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SHORT COMMUNICATION

THE EFFECT OF DIFFERENT SEEDS LOCATION IN COCOA POD ON THE GROWTH AND DEVELOPMENT SEEDLINGS

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ABSTRACT – *An experiment was conducted to evaluate the effect of different seeds location in cocoa pod on the growth and development of seedlings at the Malaysian Cocoa Board Research and Development Centre nursery in Tawau, Sabah. The experiment was laid out in Random Complete Block Design (RCBD) by sowing three different location seed from pod; the base of pod (T1), the middle of pod (T2) and the tip of pod (T3), which taken from five (5) different clones; C1 - PBC 123, C 2 - MCBC 1, C3 - DESA 1, C4 - BR 25 and C5 - KKM 22 in three replicates. Two types of data were collected: parameters of length (mm) and weight (gm) of seeds before sowed, and stem diameter (cm) and plant height (cm) on weekly interval 12 weeks after planted (WAP). The result showed that MCBC 1 seed was significantly different in length and weight from others. However, based on the measurement of stem diameter and plant height after 12 WAP, there were no significant difference on seedlings that produced from seeds either at the base of pod, in the middle or the tip of pod, although most of the highest diameter and height were seeds from the middle of pod. Therefore, it can be concluded that all seeds still can produced a good growth seedling despite of its location in the pod or its type of clones.*

Keywords: Cocoa, seeds, clones, nursery, growth development

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is a vital cash crop in many tropical regions, contributing significantly to both local economies and the global chocolate industry. The success of cocoa cultivation relies heavily on the establishment of healthy seedlings during the early stages of growth. Cocoa, as a tropical tree crop, needs to pass through a nursery stage to allow easy and good establishment on the field (Adenikinju *et al*., 1989). Generally, cocoa is propagated through the seed for plantation establishment, and the seedlings are raised in the nursery for about 3–4 months before transplanting on the field.

Previous studies stated that cocoa seedlings vigor are known to be influenced by various factors such as bean position (Ibikunle, 1967), varietal influence (Adenikinju, 1971), bean maturity (Adenikinju, 1975) and environmental factors (Atayese *et al.,* 2012). However, for this study, the factor that need to be focusing was on the location of seeds within the cocoa pod.

Cocoa pods contain multiple seeds, arranged in a somewhat structured manner. The seeds within a pod can experience varying micro-environmental conditions based on their location. These differences can potentially influence several aspects of seed biology, including germination rates, seedling vigor, and early growth performance. Therefore, the aim of this study is to determine the effect of different seeds location in cocoa pod on the growth and development seedlings.

MATERIALS AND METHODS

This trial has been carried out at Malaysian Cocoa Board Research and Development Centre nursery in Tawau, Sabah. Design for the trial was Random Complete Block Design (RCBD). The treatments studied by sowing three different location seed (Figure 1) from pod; the base of pod (T1), the middle of pod (T2) and the tip of pod (T3), which taken from five (5) different clones; C1 - PBC 123, C2 - MCBC 1, C3 - DESA 1, C4 - BR 25 and C5 - KKM 22 in three replicates. All treatments were fertilized with conventional fertilizer (5 gram / NPK Green 15:15:15) according to cocoa nursery standard which applied once a month. Each treatment sowed six (6) seeds into polybags in three replicates and total were about 270 seeds.

At first, all seeds collected from the different pods of clone were measured its length and weight

before sowed. After that, data started collected at the fourth weeks after planted (WAP). There were three parameters taken for this trial; stem diameter, plant height and number of leaf. The plant height, stem diameter and number of leaves were measured on a weekly basis. Plant height measured using a measuring ruler, from the soil surface to the apical tip of the plant, while plant stem diameter was measured using veneer calipers around the stem above the attached cotyledon. Statistical analysis was carried out with one-way ANOVA and Tukey's multiple comparison tests for mean comparison if the treatments were significantly different using SPSS software.

