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Influence of The Composition Oyster Mushroom Baglog Compos on The Growth of Cajuput (*Melaleuca cajuputi*)

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ABSTRACT

Cajuput (*Melaleuca cajuputi*) is an important essential oil-producing tree species. This species can thrive on infertile and degraded land. However, appropriate growing media are essential for successful cajuput seedling establishment. The material that can be used as growing media is oyster mushroom baglog compost. However, there is no information on the right composition of oyster mushroom baglog compost as growing medium. This study aimed to determine the effect and the right composition of oyster mushroom baglog compost on cajuput seedling growth. The study was conducted from March to April 2025 at the Permanent Nursery of the Forestry Department of Politani Kupang. The study used a completely randomised design. The study was growing medium consisting of soil composition (S), sand (S), oyster mushroom baglog compost (C). SS (1:1), SSC1 (1:1:1), SSC2 (1:1:2), SSC3 (1:1:3) and SSC4 (1:1:4). The study was repeated three times. The results showed that although no statistically significant differences were observed among the treatments ($p > 0.05$), the SSC2 treatment consistently produced the highest mean values for plant height, stem diameter, leaves number, and root length.

Keywords: Cajuput, Growing Medium, Growth, Oyster Mushroom Baglog Compost, Study

1. Introduction

Cajuput (*Melaleuca cajuputi*) is one of the major essential oil-producing plant species in Indonesia. Furthermore, this species has strong potential for land rehabilitation, including land conservation and the restoration of marginal lands, because it is a light-demanding species that requires full sunlight. Melaleuca cajuputi can thrive on degraded (barren) land [1].

Nevertheless, seedling management in the nursery plays an important role in the growth of cajuput plants in the field. Seedling growth is influenced by both genetic and environmental factors. One of the most important environmental factors affecting seedling growth is the growing medium. A good medium should provide contain nutrients and water capable of supporting the seedling development process. Understanding the importance of the growing medium as a determinant is the first step toward successful cajuput cultivation. In addition to soil and sand, organic amendments that can be used as growing medium include bokashi, manure, black soldier fly frass, vermicompost, and oyster mushroom baglog compost.

Oyster mushroom baglog compost is produced from failed and spent baglogs that are no longer suitable for mushroom cultivation. This compost contains 1.20% nitrogen (N), 0.81% phosphorus (P), 1.97% potassium (K), and 1.79% organic carbon [2]. Oyster mushroom baglog compost, due to its nutrient composition and the necessity to minimize waste from mushroom cultivation, holds significant promise as an organic growing medium. Nevertheless, there is a scarcity of information concerning its efficacy and the ideal application rate for use as a growing medium. Therefore, this study was conducted to evaluate the effects of different proportions of oyster mushroom baglog compost on the growth of *Melaleuca cajuputi* seedlings. The results are expected to identify the optimum proportion of oyster mushroom baglog compost for producing high-quality cajuput seedlings.

2. Methods

2.1. Time and Location

This study was conducted over a three-month period (March–April 2025) at the Permanent Nursery, Department of Forestry, Kupang State Agricultural Polytechnic, Lasiana Village, Kelapa Lima District, Kupang City, East Nusa Tenggara, Indonesia. Geographically, Lasiana Village is located at coordinates 10°08′38″ S and 123°40′17″ E at an elevation of approximately 15 m above sea level (asl). The average annual rainfall ranges from 700 to 1,000 mm. The area experiences approximately 3–4 wet months and 7–9 dry months annually and 7–9 dry months with a climate type of E–F according to the Schmidt–Ferguson indicating a moderately dry to dry climate.

2.2. Tool and Materials

The tools used in this study were tally sheets, shade cloth, shovels, transparent plastic sheets, seedling trays, measuring cups, buckets, hand sprayers, cutters, electronic balance, calipers, sieves, rulers, marker pens, a camera, a laptop, Microsoft Excel (version 2016), and the IBM SPSS statistics version 26, while the materials used were *Melaluca cajuputi* Subsp. Cajuputi seeds, 6x12 cm polybags, soil, sand, oyster mushroom baglog compost, water, and label paper.

