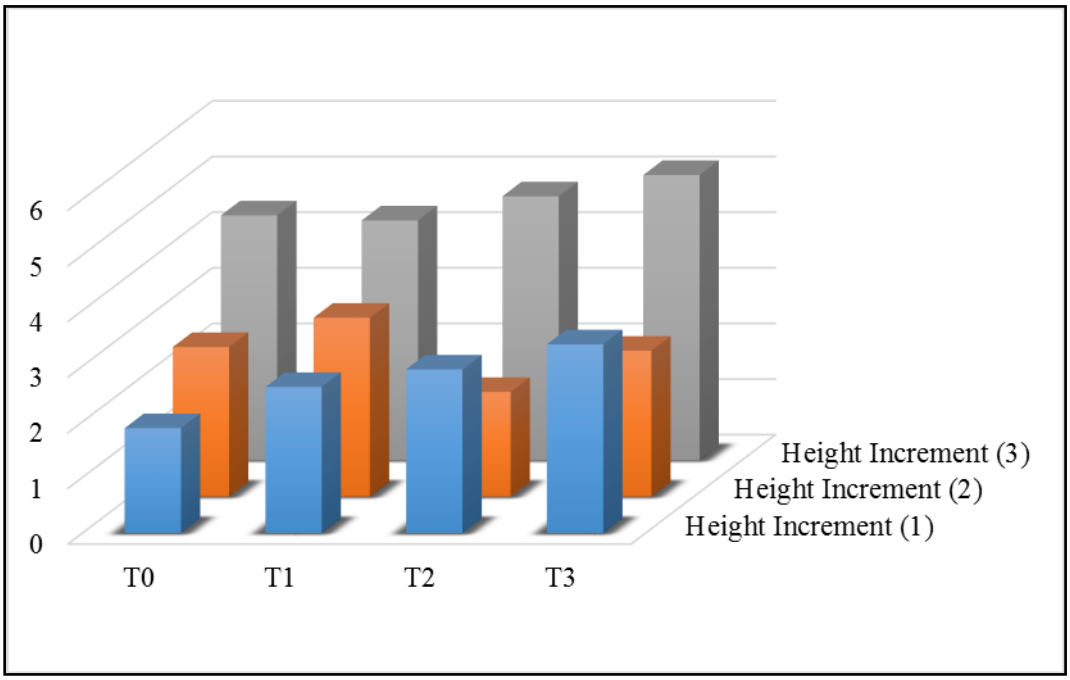

Figure 3: Column chart of the height increment (cm) after three consecutive months of fertilizer treatment.

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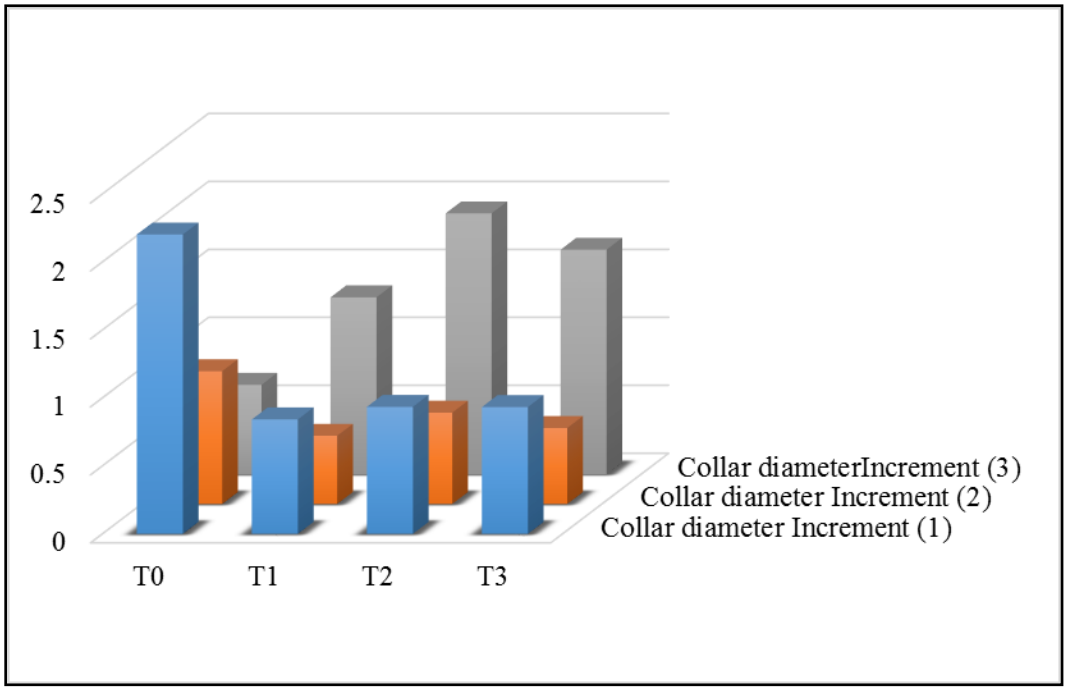

