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Research Article
Effect of Growing Media Composition on the Growth of Areca Nut (*Areca catechu* L.)

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Abstract

Background and Objective: Every plant needs a suitable growing medium to grow and develop optimally. The growing media provide nutrients and an ideal place for roots to grow and take nutrients. This study aimed to obtain a suitable growing medium composition to increase the growth of areca nut. **Materials and Methods:** The research was carried out at the Agronomy Laboratory, Faculty of Agriculture, Halu Oleo University, Indonesia from March-September, 2020. Nine treatments of growing media composition in combination with the percentage of soil medium, rice husk charcoal and organic fertilizer used and arranged in a Randomized Block Design (RBD) with three replications. **Results:** The result showed that the composition of the growing medium has a significant effect on the growth of areca nuts. Growing media using the composition of 25% soil, 25% rice husk charcoal, 50% of organic plus fertilizer (M_5) is the best growing medium composition that can increase the growth of areca nut. Another growing media is composed of 50% soil, 0% rice husk charcoal, 50% organic plus fertilizer (M_2), 50% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_4), 25% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_7) and 0% soil, 50% rice husk charcoal, 50% organic plus fertilizer (M_8) can also be an alternative in increasing the growth of areca nut. **Conclusion:** The composition of the growing medium has a significant effect on the growth of areca nuts seedling. The growing media using the composition of 25% soil, 25% rice husk charcoal and 50% organic plus fertilizer is the best growing medium composition that can increase the growth of areca nut seedling.

Key words: Areca nut, growing media, ultisol, organic plus fertilizer, rice husk charcoal, rhizobacteria, fix nitrogen

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

As an agricultural country, Indonesia has enormous potential in developing agricultural and plantation commodities as a source of foreign exchange. One of the plantation commodities which have very promising business opportunities is the areca nut because the demand is very high but areca nut is not always available. Recently, areca nut (*Areca catechu* L.) has been in great demand by cultivated farmers because its economic value tends to increase. Apart from being used as industrial raw materials, leather tanning, cosmetics, fabric dyes, medical/medicinal raw materials, areca nut is also a mandatory ingredient in traditional events (eating areca nut). Areca nut has been historically grown by local communities in Indonesia for several decades. It has been used as a medicine, economic product and ritual material by various ethnic groups in Indonesia[1].

Areca nut fruit has been known for a long time in Indonesia, that serves as chewing food in several areas in Indonesia and also consume betel nuts only in certain age and circle i.e. the nobility and the old people[2]. Optimal plant growth and development is highly dependent on growing media as a key factor, especially in providing nutrients for these plants. The growing medium is a place where roots attach and develop, which play a role in taking nutrients, water and oxygen from the media. Thus, the growing medium should be an ideal place for root growth and development so that the process of taking food can be carried out optimally. The ideal growing medium has a crumb structure, is porous and can maintain soil moisture well[3]. This ideal growing medium is a problem in Southeast Sulawesi because in general the agricultural area in this area is dominated by ultisol soils (60.3% of the total land area), characterized by high clay content, high acidity and low nutrient and organic matter content[4]. An additional mixture of organic matter is needed to produce a suitable growing medium capable of providing ideal conditions for root growth and making it easier for the roots to extract nutrients, water and oxygen for plant growth[5]. Besides, the growing medium must also have sufficient and balanced nutrient content for plant growth. Several types of materials that can be used to improve growing medium include rice husk charcoal, compost, manure or other organic matter[5,6]. The addition of organic matter to heavy textured soils such as podzolic will be able to improve the physical, chemical and biological qualities of the soil[6-8]. Moreover, if organic fertilizers were enriched with plant growth-promoting bacteria, it can increase the population of beneficial microbes in the soil so that the soil becomes more fertile and healthier could increase the microbial population in the soil so that the soil becomes more fertile and healthier[9]. This study aims to obtain the best composition of growing media namely soil, rice husk charcoal and organic plus fertilizers which could increase the growth of areca nut.

MATERIALS AND METHODS

Place and time: The research was carried out at the Agronomy Unit of Agrotechnology Laboratory Faculty of Agriculture, University of Halu Oleo and Wua-Wua District, Kendari City, Southeast Sulawesi, Indonesia from March-September, 2020.

Experimental design: The study used a Randomized Block Design (RBD), consisting of 9 treatments of growing media composition as shown in Table 1. Each treatment was repeated three times so that there were 27 experimental units.

