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IMPROVING GROWTH OF PATCHOULI CUTTINGS USING PLANT GROWTH REGULATORS AND GROWING MEDIA

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Abstract

Patchouli plant (*Pogostemon cablin* Benth.) is one of the essential oil producing plants which is widely used in the pharmaceutical, cosmetic and perfume fields, especially as a mixture or fixative (fragrance binder). The productivity and success rate of the initial growth of patchouli plants are largely determined by the cultivation techniques used. The cuttings used are stem cuttings with the best number of 4 nodes and have 2 remaining leaves for photosynthesis. The purpose of this study was to analyze the effect of growth regulator treatment and planting media composition on the growth of patchouli cuttings. The study used a factorial randomized block design with 2 factors, namely the first factor of planting media (M) consisting of 2 levels, namely: M0 = Ultisol soil (control); M1 = Ultisol soil + coconut shell biochar (2:1). The second factor of PGR (N) consists of 4 levels, namely: N0 = Water (control); N1 = 100% coconut water; N2 = 45% shallot extract; N3 = Rootone-F 150 ppm. The results showed that each independent treatment had a very significant effect on the variables of fresh cutting weight (g), root volume (cm^3) and root morphology. Furthermore, the interaction of planting media and PGR treatments had a very significant effect on the variables of fresh cutting weight, root volume and root morphology. Ultisol soil + coconut shell biochar (2:1) and Rootone-F 150 ppm planting media were the best treatments to increase the growth of patchouli cuttings.

Keywords: Biochar, plant growth regulators, Pogostemon cablin Benth., Rootone-F, Ultisol

INTRODUCTION

Patchouli (*Pogostemon cablin* Benth.) is one of the most important oil-producing plants in Indonesia. Commercially, patchouli oil is known as Patchouli Oil, which is widely used as a blending ingredient and fixative (fragrance binder) in the perfume, pharmaceutical, and cosmetics industries (Siregar et al., 2022). Patchouli oil production centers in Indonesia are located in Sulawesi (South Sulawesi, Southeast Sulawesi, and Gorontalo), Sumatra (Aceh, North Sumatra, West Sumatra), and several other areas on the island of Java (Prananda et al., 2024). Along with industrial development and the high demand for essential oils, farmers are continuously being urged to increase production. The low quantity and quality of patchouli seedlings are major challenges in patchouli essential oil production. Therefore, one approach is vegetative propagation. Vegetative propagation can be achieved through cuttings (Dona et al., 2023).

Root formation is a major obstacle in vegetative plant propagation, especially by cuttings (Marpaung et al., 2017). Therefore, efforts to stimulate root formation are crucial, which can be achieved by administering plant growth regulators (Anggraeni et al., 2019). Auxin PGRs can be derived from natural sources such as young coconut water, shallot extract, and synthetic (artificial) sources, including Rootone-F (Irwanto et al., 2019). Another factor to consider is the use of planting media. Planting media functions as a provider of nutrients and water utilized by plants (Hulu and Nadhira, 2024). Low organic matter content is one of the most prominent constraints on soil fertility that affects plant growth (Sufardi et al., 2023; Suleman et al., 2025). One alternative organic material that can be used in mixed planting media is biochar (Oni et al., 2019; Kilowasid et al., 2025). The material that can be used as raw material for making biochar is coconut shell (Liu et al., 2018).

LITERATURE REVIEW

In the plant taxonomy system, patchouli plants are classified into Kingdom: Plantae; Division: Spermatophyta; Class: Dicotyledonae; Order: Lamiales; Family: Lamiaceae; Genus: Pogostemon; Species: *Pogostemon cablin* Benth. This plant is generally propagated vegetatively (cuttings) so that it has a fibrous root system (Santoso, 2007). The main problem in nurseries is the low growth of plant roots. Therefore, the provision of growth regulators is used to stimulate initial growth and accelerate the elongation of patchouli roots to obtain optimal rooting (Safitri et al., 2022). Coconut water is rich in growth hormones such as cytokinins, auxins, and gibberellins so it can be used as a growth regulator (Banna et al., 2023). In addition, shallot extract also contains growth regulators such as auxins, allithiamin, and gibberellins, which play a role in stimulating plant tissue growth (Paelongan et al., 2023). On the other hand, Rootone-F is a commercial synthetic plant growth regulator containing the active ingredient auxin (indole-3-acetic acid), which stimulates cell division and enlargement, thereby enhancing the initiation and growth of adventitious roots in cuttings (Susanti et al., 2025).

