GROWING MEDIA EFFECTS ON THE PERFORMANCE OF COCONUT SEEDLINGS (*Cocus Nucifera L*) AT NURSERY STAGE

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ABSTRACT

The objectives of the study were to determine the effect of different growing media of coconut plant growth and to determine the optimum growing media of organic on vegetative production of coconuts. The experiments were conducted at MARDI Bagan Datuk, Perak with uniform planting materials aged 2 months' year old by applying in polybag. Growing media treatment are the combination of top soil, sand, oil palm fruit fiber (OPFF) and coco peat. The treatments namely : T1=top soil without coco peat (control), T2=top soil + sand (3:1) without coco peat, T3 top soil + sand (3:1) 5 cm coco peat = , T4= top soil + sand (3:1) 10 cm coco peat, T5= fecal + top soil + sand (1:1:1) without coco peat, T6= fecal + top soil + sand (1:1:1) 5 cm coco peat, T7= fecal + top soil + sand (1:1:1) 10 cm coco peat, T8= OPFF + top soil + sand (1:1:1) without coco peat, T9= OPFF + top soil + sand (1:1:1)5 cm coco peat, T10= OPFF + top soil + sand (1:1:1) 10 cm coco peat. After 9 month evaluation, for excellent growth performance shows clearly that treatment of T7 and T10 gave the best results for assisting in morphological improvement for coconut seedling grown in the polybags.

Key words: Growing media, plant growth, growth performance, coconut seedling, nursery stage.

INTRODUCTION

Coconut (*Cocos nucifera* L.) is currently grown in nearly 90 countries spread along the tropical belt. Of the 11.9 million hectares of coconut grown in the world, eight million hectares, or about 70% is in South East & East Asia (Carpio, *et al*., 2005). Coconut is a cross-pollinated perennial crop, which can be propagated only through seeds and the selection of the planting material is of a vital importance. The coconut seed takes a long time before it attains a stable level of production. Proper selection and planting of good quality seed nuts must be done to ensure a productive plantation (Magat, 1999).

There is a need to organize the supply of nutrients to the crop through organic and renewable sources and strengthen the initiative of integrated nutrient management (INM) (Anderson et al., 2002). Use of organic manures, apart from improving physical and biological properties of soil, helps in improving the use of efficiency of chemical fertilizers (Alam et al., 2003, 2005). Under such circumstances, an integrated approach is suggested through complementary use of inorganic and organic fertilizers to boost/sustain soil fertility and crop productivity (Lampe, 2000). The better aeration of the peat can make more root growth and will allows better growth and foliage and will increase the yield of the whole plants. (Margit *et al.* 2012) . The basis for fertilizing a crop is by understanding the amount of material which would be required to make up the difference between the nutrients needed by the crop and those supplied by the soil. This implies that crop performance will be improved, if we are in a position to estimate *i)* the amount of a particular nutrient required by the plant for unrestricted growth, and *ii)* the amount that is actually supplied by the soil medium.

Coconut seedlings grow and develop faster when fertilized with a combination of ammonium sulfate + potassium chloride + 1gram of Borex (Santos, 1987). Growing media are materials that can include organic materials such as peat, compost, tree bark, coir, poultry feathers, or inorganic materials such as clay, perlite, vermiculite, and mineral wool (Grunert et al., 2008; Vaughn et al., 2011) or mixes such as peat and perlite; coir and clay, peat and compost. Growing medium also acts as a source of nutrient for plant growth and growing place for seed germination. Coco peat is one that has good growing media component with acceptable pH. Besides, coco peat also has good physical properties, high total pore space and water content, low shrinkage and bulk density, and slow biodegradation. Organic substances or material which is add with inorganic substances can give more advantages to the culture as result in a better plant growth and higher yield as it can increase water holding capacity and aeration.

Therefore, it is needed that fertility and productivity of the soil be restored, using organic fertilizers (Khan et al., 2009). Balakrishna (1975) studied that all the inorganic and organic fertilizers mixture treatments have consistent and significant effects on the yield. Mravilla *et al*., (1978) noted that the non-responsiveness to fertilization of seedlings in the early nursery stages could be due to the already sufficient levels of nutrients available while they were still in the endosperm stage. Sumbak (1970) studied that more frequent or heavier N applications might be necessary for maximum growth. Menon & Pandalai (1960) concluded from their studies that soaking of seed nuts in water for period up to 15 days resulted in quicker and better germination.