Seed preparation and planting: The seeds used are local areca seeds that have been germinated 3 months earlier. The seeds used for the study were those with a uniform sprouts height of ±3 cm. The growing medium used was Ultisol soil (red-yellow podsolic), rice husk charcoal and organic plus fertilizer according to the treatment composition in Table 1. Organic plus fertilizer was made from fermented animal manure enriched with the best rhizobacterial mixture from the previous studies[10]. Before use, the planting medium was filtered with a 0.5 cm diameter sieve to obtain uniform media granules, then put into polybags measuring 25×25 cm. Areca seeds are planted with 1 seed per polybag.

Observation variable and data analysis: The variables observed in this study were plant height, stem diameter, leaf area and root length. Data were analyzed by analysis of variance (ANOVA) using statistical software. If the test results showed a significant difference, then tests of treatment differences were performed using Duncan's Multiple Range Test (DMRT) at $\alpha = 0.05$.

Table 1: Growing media composition treatments of areca nut

	Growing media composition (%)		
Treatments	Soil	Rice husk charcoal	Organic plus fertilizer
M_0	100	0	0
M_1	75	0	25
M_2	50	0	50
M_3	75	25	0
M_4	50	25	25
M_5	25	25	50
M_6	50	50	0
M_7	25	50	25
M_8	0	50	50

RESULTS

Plant height: The difference in growing media composition greatly affects the growth of betel nuts. Among the treatments tested, the planting medium treatment M_5 using a soil composition ratio of 25 and 25% rice husk charcoal and organic fertilizer plus 50% was more able to increase the height of the areca nut compared to other treatments. The plant height in the M_5 treatment reached 39.3 cm, while in the control treatment that did not get rice husk charcoal and organic fertilizers, the height only reached 19.2 cm. The increase in plant height reached 105% compared to the control. Meanwhile, the use of 100% soil media gave the lowest plant high performance and was significantly different from all other treatments (Fig. 1).

Stem diameter: The growing media composition also affects the stem diameter of the areca nut. Composition of the growing media used 25% soil, 25% rice husk charcoal, 50%organic plus fertilizer 50% (M_5), 50% soil, 0% rice husk charcoal, organic plus fertilizer 50% (M_2), 50% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_4), 25% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_7) and 0% soil, 50% rice husk charcoal, 50% organic plus fertilizer (M_8) produces a stem diameter of areca nut plants higher than the control and other treatments. The stem diameter in each of these treatments was M_5 = 10.2 cm, M_2 = 9.3 cm, M_4 = 9.2 cm, M_7 = 9.4 cm and M_8 = 9.8 cm. Meanwhile, in the control treatment (M_0), the stem diameter was only 6.0 cm. The increase in stem diameter reached the range of 53-70% compared to the control. While the use of 100% soil media gave the lowest stem diameter performance and was significantly different from all other treatments (Fig. 2).

Leaf area: The difference in the composition of growing media greatly affects the leaf area of the areca nut. The composition of growing media using 25% soil, 25% rice husk charcoal, 50% organic plus fertilizer (M_5) produced the highest leaf area (169.4 cm^2) and was significantly different from the control treatment (M_0) with a leaf area of 66.3 cm. This treatment was not significantly different from the soil media composition of 50% soil, 0% rice husk charcoal, 50% organic plus fertilizer (M_2), 50% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_4), 25% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_7) and 0% soil, 50% rice husk charcoal, organic plus fertilizer 50% (M_8). The leaf area in each of these treatments were M_2 = 152.7 cm^2, M_4 = 146 cm^2, M_7 = 143.1 cm^2 and M_8 = 168.1 cm^2. The increase in leaf area in the M_5 treatment reached 156% compared to the control. Meanwhile, the use of 100% soil media gave the lowest leaf area (Fig. 3).