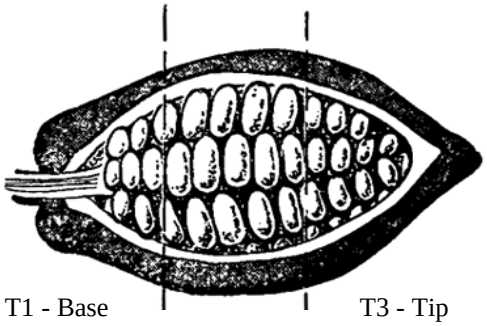
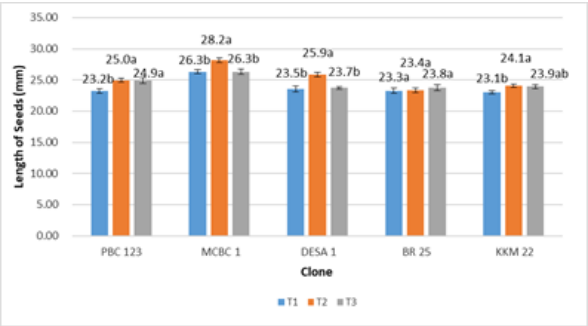


Figure 1: Different seed location in the pod

RESULTS AND DISCUSSIONS

Length and Weight of Seed

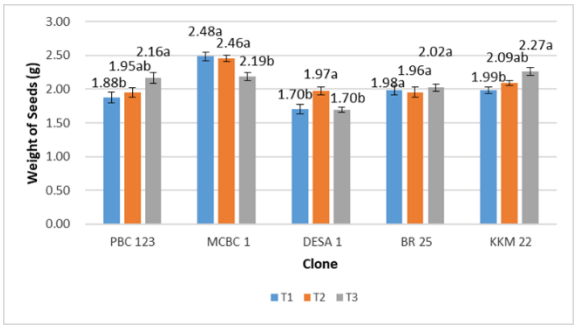
Figure 1 shows the length of different seeds location for each clone before sowed. From the observation, ANOVA result shows that there were significantly different ($p<0.05$) between treatments in clone PBC 123, MCBC 1, DESA 1 and KKM 22. These clones indicate that seeds taken from the middle of pod have 1 mm - 2.4 mm longer than the seed taken from base and tip, except BR 25 which have almost similar length. Comparison within clones according to the treatment also showed that MCBC 1 significantly have the longest seeds among the others (Figure 2).



Note: T1- Base, T2 - Middle, T3 - Tip

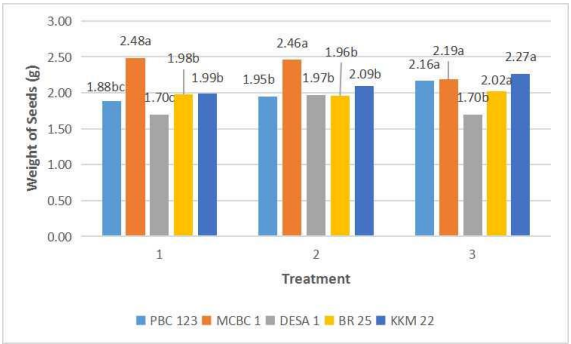
Figure 2: Mean length of different seeds location per treatment

Figure 3 shows the weight of different seeds location for each clone before sowed. From the observation, ANOVA result shows that there were significantly different ($p<0.05$) between treatments in clone PBC 123, MCBC 1, DESA 1 and KKM 22 with 0.27g - 0.29g heavier than the seed taken from either base, middle or tip, except BR 25 which have almost similar weight. Comparison within clones according to the treatment also showed that MCBC 1 significantly have the heaviest seeds particularly in the base and middle of pod (Figure 4).



Note: T1- Base, T2 - Middle, T3 - Tip

Figure 3: Mean weight of different seeds location for each clone



Note: T1- Base, T2 - Middle, T3 – Tip

Figure 4: Mean weight of different seeds location for each clone

Seed of clone PBC 123

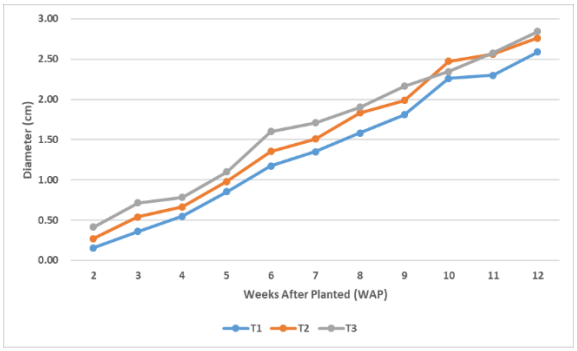
Table 1 presented the growth of different seed location of clone PBC 123 on the plant total mean diameter after 12 WAP. Both highest total mean diameter and height of the seedlings produced by seeds in the middle of pod, which were 5.14 cm and 32.48 cm, respectively, and the lowest were produced by seed in tip of pod (5.03 cm and 30.39 cm). However, there was no significance different ($p>0.05$) between the treatments. In Figure 5 (a) and (b), all treatments have showed

almost consistent of diameter and height increment throughout the 12 weeks' experiment, although such difference cannot be seen due to its small increment per week. Despite of that, it is known that the slightest differences of the diameter increment eventually will affect the actual height of seedlings.