The choice of growing medium for nurseries will determine the quality of the resulting seedlings. The function of the growing medium is to provide a place for plant roots to attach and grow (Zairani and Burlian, 2021). The application of organic matter improves the physical quality of the growing medium, particularly aeration and drainage, through the internal porosity of organic particles, which contributes to water retention and air exchange (Sugianto and Kamelia, 2021; Kilowasid et al., 2024). Organic matter can reduce soil density, making it lighter, thus providing favorable conditions for root development and influencing plant growth and yield (Saragih et al., 2024; Yusuf et al., 2025). Coconut shells can be used as a raw material for biochar production (Ajien et al., 2023). Coconut shell biochar contains volatiles that can provide a habitat for soil microorganisms, thus increasing microbial populations and activity. In addition to positively impacting soil properties, the application of coconut shell biochar also increases plant productivity (Laurenze, 2023).

METHOD

Research Location and Time

This research was conducted in Tababu Village, Tirawuta District, East Kolaka Regency. Laboratory sample analysis was conducted at the Soil Science Laboratory, Faculty of Agriculture, Halu Oleo University, Kendari. This research took place from May to July 2025.

Research Design

The study used a factorial randomized block design (RBD) with two factors: the first factor, Planting Media (M), consisted of two levels: M0 = Ultisol soil (control); M1 = Ultisol soil + coconut shell biochar (2:1). The second factor, the combination of Plant Growth Regulators (N), consisted of four levels: N0 = Water (control); N1 = 100% coconut water; N2 = 45% shallot extract; N3 = Rootone-F 150 ppm. The number of treatment combinations was 2 (N levels) x 4 (M levels), resulting in eight treatment combinations. Each treatment combination consisted of three polybags with three replications, resulting in 72 sample plants.

Research Procedure

The research procedure included preparation of planting material, preparation of plant growth regulators (PGR) consisting of 45% shallot extract (45 ml shallot extract + 55 ml water), 100% coconut water, and 150 ppm Rootone-F. Preparation of the planting medium, namely coconut shell biochar. Land preparation and shade preparation, preparation of patchouli cuttings, and maintenance were carried out.

Research Variables

Observations on the growth of patchouli cuttings were conducted on all sample plants. The parameters observed were growth rate (percentage), fresh cutting weight (g), root volume (cm^3), root morphology (root length (cm), and number of roots (strands).

Data Analysis

Observation data were analyzed using analysis of variance (ANOVA). Results showing F count > F table were followed by further testing (HSD) at the 95% level.

RESULTS AND DISCUSSION

Growth Performance of Patchouli Cuttings

The growth of patchouli cuttings using plant growth regulator and growing media composition tests is shown in Figure 1. The figure shows that the best growth performance of patchouli cuttings was achieved with the combination of Ultisol soil + coconut shell biochar and 150 ppm Rootone-F (M1N3). Meanwhile, poorer performance was demonstrated with the combination of Ultisol soil and water (M0N0) as the control treatment.

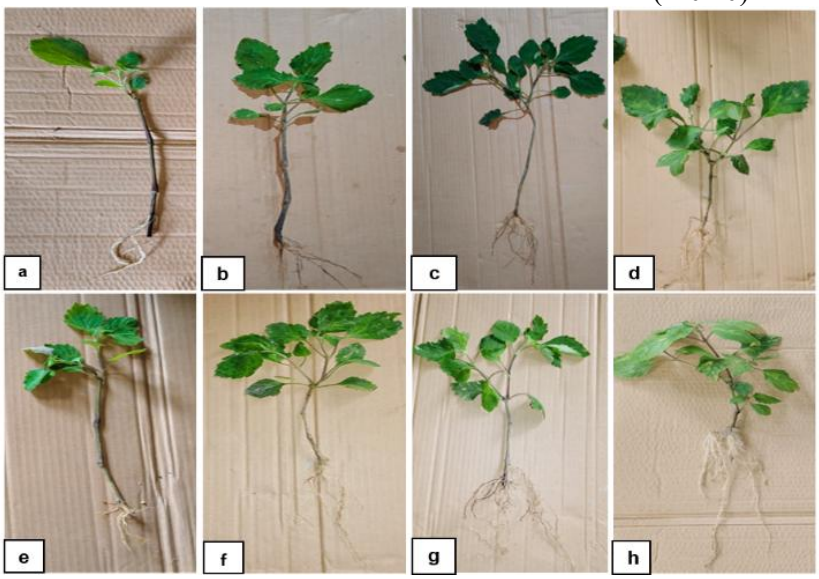

Figure 1. Growth Performance of Patchouli Cuttings at 56 Days After Planting (DAP).
(Note: a= M0N0, b= M0N1. c= M0N2, d= M0N3, e= M1N0, f= M1N2, g= M1N2, h= M1N3).