Root length: The difference in the growing media composition greatly affects the root length of the areca nut. The use of the composition of the growing media with 25% soil, 25% rice husk charcoal, organic plus fertilizer 50% (M_5), 50% soil, 0% rice husk charcoal, organic plus fertilizer 50% (M_2), 50% soil, 50% rice husk charcoal, organic plus fertilizer 25% (M_4), 25% soil, 50% rice husk charcoal, 25% plus organic fertilizer (M_7) and 0% soil, 50% rice husk charcoal, 50% organic

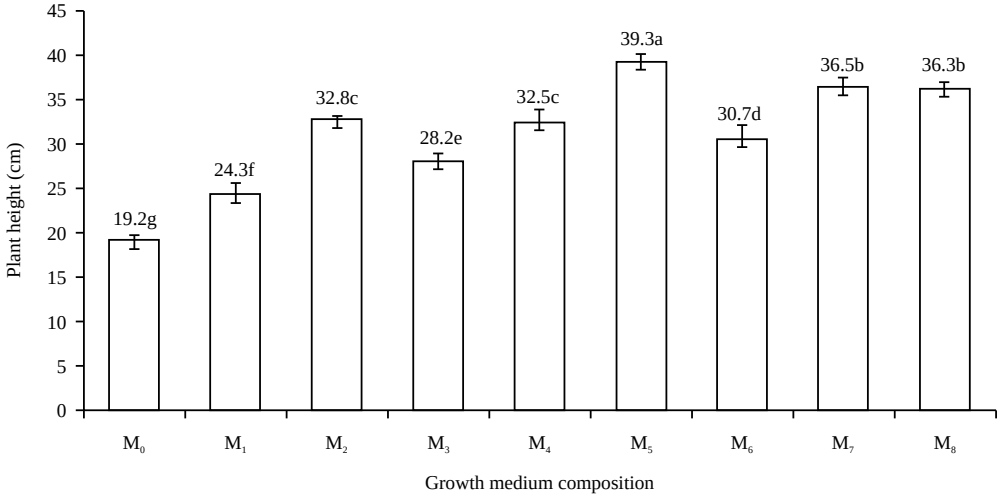

Fig. 1: Effect of growing media composition on the height of areca nut

Bars had different letters significantly differ from each other according to Duncan's Multiple Range Test (DMRT) at a = 0.05

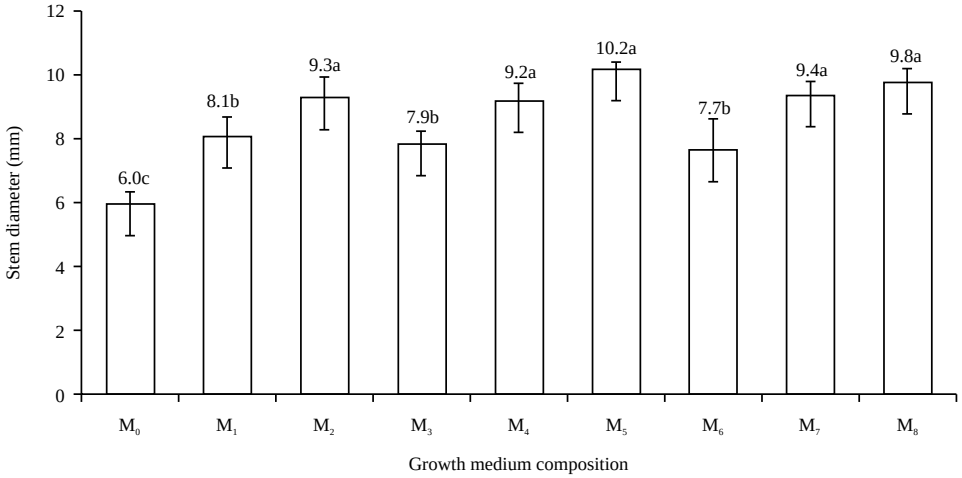

Fig. 2: Effect of growing media composition on stem diameter of areca nut

Bars had different letters significantly differ from each other according to Duncan's Multiple Range Test (DMRT) at a = 0.05

