International Journal of Research and Review
[Indexed, Peer-Reviewed Journal]
Volume 13; Issue: 8; August 2026
Website: www.ijrrjournal.com
Research Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Engineering Reclaimed Soil Media Using Compost and Liquid Organic Fertilizer from Household Waste for the Growth of Pulai Plants (*Alstonia scholaris*)

Dedisoni Rahmanto[1], Yusanto Nugroho[2], Basir Achmad[3]

[1,2,3]Department of Forestry, Master Program of Forestry, Lambung Mangkurat University, Banjarbaru, Indonesia.

Corresponding Author: Basir Achmad

DOI: https://doi.org/10.52403/ijrr.20260823

ABSTRACT

This study aims to engineer reclaimed land from a former coal mine using compost and liquid organic fertilizer derived from household waste to enhance the growth of Pulai trees (*Alstonia scholaris*). The experiment employed a 4 × 5 factorial completely randomized design, consisting of two factors: the first factor was the mixture of mine soil and compost, and the second factor was the liquid organic fertilizer. The first factor consists of four levels of mine soil and compost mixtures (1: 0, 1: 1, 1: 2, and 1: 3), while the second factor consists of five levels of liquid organic fertilizer doses (0%, 10%, 20%, 30%, and 40%) with 10 replications. The observed parameters included survival rate, plant height, number of leaves, and stem diameter of pulai plants up to 4 months of age. The results showed that the application of compost and liquid organic fertilizer significantly influenced the growth of pulai plants up to 4 months of age. All treatment combinations exhibited a 100% survival rate. The highest plant height and diameter were recorded in treatment A2B5 (50% reclaimed soil: 50% compost and 40% liquid organic fertilizer) with values of 73.10 cm for height and 10.85 mm for diameter. The highest increase in the number of leaves occurred in treatment A3B5 at 27.80 leaves. The results of the interaction test between compost and liquid organic fertilizer were found to have a significant effect on the height and diameter of pulai plants, as well as a significant effect on the increase in the number of leaves. This study shows that the optimal combination of compost and liquid organic fertilizer from household waste in treatment A2B5 supports the increase in height, diameter, and number of leaves up to 4 months of age.

Keywords: Pulai; Reclaimed Land; Compost; Liquid Organic Fertilizer

INTRODUCTION

Indonesia is one of the world's largest coal producers, with mining areas spread across Kalimantan, Sumatra, and Papua. East Kalimantan and South Kalimantan, for example, are known as regions with high coal mining intensity. This mining activity, particularly open-pit mining, causes serious environmental disruption, such as land cover destruction, ecosystem disruption, and soil degradation. The primary impact is land degradation, characterized by the loss of topsoil, decreased soil fertility, and changes

in soil structure, rendering the land unproductive and difficult to replant (Erfandi, 2017).

Reclamation of ex-mined land is crucial for restoring the ecological function and productivity of damaged land. The Central Government, through the Minister of Energy and Mineral Resources, issued Regulation No. 07 of 2014 concerning the Implementation of Reclamation and Post-Mining in Mineral and Coal Mining Business Activities as a guide and standard for reclamation and post-mining. An effective approach is the use of organic materials such as compost or litter to increase nutrient content, improve soil structure, and enhance soil microbial activity. Compost also plays a role in improving soil cation exchange capacity (CEC) and increasing water retention, which is crucial for plant growth on reclaimed land (Yudha et al., 2022).

Organic household waste, often discarded, has significant potential for use as liquid organic fertilizer containing macro- and micronutrients, as well as bioactive compounds that can stimulate plant growth (Alkatiri et al., 2024). Waste utilization not only supports reclamation but also provides a solution for sustainable waste management based on a circular economy. To optimize the benefits of compost and liquid organic fertilizer, it is necessary to select plant species that are adaptive to reclaimed land conditions and able to respond positively to fertilization treatments.

The pulai plant (*Alstonia scholaris*) was chosen because it is a local species with high adaptability to nutrient-poor soil conditions and has both ecological and economic value. Pulai is known to thrive in various soil types and has a good growth rate, making it a potential candidate for the rehabilitation of degraded land (Fajri & Garsetiasih, 2019). Pulai also has benefits as a medicinal plant and environmental protector. The pulai plant is also adaptable and has the potential to be reclaimed, so it is important to assess the effectiveness of a combination of compost and liquid organic fertilizer in supporting its growth on ex-coal mine soil. Given the importance of improving the quality of reclaimed soil and increasing plant growth success, this study focuses on soil engineering using compost and liquid organic fertilizer from household waste to support pulai plant growth. This research is expected to provide scientific and practical contributions to the fields of land reclamation and household waste management.