Based on Figure 1, it shows that the growth of patchouli plants is very different for each treatment combination. This indicates that patchouli cuttings are able to produce carbohydrates during early growth because they have a growth percentage of 100%. In subsequent growth, the effect of biochar and the PGR Rootone-F 150 ppm is increasingly visible. The application of biochar can create an environment that is much needed by patchouli plants, as evidenced by observations of the number of roots (strands), root volume (cm^3), and root length (cm). This is in line with research by Saosang et al. (2022), which states that the addition of biochar can improve soil physical properties and support plant growth. This is also supported by the results of research by Widyantika and Prijono (2019), which states that the application of biochar can increase water holding capacity and provide nutrients to improve plant nutrient uptake.

Fresh Weight of Cuttings (g)

The results of patchouli cutting growth observations, including the variable fresh weight of cuttings (g), using independent tests of growth regulators and growing medium composition, each showed a highly significant effect. Furthermore, the interaction of growth regulators and growing medium composition also had a highly significant effect. The results of the HSD test are presented in Table 1.

Table 1. The effect of the interaction of growth regulators and the composition of the planting medium on increasing the growth of patchouli cuttings based on observations of the fresh weight of the cuttings (g).

Factor M (Planting Medium)	Factor N (Plant Growth Regulator)				HSD
	N0	N1	N2	N3	
M0	16.59 a q	17.01 a q	19.52 a q	21.73 a q	5.51
M1	23.92 b p	25.40 b p	28.82 b p	49.36 a p	
HSD	6.72				

Description: The numbers followed by the letters (a, b) in the same row and (p, q) in the same column are significantly different in the 0.05 HSD test. M0= Ultisol soil (Control), M1= Ultisol soil + Coconut shell biochar, N0= Water (Control), N1= Coconut water 100%, N2= Shallot extract 45%, N3= Rootone-F 150 ppm.

Table 1 shows that the interaction of growth regulators and planting media composition on the observation of fresh cutting weight (g) has a very significant effect with the best average treatment obtained in the treatment of biochar and Rootone-F 150 ppm (M1N3) planting media which is very significantly different from no treatment. Based on the combination of treatments, it shows that the difference in fresh weight (g) of patchouli plants is thought to be due to the influence of biochar which supports root growth and hormones that stimulate plant growth. In line with the results of Pujawati et al. (2017) that the fresh weight of plants is in line with optimal root growth and if there is inhibition of root growth, the fresh weight will be inhibited due to the influence of less than optimal roots in absorbing nutrients. Fresh plant weight can be influenced by the availability of sufficient water and nutrients. According to Suleman et al. (2025), the application of biochar can increase the increase in height and number of leaves of patchouli plants including their dry weight. This is supported by the results of research by Widijanto et al. (2023) One of the benefits of biochar is its ability to make fertilizer use more effective by binding nutrients when there is an excess and releasing nutrients when plants need them (slow release), thereby preventing nutrient poisoning and deficiencies. Rauf et al. (2020) confirmed that biochar can increase porosity in Ultisol soil by up to 60.75%, and the available water value by 4.99%.

Root Volume (cm^3)

Observations of patchouli cutting growth, including root volume (cm^3), showed a highly significant effect on root volume (cm^3) through independent tests of growth regulators and planting medium composition. Furthermore, the interaction of growth regulators and planting medium composition also showed a highly significant effect. The results of the HSD test are presented in Table 2.

Table 2. The effect of the interaction of growth regulators and the composition of the planting medium on increasing the growth of patchouli cuttings in observations of root volume (cm^3).

Factor M (Planting Medium)	Factor N (Plant Growth Regulator)				HSD
	N0	N1	N2	N3	
M0	1.56 b q	2.44 a q	3.00 a q	3.22 a p	0.94
M1	3.89 c p	4.89 b p	5.78 b p	8.11 a p	
HSD	1.15				

Description: The numbers followed by the letters (a, b) in the same row and (p, q) in the same column are significantly different in the 0.05 HSD test. M0= Ultisol soil (Control), M1= Ultisol soil + Coconut shell biochar, N0= Water (Control), N1= Coconut water 100%, N2= Shallot extract 45%, N3= Rootone-F 150 ppm.