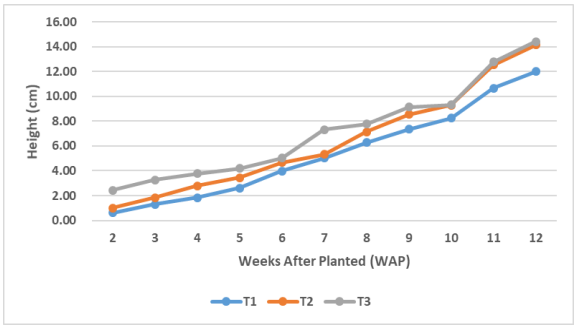
Table 1: Total mean diameter and height after 12 WAP

Treatment	Mean Diameter (± S.D)	Mean Height (± S.D)
T1 – Base	5.07 ± 0.10 a*	31.83 ± 1.06 a*
T2 – Middle	5.14 ± 0.27 a	32.48 ± 4.63 a
T3 – Tip	5.03 ± 0.64 a	30.39 ± 4.61 a
F-Test	0.061	0.233
CV (%)	6.95	10.89

**column means followed by the same letter are not significantly different (P>0.05, Tukey Test)*



(a)



(b)

Note: T1- Base, T2 - Middle, T3 - Tip

Figure 5: Mean (a) diameter and (b) height of different seeds location of clone PBC 123

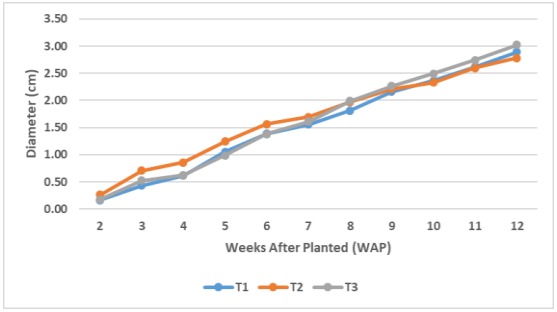
Seed of clone MCBC 1

Table 2 presented the growth of different seed location of clone MCBC 1 on the plant total mean diameter and height after 12 WAP. The highest total mean diameter of the seedlings produced by seeds at the base of pod (5.68 cm), whilst the highest total mean height of seedlings was produced by seed at the tip of pod (29.34 cm). However, there was no significance different ($p>0.05$) between the treatments. In Figure 6 (a) and (b), all treatments also showed almost consistent of growth increment throughout the 12 weeks' experiment.

Table 2: Total mean diameter and height after 12 WAP

Treatment	Mean Diameter (± S.D)	Mean Height (± S.D)
T1 – Base	5.68 ± 0.29 a*	28.71 ± 3.01 a*
T2 – Middle	5.48 ± 0.05 a	27.05 ± 3.16 a
T3 – Tip	5.65 ± 0.51 a	29.34 ± 1.73 a
F-Test	0.284	0.573
CV (%)	5.61	9.04

**column means followed by the same letter are not significantly different (P>0.05, Tukey Test)*



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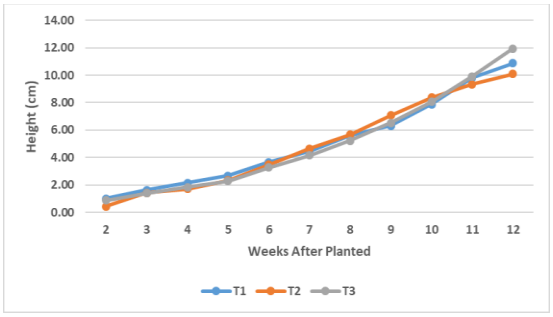


(b)

Note: T1- Base, T2 - Middle, T3 - Tip

Figure 6. Mean (a) diameter and (b) height of different seeds location of clone MCBC 1

