# *Theobroma cacao* L. GROWTH PERFORMANCE ON ORGANIC COMPOST MEDIA

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**ABSTRACT -** *Main role of soil is to accelerate the function of plant roots and soil borne microbes and nutrients availability. Mainly functioning through the soils, nutrients in the soils might be the most important factor to affect the growth of plants and their phytochemical contents. Infertile soil may lead to high percentage of seedlings mortality and unhealthy seedlings. In standard nursery practices, soil media used is mainly soil without any other mixture. The research study was carried out in the nursery of Malaysian Cocoa Board Research and Development Centre, Sarawak from April to November, 2017. The cocoa seedlings were planted into three different soil composition under 50% light intensity shade with T1 is soil mixed with pure chicken manure, T2 is soil mixed with organic compost and T3 is soil mixed with organic compost and sand. Approximately 243 cocoa seedlings of one-month grafted were used in this study. Three clones involved were MCBC8, KKM22 and APA4. Mean height (cm) and diameter increment (mm) were recorded biweekly within eigth months study period. The field layout design was a randomized complete block designed (RCBD) with three replicates. Hence, this research study was conducted to determine the effect of different soil composition on cocoa seedlings growth performance at nursery stage. The combination of compost and sand does have significant effect on enhancing cocoa seedlings height by improving soil structure. Total diameter increments within eight months period (for all three clones) were only slightly different whereas T1 with 3.54±0.29mm, followed by T2 and T3 with 3.95±0.12mm and 3.95±0.16mm. The combination of top soil, GML, CIRP, organic compost and sand gave better growth performance of cocoa seedlings.*

***Key words*:** *Theobroma cacao* L., soils, growth performance, organic, compost

## INTRODUCTION

Soil main function is to provide a suitable surrounding especially for plant roots (Latour *et al.*, 1996) and soil borne microbes (e.g. root endophytic fungi, mycorrhizal fungi, rhizobia, and plant growth-promoting microorganisms) and nutrients availability which plant can be benefitted from it. Mainly functioning through the soils, nutrients in the soils might be the most important factor to affect the growth of plants and their phytochemical contents (Yuwatida *et al.*, 2014). Besides that, soil type may play an important role to affect the interaction among plant root, soil nutrient, and soil microbes (Latour *et al.*, 1996). Less fertile soil may lead to high percentage of seedlings mortality and unhealthy seedlings. In standard nursery practices, soil media used is mainly soil without any other mixture. Hence, this research study was conducted to determine the effect of different soil composition on cocoa seedlings growth performance at nursery stage.

## MATERIALS AND METHODS

The research study was carried out in the nursery of Malaysian Cocoa Board Research and Development Centre, Kota Samarahan from April to November, 2017. The cocoa seedlings were planted into three different soil composition (T1, T2 and T3) as shown at Table 1.0 under 50% light intensity shade. Approximately 243 cocoa seedlings of one-month grafted were used in this study. Three clones involved were MCBC 8, KKM 22 and APA 4. Mean height (cm) and diameter increment (mm) were recorded biweekly within eight months study period. The field layout design was a randomized complete block designed (RCBD) with three replicates.

Table 1: Soil composition and ratio for three different treatments

| Treatment | Soil Composition | Ratio (kg) |
|---|---|---|
| T1 | Soil + GML + CIRP + pure chicken manure | 2 : 1 : 1 : 2 |
| T2 | Soil + GML + CIRP + organic compost | 2 : 1 : 1 : 2 |
| T3 | Soil + GML + CIRP + organic compost + sand | 2 : 1 : 1 : 2 : 2 |

*GML stand for Ground Magnesium Limestone
*CIRP stand for Christmas Island Rock Phosphate

**Treatment 1:** Soil + GML + CIRP + pure chicken manure (2 : 1 : 1 : 2)

**Treatment 2:** Soil + GML + CIRP + organic compost (2 : 1 : 1 : 2)

**Treatment 3:** Soil + GML + CIRP + organic compost + sand (2 : 1 : 1 : 2 : 2)

*Figure 1: Three different treatments using different organic compost (T1, T2 and T3).*

***Data analysis***

Statistical analysis were carried out for two-way ANOVA (Analysis of Variance) and Tukey's Test using Statistical Product and Service Solution (SPSS 21.0) software for mean comparison if the treatments are significantly different.