Root Length (cm)

Observations of patchouli cutting growth, including root length (cm), using independent tests of plant growth regulators and planting medium composition, each showed a highly significant effect. Furthermore, the interaction of plant growth regulators and planting medium composition also showed a highly significant effect. The results of the HSD test are presented in Table 3.

Table 3. The effect of the interaction of growth regulators and the composition of the planting medium on increasing the growth of patchouli cuttings based on observations of root length (cm).

Factor M (Planting Medium)	Factor N (Plant Growth Regulator)				HSD
	N0	N1	N2	N3	
M0	11.04 b q	14.08 b q	16.03 a q	17.83 a q	3.38
M1	21.34 b P	22.24 b p	23.61 b p	34.18 a p	
HSD	4.12				

Description: The numbers followed by the letters (a, b) in the same row and (p, q) in the same column are significantly different in the 0.05 HSD test. M0= Ultisol soil (Control), M1= Ultisol soil + Coconut shell biochar, N0= Water (Control), N1= Coconut water 100%, N2= Shallot extract 45%, N3= Rootone-F 150 ppm.

Number of Roots (Strands)

Observations of patchouli cutting growth using the variable number of roots (strands) using independent tests of plant growth regulators and planting medium composition each showed a highly significant effect. Furthermore, the interaction of plant growth regulators and growing medium composition also showed a highly significant effect. The results of the HSD test are presented in Table 4.

Table 4. The effect of the interaction of growth regulators and the composition of the planting medium on increasing the growth of patchouli cuttings in observations of the number of roots (strands).

Factor M (Planting Medium)	Factor N (Plant Growth Regulator)				HSD
	N0	N1	N2	N3	
M0	9.67 a q	14.78 a q	16.67 a q	19.11 a q	11.02
M1	24.00 b p	32.22 b p	37.33 b p	61.00 a p	
HSD	13.46				

Description: The numbers followed by the letters (a, b) in the same row and (p, q) in the same column are significantly different in the 0.05 HSD test. M0= Ultisol soil (Control), M1= Ultisol soil + Coconut shell biochar, N0= Water (Control), N1= Coconut water 100%, N2= Shallot extract 45%, N3= Rootone-F 150 ppm.

The research results indicate that the interaction between plant growth regulators and the composition of the growing medium for patchouli plants showed a highly significant effect on root volume (cm^3) (Table 2), root length (cm) (Table 3), and root number (strands) (Table 4). The best treatment average was obtained with the biochar growing medium and 150 ppm Rootone-F growth regulator (M1N3), significantly different from the untreated treatment (M0N0). These findings suggest that biochar can improve soil physical and chemical properties, such as porosity and pH, allowing roots to develop well. Root development in the soil can stimulate shoot growth. The varying root numbers in each Rootone-F treatment were due to the concentrations received by the plants. This contributed to increased auxin production in patchouli cuttings, resulting in increased root number (strands), root volume (cm^3), and root length (cm).

This is in line with the research findings of Parmila et al. (2019) found that the NAA contained in Rootone-F stimulates root cell division, resulting in the formation of a healthy root system. This in turn increases plant physiological activity, leading to water and nutrient absorption, followed by root cell elongation. This is further supported by research conducted by Dona et al. (2023), who stated that Rootone-F contains the active ingredients NAA and IBA, which stimulate cell formation, early emergence and differentiation, and regulate mRNA biosynthesis. This is particularly true in accelerating the synthesis of cell wall-forming enzymes, ultimately leading to cell elongation, and the resulting RNA is involved in root initiation early in growth.

Planting media conditions that meet plant needs enhance patchouli cutting growth, as evidenced by cutting fresh weight, root volume, root number, root length, and growth percentage. Consistent with research by Waniatri et al. (2019), cutting growth percentage is strongly influenced by the physiological condition of the plant material and the suitability of the growing environment. Furthermore, research by Samudro et al. (2025) reported that Rootone-F concentration and growing media composition significantly interacted with the percentage of live cuttings. Therefore, a growth value of 100% reflects that the Aceh patchouli variety used in this study has high viability and is suitable for development through vegetative propagation using stem cuttings.

CONCLUSION

Based on the results and discussion, it can be concluded that there is an effect of growth regulator treatment and planting medium composition on the growth of patchouli cuttings. The combination of Ultisol soil and biochar planting medium treatment and Rootone-F 150 ppm (M1N3) growth regulator is recommended as a better treatment to increase the growth of patchouli cuttings on Ultisol soil.

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