2.3. Experimental Design

This study was arranged using a non-factorial completely randomized design (CRD) [3], with the growing medium as the factor. The treatments consisted of:

SS : Soil: Sand (1:1)
SSC1 : Soil: Sand: Oyster mushroom baglog compost (1:1:1)
SSC2 : Soil: Sand: Oyster mushroom baglog compost (1:1:2)
SSC3 : Soil: Sand: Oyster mushroom baglog compost (1:1:3)
SSC4 : Soil: Sand: Oyster mushroom baglog compost (1:1:4)

Each treatment was replicated three times, and each replication consisted of four seedlings, resulting in a total of 60 cajuput seedlings. The general model for a Completely Randomized Design (CRD) is expressed as follows:

$$Yij = \mu + \tau i + \varepsilon ij \qquad (1)$$

Explanation:

Yij = Observation in treatment i and replicate j
μ = Overall mean
τi = Effect of treatment i
εij = Random effect in treatment i and replicate j

2.4. Research Procedure

The medium was subsequently irrigated with a hand sprayer until it reached saturation. Cajuput seeds were uniformly sown on the surface of the medium, covered with clear plastic, and secured using pieces of recycled inner tube rubber. The growing medium was prepared by measuring soil, sand, and oyster mushroom baglog compost, mixing them according to the experimental design, and filling the resulting mixture into polybags measuring 6 × 12 cm. Transplantation occurred when the cajuput seedlings were 30 days old in the sowing medium. The experimental units were organized in a completely randomized design. Maintenance practices included regular watering and weeding. Observations and data collection were performed biweekly over a two-month period. The parameters observed included the number of leaves, plant height, stem diameter, and root length.

2.5. Data Analysis

The effects of different growing medium treatments were evaluated using one way analysis of variance (ANOVA) performed in IBM SPSS Statistics version 26. The treatment effects were deemed statistically significant at $p < 0.05$, which aligns with a 95% confidence level. In cases where there were marked differences, Tukey's honestly significant difference (HSD) post hoc test ($\alpha = 0.05$) was conducted to establish the pairwise differences between means of treatments [3].

3. Results and Discussion

3.1. Effect of Growing Medium Composition on the Height of Cajuput Seedlings

The height of the plants was measured from the soil surface to the top shoot of the plant. The measurement of the height was done on a weekly basis for eight weeks. After eight weeks, the average height of cajuput seedlings was recorded. Average height of cajuput seedlings after eight weeks is presented in Table 1.

Table 1. Average Height of Cajuput Seedlings after Eight Weeks (cm)

Growing Medium	Replication			Total	Average
	1	2	3		
SS	4,66	4,99	5,54	15,21	5,06
SSC1	6,00	5,46	5,76	17,46	5,74
SSC2	7,64	9,62	8,52	25,71	8,59
SSC3	5,26	7,19	5,84	19,17	6,09
SSC4	5,11	4,89	5,44	13,68	5,15

According to Table 1, the highest seedling height was achieved using the SSC2 growing medium with 8.59 cm, which indicates that SSC2 medium was the most effective treatment during the eight weeks of the observation period. These results show that the SSC2 medium created the best conditions for seedling growth. The organic matter present in the compost will provide more nutrients for plant growth [4]. In order to check the statistical significance of the difference between the treatments, one-way analysis of variance (ANOVA) was conducted.

Table 2. One-Way ANOVA for Height of Cajuput Seedlings

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24,978	4	6,244	13,503	,000
Within Groups	4,624	10	,462		
Total	29,602	14			

The results of analysis of variance are shown in Table 2. It was found that the impact of the composition of growing media on the height of seedlings was statistically significant ($P<0.05$). Therefore, the composition of growing media aff ected the height of seedlings significantly. According to the Tukey's HSD test, seedlings grown in the SSC2 medium were significantly higher than seedlings in the other mediums (Table 3).

Table 3. Results of the Tukey HSD for the Height Growth of Cajuput Seedlings

Growing Medium	Height (cm)
SSC2	8.59^{b}
SSC3	6.10^{a}
SSC1	5.74^{a}
SSC4	5.15^{a}
SS	5.06^{a}

According to the Tukey HSD test, it has been identified that only the SSC2 treatment has created a unique significance group, performing superior compared to other groups. As a result, the treatment which performed the best on the growth of height of the cajuput seedling was the SSC2 treatment. This has happened because the seeds' growth has been highly influenced due to the physical and chemical condition provided by the growing medium in which the nutrients can be absorbed effectively. Suitable growing medium is one which possesses good aeration, high porosity and good water retention capability, hence helping the physiological activities of the plants. The appropriate use of oyster mushroom baglog compost can improve soil fertility, soil structure, water retention, nutrient availability, and provides favorable conditions for seedling growth [5]. The appropriate use of fertilizers promotes plant growth, whereas, the excess or deficit use of fertilizer can limit the growth of seedlings [6].

