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Effect of Different Media Combination on Growth and Biomass Production of Oil Palm (*Elaeis. guineensis*) Seedlings

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Abstract**—** *The study evaluates the effect of different media on growth and vegetative traits of oil palm seedlings. The treatments were T1 Control, T2 100% coco peat, T3 20% soil + 80% coco peat, T4 40% soil + 60% coco peat, T5 60% soil + 40% coco peat. Oxisol soil used for plantation crops was designated as a control evaluation. The new media were filled in polybag size 38cm x 57cm before transplanting the seedlings. The seedlings used were from Calix 600 series (D x P oil palm seeds). The newly produced growth media combination had the equal potential as standard media for oil palm nursery. The treatment (T4) which contained 60% coco peat and soil noticeably, enhanced growth of the seedling like plant height. Root dry weight (g) of seedlings grown in this planting medium greatly impacted plant root. This could have been due to the presence of silica content in the coco-peat which provided good aeration in the medium and indirectly stimulated root expansion. Increased in shoot dry weight of the seedlings grown in T4 was recorded compared to the plants grown in other media. The results obtained generally indicated that compost- based planting medium has the potential to influence seedling as an alternative growth medium.*

Keywords— coco peat, oil palm seedling, media, biomass, Elaeis. Guineensis

I. INTRODUCTION

Agriculture in tropics faces some challenges relating to plantation crops such as cocoa, oil palm and rubber which are grown in a marginal area predominantly covered by Ultisols and Oxisols which are basically low in key cations Noordiana et al., (2007). This has resulted in poor growth of oil palm especially at nursery stage which sometimes leads to plant death or long-term irreparable root and shoots damage. Due to the problems posed by the soils, integrated or alternative growing media are being widely considered in many parts of the world as it may positively influence plant total yield (Paranjpe et al., 2003). Many soils used in the tropics like Malaysia in the plantations including oil palm require a lot of fertilizer for adequate support of plant growth. In view of this, a soilless growing system like coco peat, vermiculite and perlite, especially for young plants, may be considered as an alternative growing medium to the soil (Van and Postma, 2000).

Soilless medium helps to prevent root-infecting pathogen related problems. This is due to its superior physicochemical characteristics coupled with lower infestation rate of pathogenic pests at the initial stage. Strongly weathered and sedimentary soils which are classified as Ferralsols, Nitosols, and Acrisols, (Oxisols and Ultisols) are mostly used for planting perennial crops including oil palm in Malaysia (Sabri, 2009). Thus, better performance of many plantation crops is achieved in Malaysia when it is planted in Ultisols and Oxisols soils which possess some of these qualities and could be found in most oil palm planting areas in the country (Salisu et al., 2013). However, these soils still heavily depend on fertilization and planting of cover crops for a better plant yield (Rantala, 2006). This could be attributed to its low cation exchange capacity (C.E.C) and high aluminium content Yaacob et al., (1992). Apart from crusting and low nutrients, the soils are susceptible to erosion (Eswaran et al., 1992). Despite the obvious weaknesses of the soils, many farmers still largely depend on it for future expansion of agriculture (Joint F.A.O, 2000). The soils have been continuously used for plantation crops like oil palm and rubber with continuous improvement (Shamshudin and Fauziah, 2010). Consequently, Adekunle, (2014) suggested a continuous evaluation of the soils for growth and nutritional need of the plantation crops. Establishment of high-quality seedlings of plantation crops involves different input such as suitable fertilizer rate. The type of growing medium plays a significant role Baiyeri and Mbah, (2006). Traditionally

plants are grown in soils, but its use had caused a significant setback. Objective of this experiment was to evaluate the effect of different media on growth and vegetative traits of oil palm seedlings.