Therefore, the main objectives of this study were to determine the effect of different growing media on coconut plant growth and to determine the optimum growing media of organic on vegetative production of coconuts with the measurable of characters of seedlings viz. chlorophyll contents, plant height, stem diameter, number of leafs, number of fronds, length of leafs, root length, width of leafs and dry weight of (roots, trunks and leafs).

METHODOLOGY

The experiments were conducted at MARDI Bagan Datuk, Perak with daily temperature was in the range of 24–36°C and average annual rainfall of 600 mm in 30 rainy days distributed from September to November on year of 2018. Uniform planting materials aged 2 months' year old and 7 months were selected by applying in polybag. Types of fertilizer used are phosphate fertilizer at 113 g/bag. The selections criteria of planting materials for growing media are: 1. Single shoots, 2. Uniformity in shoots and size, 3. Healthy planting material without infection. All the treatments and experiments were laid out in Completely Randomize Design (CRD) with 3 replications. Varieties used are Malayan Red Dwarf (MRD). The soil samples and organic biomass from experimental plots were taken randomly before the treatments were applied for analysis of selected chemical components to determine the nutrient availability (Table 1). Growing media – experiment treatment combination of top soil, sand, oil palm fruit fiber (OPFF) and coco peat filling at the top of seedling polybag namely:

T1=top soil without coco peat (control)
T2=top soil + sand (3:1) without coco peat
T3 top soil + sand (3:1) 5 cm coco peats
T4= top soil + sand (3:1) 10 cm coco peat
T5= fecal + top soil + sand (1:1:1) without coco peat
T6= fecal + top soil + sand (1:1:1) 5 cm coco peat
T7= fecal + top soil + sand (1:1:1) 10 cm coco peat
T8= OPFF + top soil + sand (1:1:1) without coco peat
T9= OPFF + top soil + sand (1:1:1) 5 cm coco peat
T10= OPFF + top soil + sand (1:1:1) 10 cm coco peat

Chlorophyll content of plant leafs were estimated from newly planted seedlings once in three months using SPAD meter at three leaves of the same plant. Data of growth performance for 9-month evaluation are computed from parameters such as plant height, stem diameter, number of leafs, number of fronds, length of the leafs, root length and width of leafs are collected. At the end of experiment, data on dry weight of (roots, trunks and leafs) are collected. All treatment means of the measured variables were analyzed using ANOVA procedure (SAS Institute 1989) and mean separation was done using the Duncan test (DMRT) at ($P<0.05$). Where ever necessary, selected variables were normalized accordingly by using the appropriate numeric transformation.

CHEMICAL PROPERTIES OF GROWING MEDIA COMPONENTS

Table 1 presented the results of chemical characteristics of soil, sand, coco peat and OPFF used in the growing media at the experiment plot. The nutrient of N is higher in top soil while the others are lower than 3%. The amount of K, Mg and Na are also lower than 3% at all component of growing media while P are higher in top soil but lower in coco peat, sand and OPFF. The nutrient content was low and requires additional fertilizer application especially for long term crops. The application of NPK fertilizer is necessary for extended period to complement the availability of nutrient content in soil for plant growth and productivity. The nutritional balance is essential to obtain high and a sustainable yield (Reddy et al., 2002).

For a healthy growth and sustainable coconut production, nutrients must be available in correct quantities, proportion and in an uptakable form at the right time (Mohandas, 2012; Nadheesha and Tennakoon, 2008). This problem however is complicated, owing to the fact that the grower is dealing with a dynamic system, the outcome of which, in terms of crop production, is dependent upon a constellation of factors associated with the soil, the plant and the climatic environment, which would require manipulation in such a manner as not to restrict plant growth. Since the system influencing plant growth in a natural or agricultural environment cannot be defined, except in broad terms, the amount of growth to be made by the plant and the supply of nutrients to be delivered from the soil cannot be estimated too readily or with great precision. In fact, the problems of crop nutrition are legion and in attempting to solve them, researches ranging under many branches of Study are not infrequently required