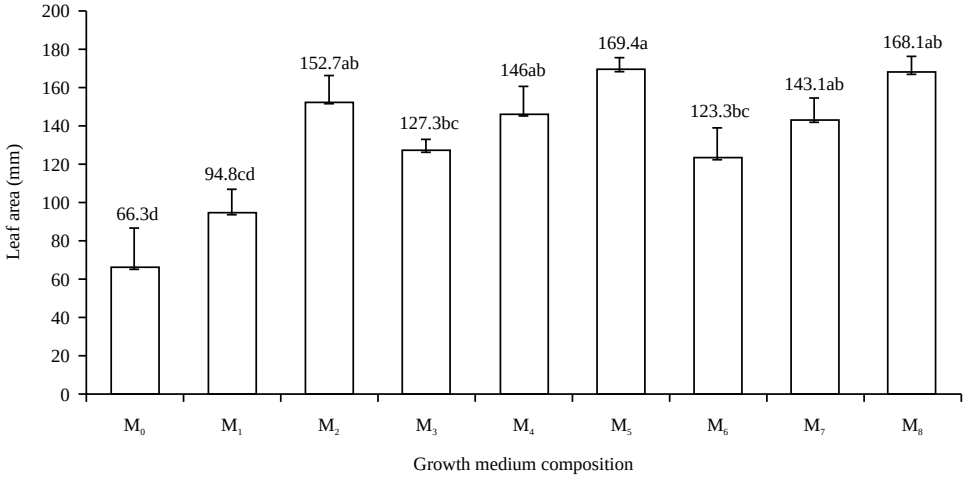

Fig. 3: Effect of growing media composition on the leaf area of areca nut

Bars had different letters significantly differ from each other according to Duncan's Multiple Range Test (DMRT) at a = 0.05

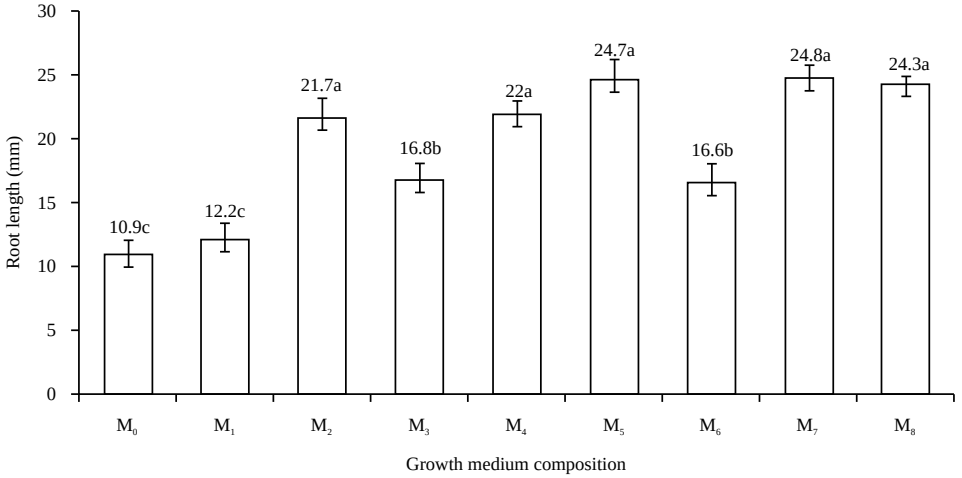

Fig. 4: Effect of growing media composition on the root length of areca nut

Bars had different letters significantly differ from each other according to Duncan's Multiple Range Test (DMRT) at a = 0.05

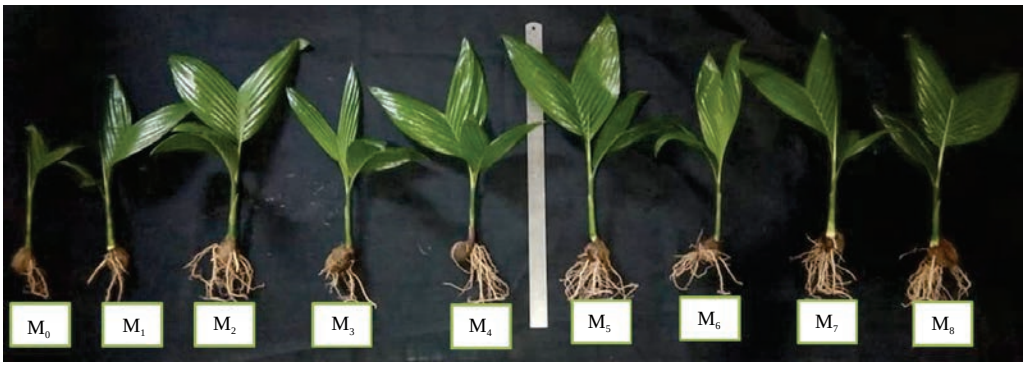

Fig. 5: Growth performance of areca nut in various compositions growing media

plus fertilizer (M_8) produces longer roots, significantly different from the controls. The root length in treatment M_5 = 24.7 cm, M_2 = 21.7 cm, M_4 = 22 cm, M_7 = 24.8 cm and M_8 = 24.3 cm. While the root length in the control treatment (M_0) was 10.9 cm. The increase in root length reached a range of 99-127% compared to controls. Meanwhile, the use of 100% soil media gave the lowest root length (Fig. 4).