II. MATERIALS AND METHODS

The experiment was carried out at Field 10 of the Universiti Putra Malaysia, Serdang Malaysia for a period of four months. The study consists of five treatments which are different rates of coco peat combinations and soil as a planting media on the oil palm seedlings. The treatments combinations were T1 Control, T2 100% coco peat, T3 20% soil + 80% coco peat, T4 40% soil + 60% coco peat, T5 60% soil + 40% coco peat. Oxisol soil commonly used in plantation in Malaysia was used as a control treatment. The growth media was prepared early before transplanting of seedlings into the large polybag. Large polybag size 38cm x 57cm, according to the standard in oil palm nursery was used. The seedlings used were from Calix 600 series (D x P oil palm seeds) and collected from Sime Darby Seeds and Agricultural Services Sdn. Bhd. Seedling selection was based on average height and fronds sizes. The seedlings were watered before the transplanting in order to reduce the transplanting shock. The seedlings were kept under a shelter house for about 7 days before they were placed in the field plot. Experimental design was a Randomized Complete Block Design (RCBD) with 4 replications. Fertilization was carried out once a month. N.P.K Blue special with composition 12: 12: 17: 6 + TE were used at a rate of 20g/plant. Irrigation was carried out twice a day, which is in the morning and in the evening especially during early plant establishment. Weeding was manually done. In order to control pests, Malathion (insecticides) was applied on the seedlings. Data collection began at second month after planting and was taken once a month until fourth months. Growth parameters such as height were taken monthly using standard measuring tape while girth size was taken using digital Vernier calliper. Leaf chlorophyll content was also measured with SPAD meter-502. For the biomass production, shoot dry weights were collected and determined. Fresh biomass for leaves, stem and roots were oven-dried at 50°C for 48 - 72 weighed (g) to a constant weight 0.01 g. Root: shoot ratio was also determined using an equation proposed by Hunt (1978).

$$RSR = \left(\frac{Total\ root\ dry\ weight\ (g)}{Total\ shoot\ dry\ weight\ (g)}\right)$$

Chlorophyll content was determined by first taken leaf samples with a leaf punch. Portions of the leaf samples (1.0 cm leaf disks) were collected in scintillation bottles containing 15 ml aqueous 80% acetone and kept in dark for two weeks after the extraction, the absorbance was determined at 664 and 647 nm using a light spectrophotometer (UV-2550). Actual total chlorophyll content was determined using described and published equation by Coombs et al., (1987).

III. FOLIAR NUTRIENT ANALYSIS

Nutrient analysis was carried out to determine N, P and K using Kjeldahl method. The plant leaves were dried and grounded with machine. Thereafter, weighed 0.25g and put it into a digestion tube. Then, 5 ml concentrated Sulphuric acid (H_2SO_4) was added. This process was conducted in a fume chamber. Thereafter, the mixture digestion tubes were placed in the digestion block at the temperature 450°C in the Fume Chamber for approximately 45 minutes. The digestion tubes were removed and allowed to cool, after which, 2 ml of 50% hydrogen peroxide (H_2O_2) was added and the heating process was repeated in the Fume Chamber. After the stipulated heating period, the sample in the tube became colourless. The solution was left to cool and later diluted with distilled water to make up 100 ml. The samples were analyzed for N, P, and K using Auto Analyzer, while Mg was analyzed with Atomic Absorption Spectrophotometer (Perkin-Elmer, Model AAS 3110). All data from this experiment were analysed by using Statistical analysis System (SAS) and Analysis of variance (ANOVA). The mean comparisons between the treatments were determined by using Least Significant Difference (LSD) at $p < 0.05$.

IV. RESULTS

There were significant differences between the treatments on the height increment at $p < 0.05$. Figure 1 showed the response of the plants towards different combination of soil and coco peat at different percentage for the second month of planting, whereby the treatment T4 showed the highest height increment with 3.01 cm followed by T5 and significantly different from T1, T2, and T3 1.89 cm, 1.77 cm and 1.74 cm respectively. Treatments T1, T2, and T3 and T5 were not significantly different. Meanwhile, at the third month of planting, different treatments showed growth improvement of the oil palm seedlings. Treatment T4 had the highest mean value with 3.27 cm and significantly different from T2 which gave the lowest mean value of 2.28 cm.