The outstanding performance of the SSC2 medium could be attributed to the fact that the medium has excellent moisture retention capacity and higher nutrients availability that support cell division and elongation of cells in meristematic tissue. This reaction may be because of the optimal composition of oyster mushroom baglog compost that enhances physical characteristics of the growing medium such as porosity and water retention capability. The enhancements make sure there is an adequate water supply, nutrient movement to the roots, maintenance of cell turgor, and cell elongation to enhance height growth of the seedlings. Ideal growing medium conditions will improve cell division and elongation in the meristematic tissues of the plant resulting in accelerated height growth of the seedlings. Therefore, the SSC2 growing medium is recommended for the nursery cultivation of *Melaleuca cajuputi* seedlings since it consistently produces the highest seedling height in the present research context. Therefore, the SSC2 growing medium is recommended for the nursery production of *Melaleuca cajuputi* seedlings since it consistently produces the highest seedling height in the present research context.

3.2. Effect of Growing Medium Composition on the Diameter of Cajuput Seedlings

Diameter of the stem is an important morphological factor that determines the quality of seedlings, indicating the strength of the stem, growth in biomass, and the resilience of the seedlings against environmental stress after transplantation. Variations in the diameter of the stem were observed in different experimental treatments. A summary of the measurements for stem diameter can be found in Table 4.

Table 4. Mean Diameter of Cajuput Seedlings after Eight Weeks (mm)

Growing Medium	Replication			Total	Average
	1	2	3		
SS	1,03	0,94	1,06	3,02	1,01
SSC1	1,09	1,07	1,09	3,26	1,09
SSC2	1,00	1,16	1,16	3,32	1,11
SSC3	0,99	1,13	1,14	3,26	1,09
SSC4	0,98	0,97	1,08	3,03	1,01

As shown in Table 4, the lowest mean stem diameter was observed in the SS and SSC4 treatments (1.01 mm), whereas the highest value was recorded in SSC2 (1.11 mm). Although SSC2 showed the highest mean stem diameter, the differences among treatments were relatively small. Therefore, the present results only suggest that a moderate proportion of oyster mushroom baglog compost may provide a more favorable growing environment adequate availability of macro and micro nutrients promotes cell division and stem tissue formation, thereby contributing to improved vegetative growth [7]. One way analysis of variance (ANOVA) was performed to determine whether the observed differences among treatments were statistically significant.

Table 5. One-Way ANOVA for Stem Diameter of Cajuput Seedlings

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	,025	4	,006	1,357	,316
Within Groups	,047	10	,005		
Total	,072	14			

Based on the ANOVA results (Table 5), the p-value (0.316) was greater than the significance level (α = 0.05), indicating that the treatments had no statistically significant effect on stem diameter indicated that the treatments had no significant effect on the stem diameter of cajuput seedlings. This finding suggests that the differences in growing medium composition were insufficient to produce significant changes in stem diameter. Stem diameter generally develops more slowly than seedling height and is less responsive to short term changes in growing medium composition; therefore, the differences among treatments did not result in a significant response in stem diameter growth. Although no statistically significant differences were detected, SSC2 exhibited the highest mean stem diameter among all treatments. The nutrients potassium and phosphorus can increase stem diameter growth because the function of these two elements is to enhance cell division and strengthen the stem to keep it sturdy [8].

Although the statistical analysis did not detect significant differences, the slightly higher mean diameter observed in SSC2 may indicate that this growing medium composition provides favorable physical and biological conditions for seedling development, improve soil aggregation, porosity, water retention, and nutrient availability and sufficient organic matter content can enhance soil microorganism activity and improve the medium’s structure, thereby optimizing nutrient uptake. Although the SSC2 (Figure 1) treatment did not produce a statistically significant effect on stem diameter, the observed increase in diameter suggests that this growing medium has the potential to enhance seedling vigor.

Organic based growing media have the potential to improve stem diameter by enhancing the physical, chemical, and biological properties of the growing medium [9]. Growing medium possessing balanced nutrient availability, adequate aeration, and favorable porosity generally promote stem thickening by facilitating root growth and nutrient uptake [10].