**RESULTS AND DISCUSSIONS**

Results showed that mean height increment (cm) of all three clones used (MCBC 8, KKM 22 and APA 8) had significantly different ($p<0.001$) only for Treatment 1 (Top soil + CML + CIRP + pure chicken manure) and Treatment 3 (Top soil + GML + CIRP + organic compost + sand) as shown at Table 1. Mean height increment (cm) increasing gradually according to soil composition whereas T1 had the lowest with 15.36±2.23cm, followed by T2 and T3 by 21.44±1.49cm and 26.68± 1.38cm, respectively.

Figure 1.0. showed mean height (cm) for three clones were grown in different treatments in terms of clones whereas only T2 and T3 of MCBC 8 and KKM 22 mean height (cm) showed significant different with T1. Cocoa seedlings in T1 showed the lowest mean height increment (cm) compared to T2 and T3 for all clones ranging from 5.21 – 22.64cm (T1), 15.67 – 25.67cm (T2) and 22.64 – 28.72cm (T3).

The combination of compost and sand does have significant effect on enhancing cocoa seedlings height by improving soil structure. Sand helps to increase the soil porosity (Rosilaine *et al.*, 2007) enabling water and nutrient particles to infiltrate easily and be taken by cocoa seedlings root systems. Unlike T1 which only had top soil as the composition, T3 had a well-developed structure which contributed to large pores that promotes aeration and accommodates soil aeration. This will eventually help in plant nutrient uptake (Catriona *et al.*, 1999). Compost on the other hand, helps to provide suffice amount of nutrients needed for cocoa seedling unlike chicken manure, by reducing

N leaching and gaseous losses (Stainer *et al.*, 2008). This observation agreed by Catriona *et al.*, (1999), which immature or pure compost have adverse effect on plant growth which it can indirectly by N availability in soil or it can be too excessive. Hence, explaining the lowest height increment of T1 compared to T2 and T3.

However, there were no significantly different for mean diameter increment (cm) for all treatments (T1, T2 and T3) (Figure 1.1). Total diameter increments within four months period (for all three clones) were only slightly different whereas T1 with 3.54±0.29mm, followed by T2 and T3 with 3.95±0.12mm and 3.95±0.16mm, respectively. This observation is consistent with Akanbi *et al.*, (2014) findings whereas the stem diameter of cocoa seedlings planted in cocoa pod husk ash (CPHA) and oil palm bunch-ash (OPA) were depress in values. This may be due to the immobilization of soil organic matter and edaphic factor contribute to unavailability to the seedlings (Akanbi *et al.*, 2013).

Mean diameter increment (cm) over three clones showed no significant different as showed (in Figure 2.1) in terms of clones except MCBC 8. This may be due to the efficacy of stem phloem in nutrient absorption are at similar rate among clones.

Figure 1.0 showed mean height (cm) for three clones were grown in different treatments in terms of clones whereas only T2 and T3 of MCBC8 and KKM22 mean height (cm) showed significant different with T1. Cocoa seedlings in T1 showed the lowest mean height increment (cm) compared to T2 and T3 for all clones ranging from 5.21 – 22.64cm (T1), 15.67 – 25.67cm (T2) and 22.64 – 28.72cm (T3).