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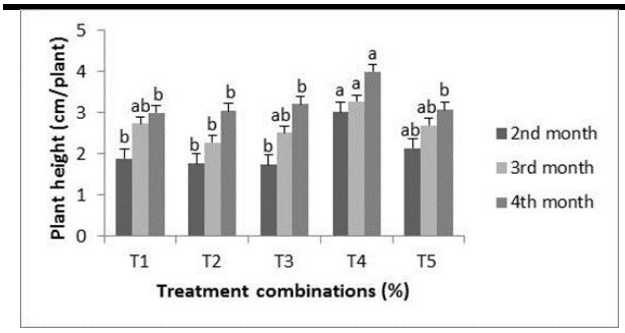

Fig.1: Effects of different treatment combinations of cocopeat on height of oil palm seedlings in each month. Means sharing the same letter in the figure for treatment combinations in each month are not significantly different at p<0.05.

However, the T4 was not significantly different T1, T3, and T5. Different coco peat combinations on the growth of oil palm seedlings at the fourth month after planting indicated that there were significant differences between the treatments on the plant height increment at p<0.05 of the oil palm seedlings. However, the results showed that treatment T4 had significantly higher increment of the oil palm seedling than all other treatments. This indicated suitable suitability of the composition of the treatment T4. There were significant differences as the seedlings demonstrated plant girth increment whereby T4 recorded the highest mean value (4.78cm) followed by the T3 in the third month as shown in Figure 2. The results from the two treatments were significantly different from T1 (3.19cm), T2 (3.35cm) and T5 (2.83cm). Similarly, the results show that treatment T4 had significantly higher girth increment than all other treatments in the fourth month. The remaining treatments were not significantly different from each other.

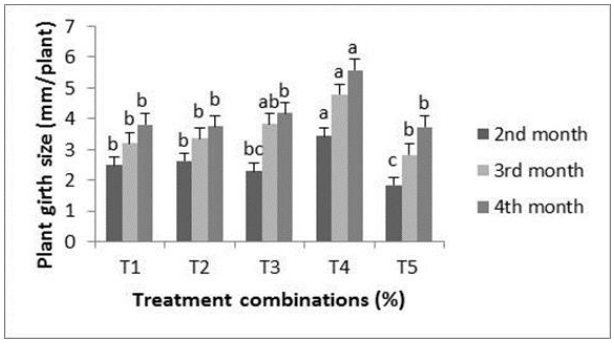

Fig. 2: Effects of different treatment combinations of coco peat on girth size of oil palm seedlings in each month. Means sharing the same letter in the figure for treatment combinations in each month are not significantly different at p<0.05.

There was a significant difference among the treatments in the fourth month of planting in terms of chlorophyll content. Figure 3 show that the treatment T3 and T4 had significantly higher chlorophyll content and significantly different from T1, T2 and T5.

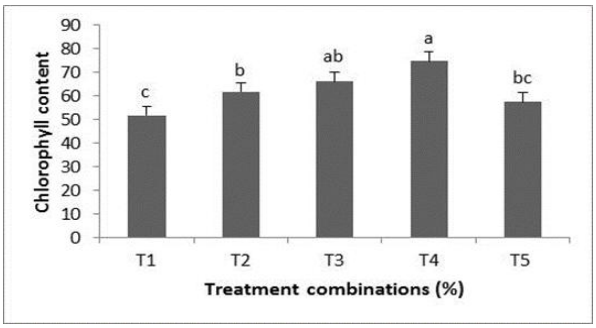

Fig. 3: Effects of different treatment combinations of coco peat on chlorophyll content of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.

V. PLANT BIOMASS YIELD

At the end of the experiment, the biomass yield of the oil palm seedlings grown on the coco peat combinations at the fourth month indicated that there were significant differences between of the treatments on the shoot dry weight at P < 0.05. The results showed that the treatment T4 had significantly higher shoot dry weight than the seedlings grown on all other treatments as shown in Figure 4.