Seed of clone DESA 1

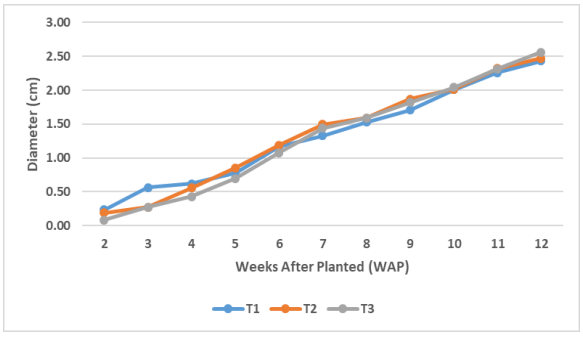
Table 3 presented the growth of different seed location of clone DESA 1 on the plant total mean diameter and height after 12 WAP. The highest total mean diameter of the seedlings produced both by seeds in the middle

and at the base of pod with similar height of 4.98 cm. However, there was no significance different (p>0.05) between the treatments. In Figure 7 (a) and (b), all treatments also showed almost consistent of growth increment throughout the 12 weeks' experiment.

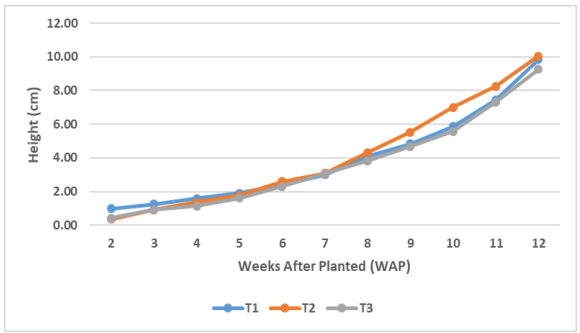
Table 3: Total mean diameter and height after 12 WAP

Treatment	Mean Diameter (± S.D)	Mean Height (± S.D)
T1 – Base	4.79 ± 0.11 a*	26.26 ± 2.16 a*
T2 – Middle	4.98 ± 0.26 a	29.21 ± 0.78 a
T3 – Tip	4.98 ± 0.25 a	27.63 ± 2.54 a
F-Test	0.763	1.669
CV (%)	4.37	7.72

**column means followed by the same letter are not significantly different (P>0.05, Tukey Test)*



(a)



(b)

Note: T1- Base, T2 - Middle, T3 - Tip

Figure 7: Mean (a) diameter and (b) height of different seeds location of clone DESA 1

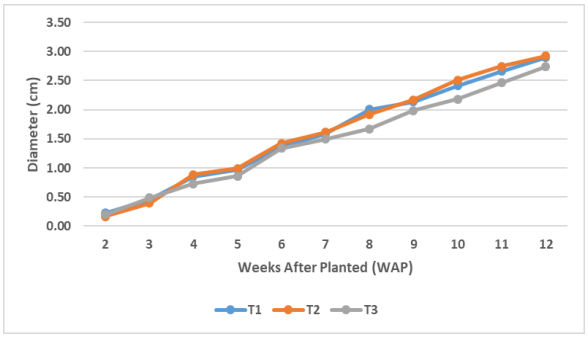
Seed of clone BR 25

Table 4 presented the growth of different seed location of clone BR 25 on the plant total mean diameter and height after 12 WAP. The highest total mean diameter of the seedlings produced by seeds in the middle of pod (5.46 cm), whilst the highest total mean height was produced by seeds of the tip of the pod (28.55 cm). However, still there was no significance different (p>0.05) between the treatments. In Figure 8 (a) and (b), all treatments showed almost similar trend of growth increment throughout the 12 weeks' experiment.

Table 4: Total mean diameter and height after 12 WAP

Treatment	Mean Diameter (± S.D)	Mean Height (± S.D)
T1 – Base	5.32 ± 0.54 a*	27.51 ± 4.19 a*
T2 – Middle	5.46 ± 0.31 a	27.87 ± 1.48 a
T3 – Tip	5.38 ± 0.20 a	28.55 ± 0.98 a
F-Test	0.106	0.121
CV (%)	6.22	8.31

**column means followed by the same letter are not significantly different (P>0.05, Tukey Test)*



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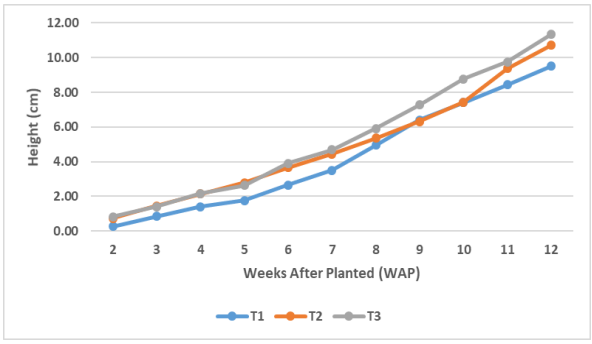