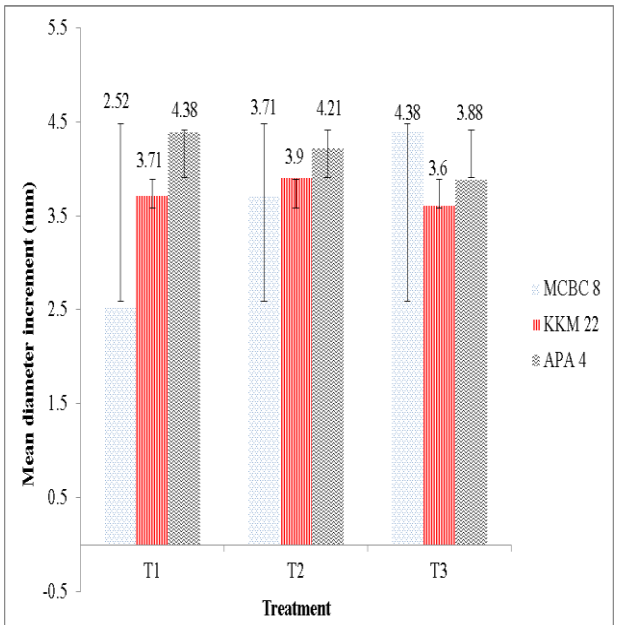



*Figure 1.0 Mean height increment (cm) of MCBC 8, KKM 22, APA 4 after 32 weeks study period.*

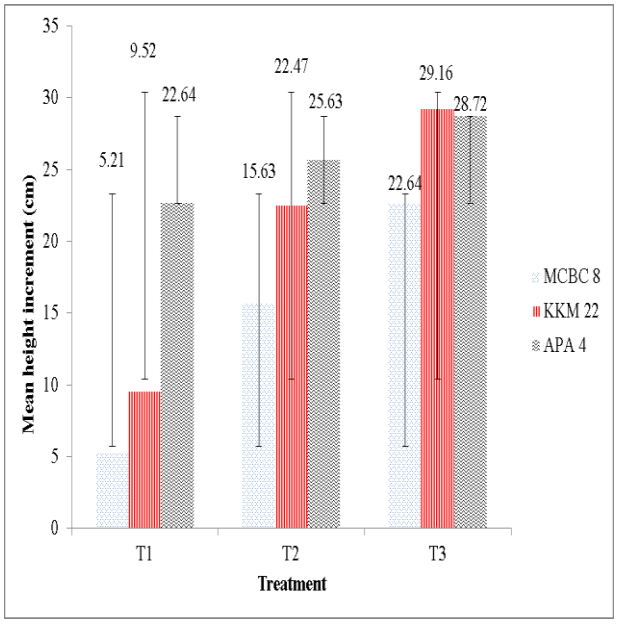
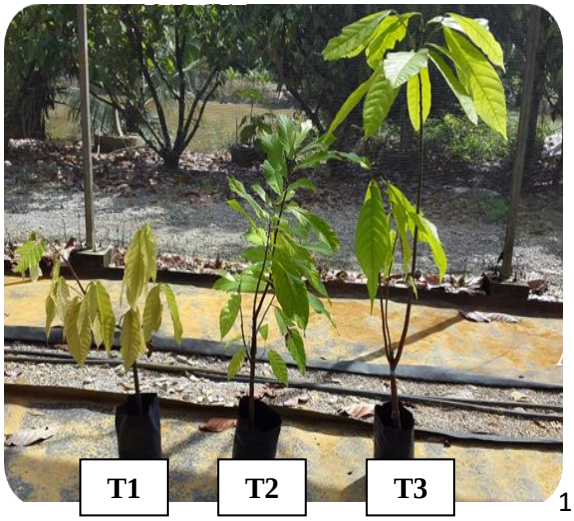



*Figure 1.1 Mean diameter increment (mm) of MCBC 8, KKM 22, APA 4 after 32 weeks study period.*

Table 1: Significance difference of mean height increment (cm) and mean diameter increment (mm) of Theobroma cacao L. on different organic soil media used.