The growth performance of areca nut in various treatments of the growing media composition can be seen in Fig. 5.

DISCUSSION

The results showed that the differences in the composition of growing media greatly affected the growth of areca nut. The use of growing media of 100% soil (Ultisol) showed the lowest plant growth performance compared to other treatments. This is easy to understand because Ultisol soil is not suitable for plant growth. Ultisols are a major group of marginal soils extensively found in the upland area of Indonesia[11]. The main constraint in the development of ultisol soil because of characteristics that have high soil acidity, high Al saturation and poor macro nutrients[12], making it unsuitable for plant growth.

The use of growing media with a composition of 25% soil, 25% rice husk charcoal and organic plus fertilizer 50% is the most ideal composition in increasing the growth of areca nut. The organic plus fertilizers used have been enriched with endophytic and rhizobacteria which have been shown to act as stimulants for plant growth. Besides, the organic matter used also plays a role in improving the physical, chemical and biological properties of the soil so that root growth is optimal and can absorb nutrients from the growing media optimally as well[13,14]. Endophytic and rhizobacterial isolates isolated from areca nut roots can dissolve phosphate which is indicated by the presence of a clear zone on the media containing a source of phosphate. The isolate is also able to fix nitrogen and synthesize the growth hormone indole-3-acetic acid (IAA)[10]. The ability of endophytic and rhizobacteria to dissolve phosphate, fix nitrogen and synthesize the hormone IAA was also reported by other researchers[15-17].

The use of rice husk charcoal as a mixture for growing media is also able to improve soil conditions which have implications for improving the growth of plant seeds, although the effect is not as good as using organic plus fertilizers. As explained, rice husk charcoal can replace the role of soil as a growing media but fertilization must be added, especially nitrogen because the Nitrogen (N) content in the rice husk charcoal is very low[18]. Therefore, the addition of organic plus fertilizers in the growing media, especially in Ultisol soil, must be done to provide ideal conditions for root growth and development. Organic fertilizers made from animal manure and forage materials undergo a long decomposition process so that the nutritional needs of plants can be met for a long time. It is stated that there is an increase in Nitrogen, Phosphorus and Potassium in organic fertilizers made from animal manure[19].

This study's results have implications for the selection of a good and suitable planting medium, especially for areca nut nurseries. There are because the critical phase for areca seedlings is the initial phase of seedling growth. In the early stage of nurseries, there are often many deaths because the planting media conditions are not supportive of seedling growth. The results of this study will be beneficial for growing betel nuts on less fertile soil media. The use of rice husk charcoal and organic fertilizers will increase the soil's ability to provide nutrients and hold water, which is very useful for the early growth of seedlings, which occurs in the initial phase starting plant seeds. Therefore, this study's results can be used for the nursery of plants with similar characteristics to areca nut, mainly because of the thick skin and coir.

CONCLUSION

The composition of the growing medium has a significant effect on the growth of areca nuts. Growing media using the composition of 25% soil, 25% rice husk charcoal, 50% of organic plus fertilizer (M_5) is the best growing medium composition which can increase the growth of areca nut but the growing media which is composed of 50% soil, 0% rice husk charcoal, 50% organic plus fertilizer (M_2), 50% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_4), 25% soil, 50% rice husk charcoal, 25% organic plus fertilizer (M_7) and 0% soil, 50% rice husk charcoal, 50% organic plus fertilizer (M_8) can also be an alternative because its effect is not significantly different in increasing the growth of areca nut.

SIGNIFICANCE STATEMENT

This study discovers the effect of soil media in good composition between soil, rice husk charcoal and organic fertilizer that can be beneficial for the growth and development of areca nut seedling. The main problem in planting areca nut is difficult to find the media composition that suitable for the growth and development of seedling areca nut. This study discovers the possible using organic media composition to boost the growth of areca nut seedling. Our finding revealed that the best growing media for areca nut seedling are a composition of rice husk charcoal in combination with organic fertilizer. The best composition in growing media will increase the seedling vigor and the growth of the seedling. This study will help the researcher to uncover the critical areas of growth of areca nut seedling that many researchers were not able to explore.

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