(b)

Note: T1- Base, T2 - Middle, T3 - Tip

Figure 8: Mean (a) diameter and (b) height of different seeds location of clone BR 25

Seed of clone KKM 22

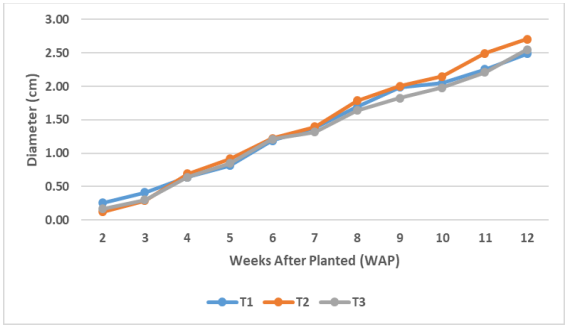
Table 5 presented the growth of different seed location of clone KKM 22 on the plant total mean diameter after 12 WAP. Both highest total mean diameter and height of the seedlings produced by seeds in the middle of

pod, which were 5.47 cm and 31.75 cm, respectively, and the lowest diameter and height seedlings were produced by seed at base of pod (5.03 cm) and at tip of pod (28.41 cm). However, there was no significance different ($p>0.05$) between the treatments. In Figure 9 (a) and (b), all treatments also showed almost similar trend of growth increment throughout the 12 weeks' experiment.

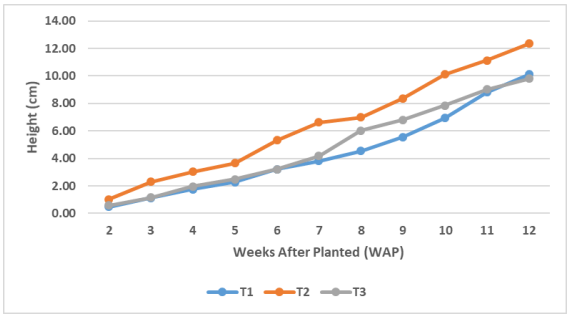
Table 5: Total mean diameter and height after 12 WAP

Treatment	Mean Diameter (± S.D)	Mean Height (± S.D)
T1 – Base	5.18 ± 0.31 a*	28.97 ± 0.53 a*
T2 – Middle	5.47 ± 0.41 a	31.75 ± 3.76 a
T3 – Tip	5.33 ± 0.16 a	28.41 ± 2.01 a
F-Test	0.663	1.556
CV (%)	5.66	8.92

**column means followed by the same letter are not significantly different (P>0.05, Tukey Test)*



(a)



(b)

Note: T1- Base, T2 - Middle, T3 - Tip

Figure 9: Mean (a) diameter and (b) height of different seeds location

Based on the study, all clonal seeds despite of its location showed no significant differences in growth performance (diameter and height), although most seeds taken from middle of pod gave higher measurement after 12 WAP. This result was aligned with Billy *et al*. (2021) study stated that the seeds position of the cocoa pod produced an insignificant effect on all parameters of seedlings growth. The reason for this is because soil media during early stage has adequate nutrients needed for seedlings to growth. However, previous study by Sutardi & Hendrata, (2009) added that the best cocoa seeds to support the growth of seed height, number of leaves and root length are found in the middle of the fruit. This was indicated earlier in this study on the length and weight measurement of seeds before sowed which eventually can be seen the effect on the growth of seedlings. Besides that, study by Iremiren *et al*., (2007) also stated that seed size in the middle pod have higher amount of food reserves contained therein, therefore giving slightly more stimulation on the germination and growth of the seedlings.

CONCLUSIONS

From the study, it was showed that that seeds taken from middle of pod and clone MCBC 1 have the potential on giving better growth performance based on its length and weight of seed produced. However, once sowed, seeds taken from either at the base of pod, in the middle or the tip of pod in every clone still produced almost the same growth performance, although most of the highest diameter and height were from seeds produced in the middle of pod. Therefore, it can be concluded that all seeds can produced a good growth and development despite of its location in the pod and its clone. It is also important that all seedlings need to be care and well maintained according to its standard nursery management practices.

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