| Treatment | Mean height increment (cm) ± SE | Mean diameter increment (mm) ± SE |
|---|---|---|
| **T1** | 15.39 ± 2.23ab | 3.54 ± 0.29a |
| **T2** | 21.44 ± 1.49b | 3.95 ± 0.12a |
| **T3** | 26.68 ± 1.38c | 3.95 ± 0.16a |

*Mean within columns followed by the same letter is not significantly different at p=0.05 according to Tukey's Test

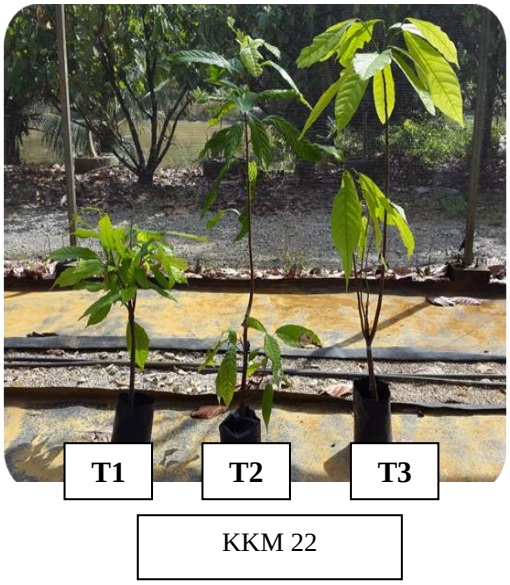




*Figure 2.2 Physical growth performance of MCBC 8, KKM 22, APA 4 after 32 weeks study period.*

## CONCLUSIONS

The combination of top soil, GML, CIRP, organic compost and sand gave better growth performance of cocoa seedlings in term of height increment. Therefore, it is advisable to add organic compost and sand to improve soil texture in for cocoa seedlings in the nursery, and which are important before field planting.

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## REFERENCES

Akanbi, O.S.O., Ojeniyi, S.0., Fawaye, A.O., Ipinmoroti, R.R., Ibiremo, O.S., Oloyede, A.A., Taiwo, N., Adecode, I.A & Orisasona, T.T,. (2013). Utilization of ashed cocoa pod husk and urea fertilizer on growth and dry matter yield of coffee on Alfisol in Ibadan. *Nigerian Journal of Soil Science*, **23.** 10-16.

Akanbi, O.S.O., Fawaye, A.O., Ibiremo, O.S., Ipinmoroti, R.R., Ogunlade, M.O., Oloyede, A.A., Ayegbonyin, K. & Ojeniyi, S.0. (2014). Effect of organic amendment on cocoa soil and leaf nutrient contents. *Journal of Biology, Agriculture and Healtcare*, **4 (27):** 8-12.

Catriona, M.K., Laryea, K.B. & Unger, P.W. (1999). Soil Physical Constraints To Plant Growth And Crop Production. Conservation and Production Research Laboratory, Bushland, Texas, US.

Latour, X., Corberand, T., Laguerre, G., Allard, F. & Lemanceau, P. (1996). The composition of Flourescent Pseudomonad population associated with roots is influenced by plant and soil type. *Appl Environ Microbiology*, **62**: 2449-2456.

Rosilaine,C., Sandra, F.B.T., Vera Lúcia, R.B. & Eraldo, S.S. (2007). The effect of different soil properties on arbuscular mycorrhizal colonization of peanuts, sorghum and maize. *Acta botanical bras*., **21(3):** 723-730.

Steiner, C., Glaser, S., Teixeira, W. G., Lechmann, J., Blum, W.E.H., Zech, W. (2008). Nitrogen retention and plant uptake on highly Central Amazonian Feralsol amendmend with compost and charcoal. *Journal of Plant Nutrition and Soil Science*, **171**.

Yuwatida, S., Mei-Hua, H., Chiu-Chung, T. (2014). Effects of Soil Type and Plant Growth Promoting Microorganism on Cabbage and Spodoptera litura Performance.