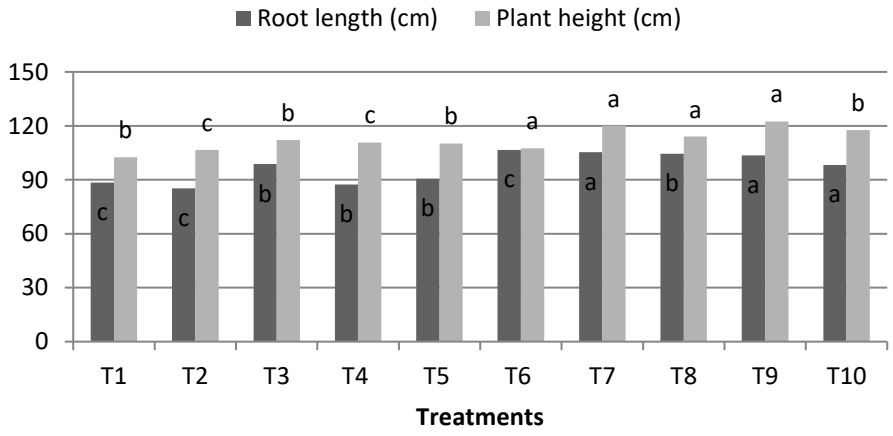
Table 1: Soil chemical characteristics components from experimental plot

Chemical properties (%)	Top soil	Coco peat	Fecal	Oil palm Fruit Fiber (OPFF)
N	18.0	2.08	2.50	0.83
P	4.72	1.80	1.29	0.68
K	0.36	2.72	2.28	1.73
Ca	3.75	nd	nd	nd
Mg	2.44	0.87	0.82	nd
Na	0.57	0.49	0.35	nd

GROWTH PERFORMANCE OF COCONUT SEEDLINGS AT DIFFERENT MEDIA MIXTURE

Figure 1 shows the media mixture treatments effects to plant height and root length. There are significantly different at $p<0.05$ in plant height affected by different media mixture. Treatment of T9 gave better result of growth performance of plant height with 122.49 cm respectively. On the other hand, treatment of T1 gave the lowest plant height with 102.44 cm. The graph also shows the results of roots length of the coconut seedlings. Liyanage & Abeywardena (1957) concluded that the seedling vigor was highly correlated with adult palm characters such as early flowering, nut yield and copra production. Jithya (2010) concluded that the fertilizer application is mainly based on chemical fertilizers which are costly and exerts negative impacts on soil health.

Figure 1: Growing media effect to the number of leaf and number of fronds. Bars with the same letter for each treatment are not significantly different at $P < 0.05$.



The diameter of plants stems that significantly different at $p<0.05$ affected by different media mixture. Treatment of T6 gave the best results with 106.59 cm compared to the other treatments, while treatment of T2 gave the lowest number of roots length with 85.25 cm respectively. and inorganic fertilizers (Titiloye, 1982). Kang and Balasubramanian (1990) also found that high and sustained crop yields could be obtained with judicious and balanced NPK fertilization combined with organic matter amendments. They reported a higher yield of crops from a combined use of NPK fertilizer and poultry manure than from sole applications

Figure 2: Growing media effect to the number og fronds and stem diameter. Bars with the same letter for each treatment are not significantly different at $P < 0.05$.

