SOIL COMPOSITION AMENDMENT TO ENHANCE COCOA (*THEOBROMA CACAO* L.) SEEDLINGS GROWTH

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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 (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 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.

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

INTRODUCTION

Main role of soil is to accelerate the function of 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. 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 plays 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.

MATERIAL AND METHOD

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 (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	Top soil + CML + CIRP + pure chicken manure	1: ¼:¼:1
T2	Top soil + GML + CIRP + organic compost	1:¼:¼:1
T3	Top soil + GML + CIRP + organic compost + sand	1:¼:¼:1:1

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

Figure 1: Soil composition of different treatment (T1, T2 and T3).

RESULT AND DISCUSSIONS

Figure 2.0 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 difference 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).

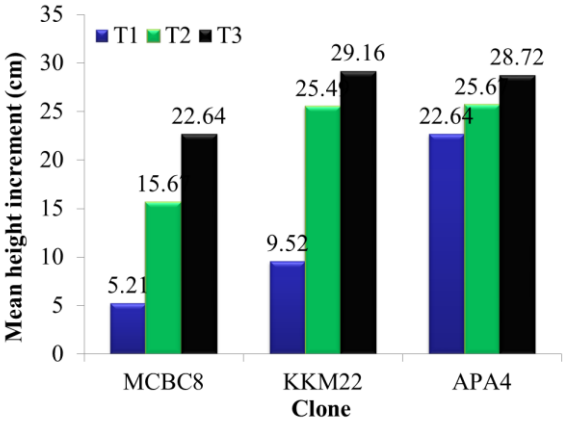

Figure 2.0: Mean height increment (cm) of MCBC 8, KKM 22, APA 4 after 32 weeks study period.

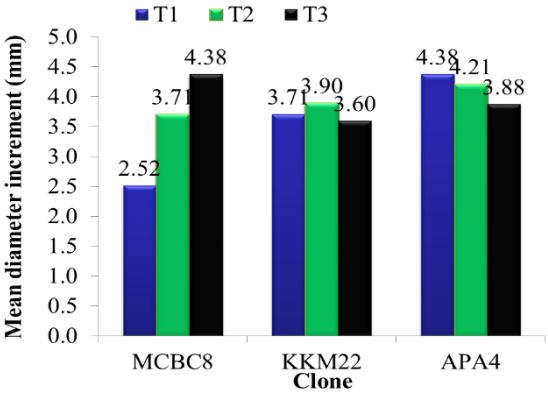

Figure 2.1: Mean diameter increment (mm) of MCBC 8, KKM 22, APA 4 after 32 weeks study period.

Table 2: Soil composition and ratio for three different treatments

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

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 (Bay of Plenty Council, nd). 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 significant differences for mean diameter increment (cm) for all treatments (T1, T2 and T3) (Figure 2.1, Table 2). 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, 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).

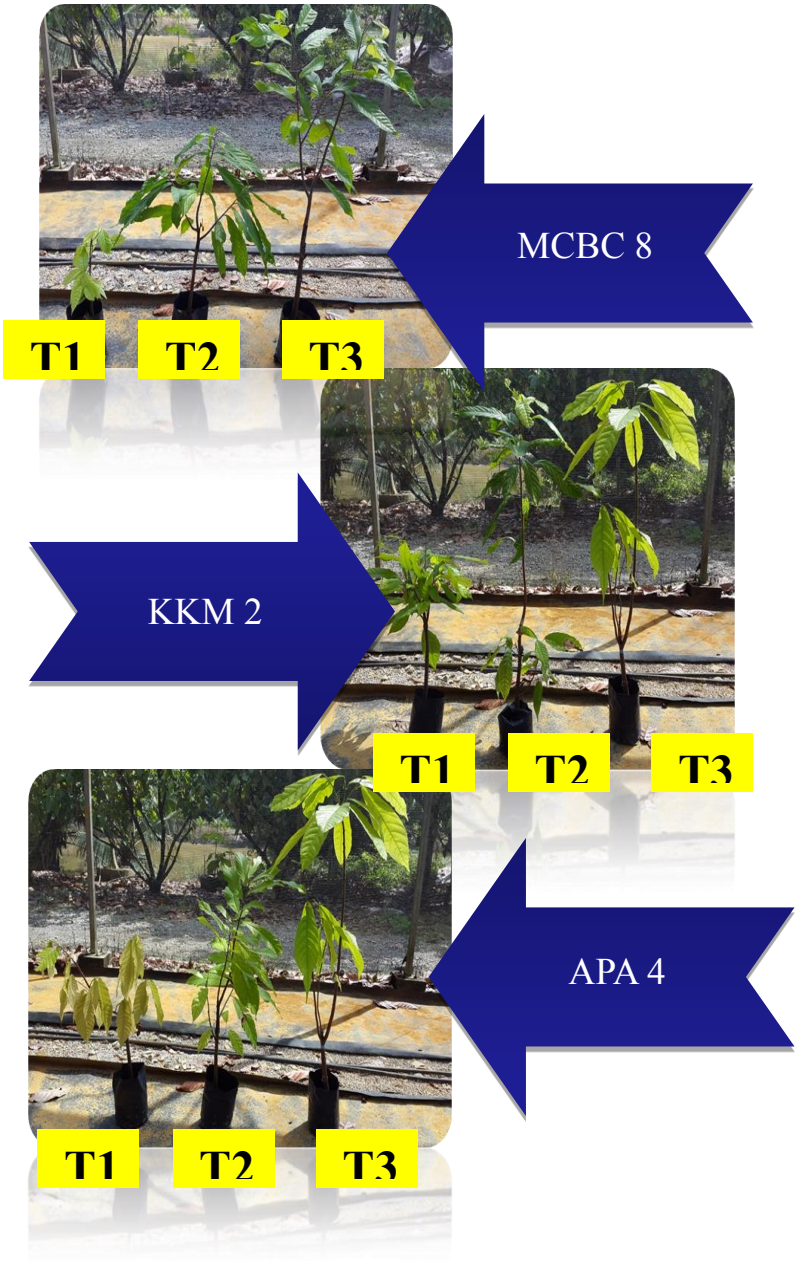

Figure 2.1: Physical growth performance of MCBC 8, KKM 22, APA 4 after 32 weeks study period.

CONCLUSION

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–which are important before field planting.

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