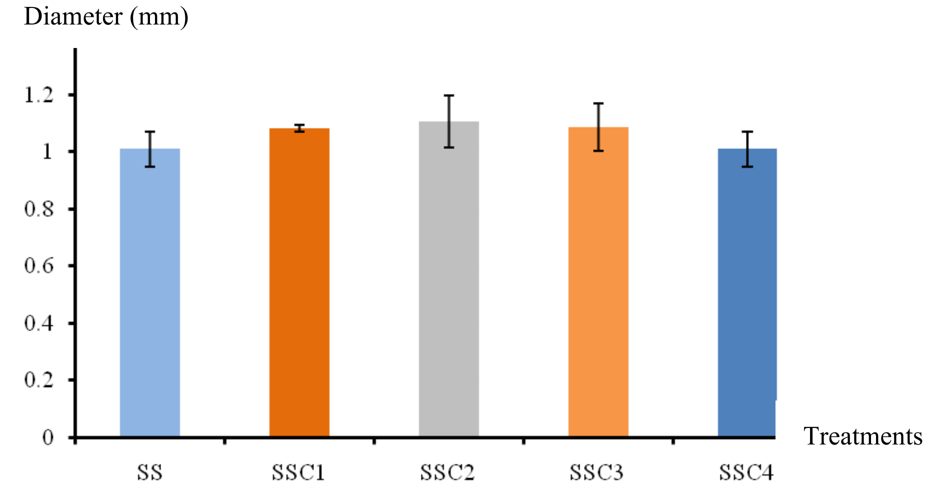

Figure 1. Average Seedling Diameter of Cajuput

3.3. Effect of Growing Medium Composition on the Leaves Number of Cajuput Seedlings

The primary organ in plants responsible for photosynthesis is the leaf, although other green organs are also capable of photosynthesis. Based on observations of the number of leaves of *Melaleuca cajuputi* seedlings. The average number of leaves for each treatment is presented in Table 6.

Table 6. Mean leaves number of Cajuput Seedlings after Eight Weeks (Leaves)

Growing Medium	Replication			Total	Average
	1	2	3		
SS	15,94	17,25	15,63	48,81	16,27
SSC1	18,13	14,44	18,38	50,94	16,98
SSC2	18,00	23,38	22,81	64,19	21,40
SSC3	15,00	21,06	16,13	52,19	17,40
SSC4	17,44	17,50	17,56	52,50	17,50

The SSC2 growing medium produced the highest mean number of leaves (21.40 leaves per seedling), indicating that this treatment promoted better vegetative growth than the other treatments. The lower leaf number observed in the SS treatment may be associated with lower availability of macronutrients (N, P, and

K), which are essential for leaf development. To determine the effect of the treatments applied, an Analysis of Variance (ANOVA) was conducted. The results of the Analysis of Variance are presented in Table 7.

Table 7. One-Way ANOVA for Leaves Number of Cajuput Seedlings

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	48,378	4	12,094	2,445	,115
Within Groups	49,457	10	4,946		
Total	97,835	14			

Based on the ANOVA results (Table 7), it was found that the α value was greater than 0.05 (0.115), indicating that there was no significant effect of the treatments on the number of cajuput seedling leaves. However, differences in growing medium composition resulted in variations in the number of cajuput seedling leaves (Figure 2).

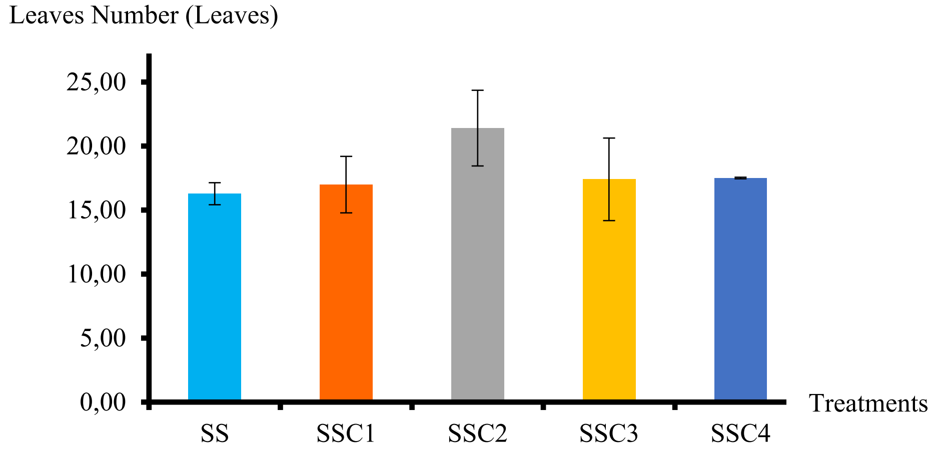

Figure 2. Average Number Leaves of Cajuput Seedling

Plant height is positively correlated with leaf number because each newly formed leaf emerges at a node along the stem. Therefore, an increase in leaf number generally indicates continued stem elongation and vegetative growth, resulting in taller plants [11]. The present study showed that the SSC2 treatment produced the highest mean plant height and leaf number.