VI. ROOT-SHOOT RATIO (RSR)

Result of the root: shoot ratio indicated that the effects of the treatments varied significantly at p < 0.05. However, seedlings grown with the treatment T4 (0.37) significantly higher than T1 (0.33), T2 (0.30), T3 (0.29) and T5 (0.33) as shown in Figure 5.

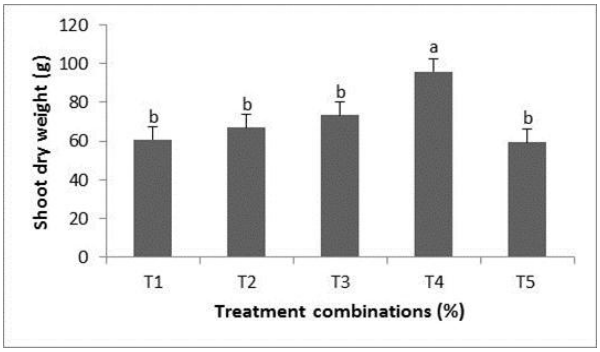

Fig. 4: Effects of different treatment combinations of coco peat on shoot dry weight of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.

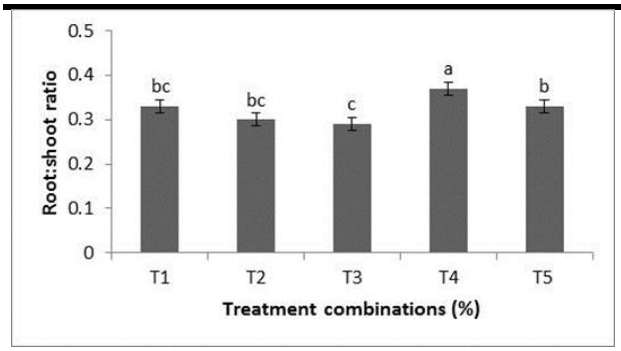

Fig. 5: Effects of different treatment combinations of coco peat on root: shoot ratio of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.

VII. PLANT NUTRIENT CONCENTRATION

Foliar nutrient analysis showed nitrogen concentration from the various treatments in the oil palm seedlings whereby in plant grown with T1 had significantly higher nitrogen content in the leaves of the oil palm seedlings than plant grown in T2 (Figure 6). Furthermore, T4 had significantly higher phosphorus content in the leaves of the oil palm seedlings than the plants grown with T5 (Figure 7). There was a significantly different among the seedlings to different treatments. Noticeably, potassium concentration in leaves of seedlings grown with T1 was significantly different from seedlings grown on T5.

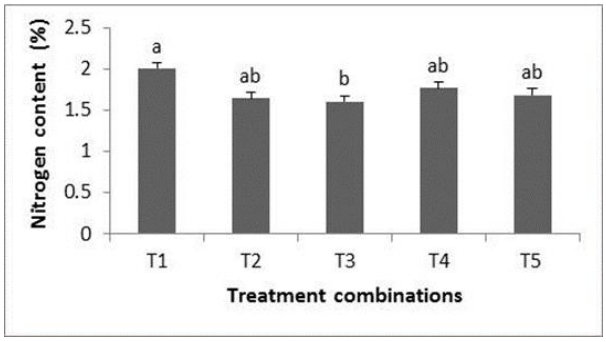

Fig. 6: *Effects of different treatment combinations of coco peat on nitrogen concentration of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.*

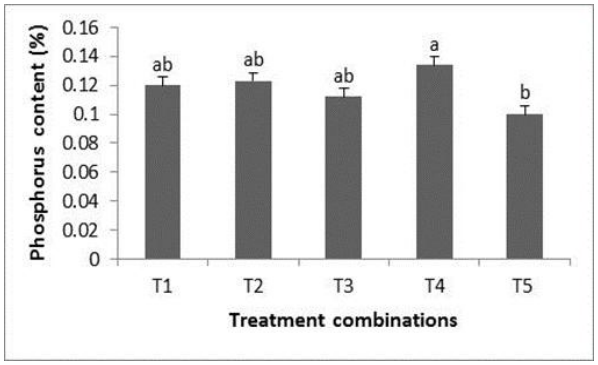

Fig. 7: Effects of different treatment combinations of coco peat on phosphorus concentration of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.