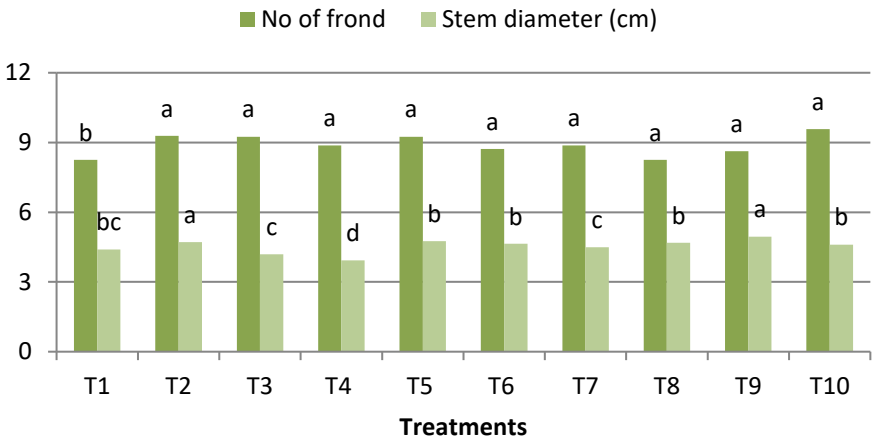


Figure 2 shows the media treatments effects to the number of fronds and stem diameter. There are significantly different at p<0.05 in leaf length affected by different media mixture. Treatment of T10 gave better result of growth performance of fronds number with 9.58 respectively compared to other treatment, while treatment of T1 gave the lowest number of fronds with 8.25. Figure 1 also shows the diameter of plants stems that significantly different at p<0.05 affected by different media mixture. Treatment of T9 gave the best results with 4.95 cm compared to the other treatments. Unfortunately, treatment of T4 gave the lowest number of fronds with 3.93 cm respectively. The most satisfactory method of increasing yield was by judicious combination of organic wastes. Crops yields with complementary inorganic + organic fertilizers and with sole inorganic fertilizer treatment were comparable because nutrients were readily released from the inorganic fertilizer and crops being an aggressive feeder, were able to utilize it for its growth and yield. Marimuthu & Natarajan (2005) observed that to get more quality seedlings, the seed nuts are to be cured for one month in open shade followed by sand curing for 2 or 3 months. Chattopadhyay *et al.*, (2004) compared 5 seed sizes ranging 600-1100g and 2 planting methods viz., horizontal and vertical and concluded that horizontal planting with higher weight of seed nut recorded early and maximum germination and more seedling vigor.

Table 2: Effect of growing media on width, length and number of leaf at nursery stage.

Treatments	Leaf width (cm^2)	Leaf length (cm)	No of leaf
T1	18.14 b	57.73 b	15.25 c
T2	18.17 b	56.44 b	16.33 b
T3	18.31 b	58.33 a	15.88 c
T4	18.56 b	57.12 b	16.33 b
T5	19.45 b	58.81 a	16.75 b
T6	20.04 a	58.98 a	16.28 b
T7	20.56 a	61.23 a	17.21 a
T8	19.35 b	58.46 a	16.71 b
T9	20.24 a	59.86 a	16.80 b
T10	19.36 b	57.31 b	17.25 a

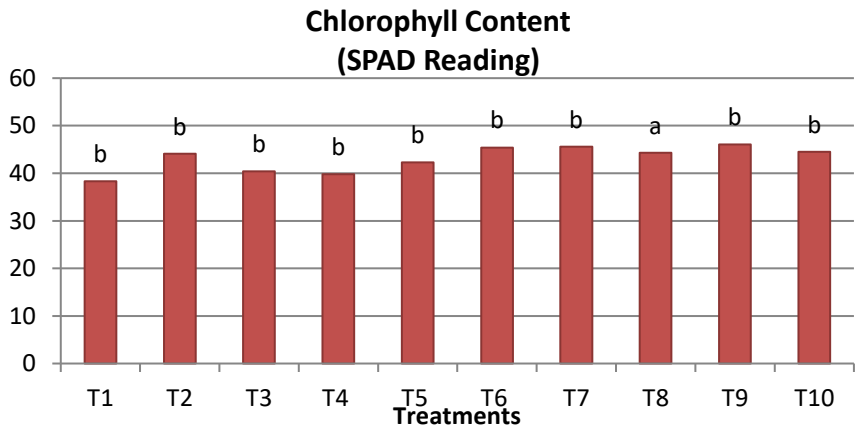
Means values followed by the same letter(s) in a column for each soil are not significantly different at $P < 0.05$.

Table 2 showed the combination growing media treatment affect to the performance of the width, length and number of leafs for coconut seedlings. There are significant differences at p<0.05 in performance of the width, length and number of leafs respectively. Mixed media treatment of T7 shows highest number of leaf width with 20.56 cm2 while treatment of T1 shows the lowest with 18.14 cm2. For result of leaf length, it was clearly shows that treatment of T7 shows significantly highest number with 61.23 cm respectively, but unfortunately the treatment of T2 shows the lowest with 56.44 cm. There are significant a difference in number of leafs from coconut seedlings. It was showed that treatment of T10 was recorded highest with 17.25, while T1 which treatment with top soil only gave lowest number of leaf with 15.25 respectively.