Media containing organic matter provide better growing conditions because they enhance nutrient availability and soil microorganism activity [10]. The use of organic-based media for cajuput seedlings can enhance vegetative growth, including leaf count and seedling height. The organic matter content in the growing medium improves its physical, chemical, and biological properties, thereby promoting photosynthesis and overall plant growth. The smooth functioning of physiological processes such as photosynthesis can increase leaf growth, which is controlled by nutrient availability [12].

3.4. Effect of Growing Medium Composition on the Length Root of Cajuput Seedlings

Roots play an essential role in water and nutrient uptake, plant anchorage, and overall seedling development. Observations and measurements of root length indicate that the SSC2 treatment yielded the highest average value (Table 8). Although no significant difference was detected, the higher average root length observed in SSC2 may be associated with improved phosphorus availability. Phosphorus functions as a component of proteins and minerals required by plants, a stimulator of root growth and development, and a distributor of energy to all plant organs [13].

Table 8. Mean Root Length of Cajuput Seedlings after Eight Weeks (cm)

Growing Medium	Replication			Total	Average
	1	2	3		
SS	5,69	6,14	8,19	20,01	6,67
SSC1	7,40	4,35	5,78	17,53	5,84
SSC2	7,85	8,06	8,61	24,53	8,18
SSC3	6,81	7,31	6,46	20,59	6,86
SSC4	6,48	7,60	7,40	21,48	7,16

The results of the analysis of variance (Table 9), indicate that although there was no statistically significant difference ($p > 0.05$, specifically 0.268) in root length, the study results showed a trend suggesting that the SSC2 treatment composition resulted in longer roots compared to the other treatments studied (Figure 3). Although not statistically significant that the growing medium composition in the SSC2 treatment can optimize the physical and chemical properties of the soil and improve the availability of water and nutrients for root growth.

Table 9. One-Way ANOVA for the Length Roots of Cajuput Seedlings

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	8,549	4	2,137	2,227	,139
Within Groups	9,596	10	,960		
Total	18,145	14			

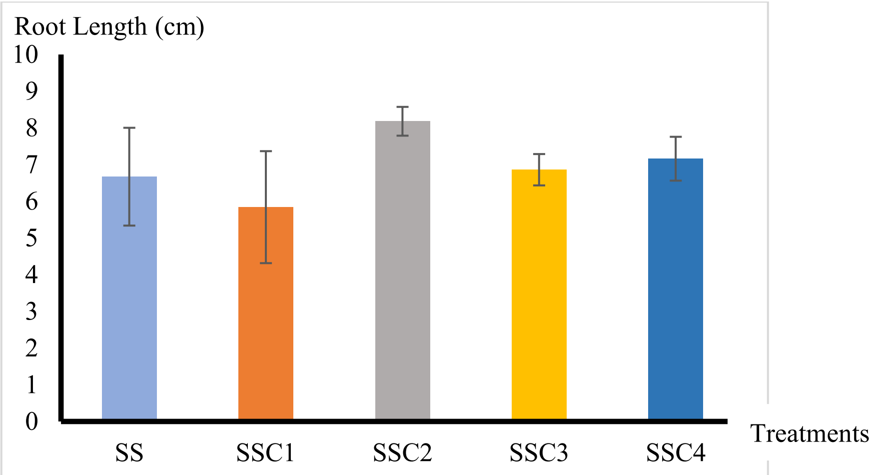

Figure 3. Average Root Length of Cajuput Seedlings

In addition to providing adequate air and maintaining nutrient availability, the growing medium must also be able to absolute moisture content around the roots [14]. To develop a healthy root system, a high quality growing medium with a balanced nutrient content is essential [15]. Recent study has also found that the right combination of growing medium can enhance the vegetative growth of cajuput cuttings, as the medium provides a more suitable growing environment for root and shoot development [16].

4. Conclusion

Although no statistically significant differences were detected among treatments ($p > 0.05$), the SSC2 treatment consistently produced the highest mean values for plant height, stem diameter, leaves number, and root length. Therefore, this treatment showed the greatest potential as a growing medium for cajuput seedlings.

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