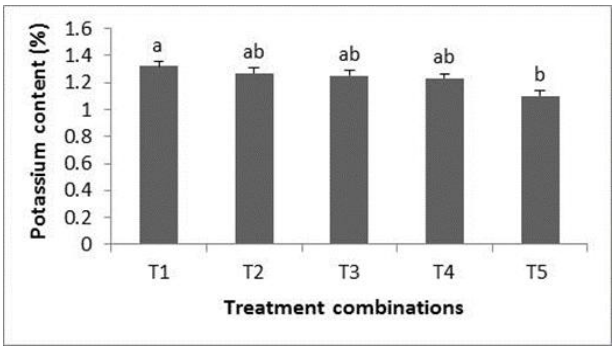

Fig. 8. Effects of different treatment combinations of coco peat on potassium concentration of oil palm seedlings. Means sharing the same letter in the figure for treatment combinations are not significantly different at p<0.05.

VIII. DISCUSSION

The results showed that combination of coco peat with soil, used as a growing medium during planting of the oil palm seedlings, had beneficial effect on plant growth. The combination of coco peat with soil indicated the faster plant growth and development of oil palm seedlings. This may due to good root system and better heat properties of coco peat (Salisu et al, 2017). Hence, it is clearly seems that the combination of coco peat with soil on treatment T4 indicated the best combination growing media for oil palm seedlings growth as shown in height and girth increment. This study was in line with study by Salisu et al. (2016) who found shoot length, growth and development of plant were higher on medium containing coco peat or coconut husk on rubber plant. In term of root dry weight, treatments T4 (40% soil + 60% coco peat) and T5 (60% soil + 40% coco peat) showed the highest mean value which could have been due to coco peat combination with the soil. The positive response was noticed in good root growth and vegetative traits. Noticeably, seedlings grown in treatment T1 had the lowest mean value of root dry weight. This may be due to heavy structure and compaction of the soil which could have caused root restriction which translated into the poor plant vegetative growth. Similar results were also found on shoot-root ratio. This could have been due to good physical and chemical properties of coco peat (Prasad, 1997). The concentration of Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca) and Magnesium (Mg) in finely ground dried sample were determined. Nutrients concentration of the seedlings indicated normal range which could be found in healthy mature tissue of various plant species including oil palm. Noticeably, micronutrient analyzed showed that N.P.K were not negatively affected by the treatments. Consequently,

variation in the growth and vegetative traits of oil palm seedlings observed in this study could have been due to differences in the physical properties of the media. Weight of planting media showed that treatment T4 (40% soil + 60% coco peat) had less 50% of weight (10kg) compared to the treatment T1 (100% soil) had 20kg. This indicated that the materials used for the planting medium composition fulfilled requirements of a suitable planting medium which includes lightweight for easy handling and transportation. This was supported by Asiah et al., (2004) who noted that lightweight of a growing medium is important for commercial or economic purpose. Also, Hashim et al., (1987), observed that use of lightweight potting medium would burden for workers during field planting operation and would certainly reduce the palm distribution time during planting or re-planting exercise.

IX. CONCLUSION

The study showed that the Calix 600 (Sime Darby sources) seedlings have a greater response to utilization of the new growth media combination. For instance, the new growth media combination performed equally as soils. Good planting media management is essential for the production of quality oil palm seedlings. Combination of soil and coco peat significantly enhanced growth of oil palm seedling. The study indicated that various coco peat ratio with soil tends to increase oil palm seedlings growth at nursery stage. The performance is noticeable in plant grown in T4 which contained 60% coco peat and root dry weight. The treatment equally influenced root: shoot ratio of the seedlings. This could have been due to the presence of nutrient concentration in the treatment (T4). The results obtained generally indicated that compost- based planting medium has the potential to influence seedling as an alternative growth medium compared to the soils used in oil palm nursery.

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