CHLOROPHYLL MEASUREMENT AND DRY MATTER CONTENT AT DIFFERENT MEDIA MIXTURE

Figure 3 shows the averages of chlorophyll content at different treatment. The chlorophyll content was significantly different at $p<0.05$ which slightly highest at T7 (45.59) compare to other treatments while treatment T1 slightly lowest (38.30). More light received might promotes higher rate of photosynthesis for the new planted seedlings. Light intensity has linear negative respond to old palm shading which meant that a reduced canopy permits more light intensity received in the area. Table 3 showed the combination treatment affect to the dry weight of leafs, trunks and roots of coconut seedlings. There are significant differences at $p<0.05$ in leaf, trunk and root dry weight. Mixed media treatment of T10 shows highest leafs dry weight at 69.11 g while treatment of T1 shows the lowest with 51.11 g. For result of trunk dry weight, treatment of T9 shows significantly highest with 65.29 g respectively while treatment of T1 shows the lowest with 50.36 g. SPAD reading has positive linear response to palm shading which meant that a reduced canopy might result in a reduced SPAD reading. Since SPAD reading is closely related to chlorophyll content of the leaf, than a reduced palm canopy might reduce chlorophyll content of the leaf. Light intensity has linear negative respond to palm shading which meant that a reduced canopy permits more light intensity received in the area. More light received might promotes higher rate of photosynthesis for the new planted seedlings.

Figure 3: Growing media effect to the chlorophyll content (SPAD reading) of coconut seedlings seedlings. Bars with the same letter for each treatment are not significantly different at $P < 0.05$.



There are significant differences in roots dry weight affected by different media. Treatment of T5 was recorded highest with 68.93 g, while T1 which treatment with top soil only gave lowest leaf dry weight at 50.91 g. However, if the nutrient recycling rate from the soil and biomass by the extractor is known, that is, the relation between the recycled nutrient quantity by the extractor and the nutrient quantity applied to the soil, it is possible to estimate the available quantity of nutrient to be applied for plants, according to the soil volume and the roots explore. Thomas (1973) observed that the coconut palm with developed root system is invariably better yielder than those with scanty roots. In the case of aged seedlings with lesser food reserve the transplantation shock and root injury will be considerable and will lead to delayed establishment in the field.

Table 3: Effect of growing media on the weight of leafs, trunks and roots of seedling at nursery stage.

Treatments	Dry weight (g)		
	Leaf	Trunk	Root
T1	51.11 c	50.36 b	50.91 c
T2	53.79 c	57.47 b	64.13 b
T3	57.16 c	55.16 b	54.01 c
T4	57.72 c	58.69 b	57.89 c
T5	60.36 b	56.57 b	68.99 a
T6	64.47 b	63.86 a	61.28 b
T7	68.93 a	61.36 b	62.29 b
T8	65.02 b	64.05 a	68.43 a
T9	67.46 a	65.29 a	71.74 a
T10	69.11 a	64.92 a	64.41 b

Means values followed by the same letter(s) in a column for each soil are not significantly different at $P < 0.05$.

CONCLUSION

From the results of the study, it was indicated that the growth of seedlings at nursery stage likely depended to the nutrition of biomass organic in growing media mixture. After 9-month evaluation, it found that treatment of T7 and T10 are available dosage mixture for excellent growth performance of coconut seedlings planted in the polybags. The application of biomass organic waste will increase the nutrient contents for plants uptake. Further evaluations are needed to determine the relationship of level of biomass organic with total amount of NPK supply needed in inducing the growth of coconut seedlings at field stage.

The study also has the limitation that the information on the nutrient study in nursery stage of coconuts is limited. It was unclear whereas that the organic materials can be stabilised with limited spaces inside the polybags because the coco peat is porous and lighter than soil particle. Also there is less comparison study for the uses of organic materials for coconut seedlings performance between polybags and sand-bed nursery. Furthermore, there is there is less information for the uses of different size of polybags that effected to the coconut seedlings performance at nursery stage. Thus, more research is needed to explore these areas.

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