Figure 4: Column chart of the collar diameter (mm) after three consecutive months of fertilizer treatment.

Fertilizer is an essential facilitator which boost the growth of many plants regardless either for commercialized crops or forest plantations. It is widely utilized by many foresters and farmers since time immemorial in order to yield bigger size and better production. The need to grow food and fodder crops on poor soils becomes a necessity due to the reduced land availability, consequently, requires an incremental consumption of fertilizers (Kanapathy, 1976).

Plants prerequisite nutrients in order to grow healthily. Most fertilizer brands available on market shelves equipped with essential elements such as Nitrogen (N), Phosphorus (P) and Potassium (K) which carry their own functions, important for plant's growth. Nitrogen is a pivotal element in plant as it exists in plant's food processing machine, chlorophyll. It also can be found in plant's proteins, alkaloids, enzymes as well as hormones. Nitrogen deficiency eventually leads to yellow colouring of the leaves. Application of nitrogenous fertilizer will instantaneously consume by the plants and helps in overcoming nitrogen deficiency.

Meanwhile, phosphorus is an essential constituent of many vitally important plant's compounds such as the nucleotides. In the case where a plant is facing phosphorus deficit, this leads to the poor roots development and portray signs of generally disturbed growth. Other than that, if a plant is lacking potassium element, water imbalance within the plant is created. Potassium is a

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significant element which provides ionic environment within the plants. Lacking potassium eventually disrupts the equilibrium leading the plants to wilt (Leigh & Wyn Jones, 1984).

Despite ample of benefits, a fertilizer able to offer, over consumption of the fertilizer is undesirable towards the growth of the plants and also environment. Its aftermath includes root burn condition in plants and also water pollution where leachates carrying excess fertilizers from agricultural activity leaks into the drain nearby (Problems of Overusing Fertilizers, 2017). Therefore, the application of fertilizers either at the nursery stage or at the plantation should always be in controlled manner. The optimum amount of fertilizer applications is crucial information, especially at nursery stage. This is because plants are potted in polybags and there is only minimum amount of media or soil available. Over application of the fertilizer amounts could be a c ause of death.

In this present day, the market rivalry has getting berserk and stronger competition has incurred. Fertilizer products are now not only produce by only a few companies, instead, dozens of companies have grabbed the opportunity of venturing into fertilizer trading and some even owned their self-brand. The fertilizers may deliver as organic or inorganic depending on the recipe they used. Consequently, consumers are offered with tons of choices assorted with different prices and functions suiting the consumers' favourable pallet. Choosing the right fertilizer with the right ratio of nutrients components, however, required extensive experimental study since different species reacted differently.

CONCLUSION

Early findings indicated that, organic fertilizer might have performed better in improving the growth performance of *E. longifolia*' wildings at nursery stage. However, ANOVA showed no significant different on the growth increment data of height and diameter at collar region except for the third month observation. This probably due to low amount of fertilizer applied. Therefore, extended test is needed to determine the optimum amount of fertilizer required by the wildings at the nursery stage.

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