MATERIALS & METHODS

This research was conducted in the shade house of the Faculty of Forestry, which was chosen as the research location because it is able to provide a controlled and stable environment, especially in terms of lighting, humidity, and temperature. This condition is very important to reduce interference variables from external environmental factors, such as climate fluctuations, rainfall, or excessive light intensity that can significantly affect plant growth. The time required for this research is 4 months, from April 2024 to August 2024, which includes several stages of activities, such as initial preparation (preparation of tools and materials, as well as planting media) which takes about 1 month. The implementation of the research includes providing treatment and plant maintenance as well as periodic observation of the variables studied which takes 4 months.

Materials and Equipment

The materials used in this study were pulai (Alstonia scolaris) seedlings, mine soil, compost, and liquid organic fertilizer. The equipment used were 15 x 10 cm polybags, calipers, watering cans, hoes, label paper, rulers, tally sheets, stationery, cameras, and laptops.

Research Procedure

Preparation of pulai plant seedlings originating from weaning of sprouts with a height of 3 cm, a minimum of 2 leaves and in healthy condition (not attacked by pests

and diseases). Next, preparation of planting media and treatment, sifting the collected reclaimed soil, making a mixture of planting media according to the treatment: 100% mine soil as a control, 75% mine soil: 25% compost, 50% mine soil: 50% compost, and 25% mine soil: 75% compost, each 50 polybags so that the total number of seeds used is 200 polybags. Next, fill the polybags until the top of the polybag is level in each treatment. In this case, the planting media is left for ± 3 days for the stabilization process before planting the seeds. Next, planting is carried out, but before planting, a planting hole is made, then the seeds are planted in an upright position then the hole is covered with soil around the hole. After planting, each plant is watered with enough water until the media is moist. Next, liquid organic fertilizer is given. Liquid organic fertilizer is applied once during the preparation of the planting medium according to the treatment dosage (0, 10%, 20%, 30%, and 40%). A 10% dosage means a mixture of 1 liter of liquid organic fertilizer with 10 liters of water, which is then poured onto the pulai seedlings as much as 200 ml (and so on according to the dosage). Liquid organic fertilizer is prepared using a measuring cup. Liquid organic fertilizer is applied by pouring it onto the planting medium. Plant maintenance includes watering, carried out daily in the morning or evening to maintain the humidity of the planting medium, except during rain. Weeding is carried out if there are weeds growing around the plants to prevent them from interfering with plant growth. Growth monitoring is carried out weekly, including measuring plant height.

Data Analysis

1. Research Parameter

a. Survival Rate (%)

The survival rate was calculated to determine the plant's survival rate during the study period. Observations were made at the end of the study period using the following formula according to Mawazin & Susilo (2016):

Survival rate = Number plants alive/total of plant planted × 100%

b. Leaf Increase

The number of leaves was calculated weekly by counting all the leaves growing on each plant. Leaf increase was calculated by the difference between the initial and final leaf numbers during the study period, averaged per week, using the following formula, according to Pala et al. (2022):

Increase in number of leaves = Final number of leaves – Initial number of leaves

c. Plant Height Growth (cm)

Plant height was measured from the base of the stem to the highest growing point using a ruler. Measurements were taken weekly, and height growth was calculated from the difference between the initial and final heights using the following formula according to Mawazin & Susilo (2016):

Initial plant height = Final height - Initial height

d. Stem Diameter Increase (mm)

Stem diameter was measured at a height of approximately 1 cm from the surface of the growing medium using a vernier caliper. Measurements were taken periodically, and diameter increase was calculated from the difference between the initial and final diameters using the following formula according to Mawazin & Susilo (2016):

Diameter increase = Final diameter – Initial diameter

2. Research Design

This study used a Completely Randomized Design (CRD) experimental design with a 4 × 5 factorial pattern, which allows testing of two treatment factors simultaneously and their interactions on plant growth parameters, namely:

a. Factor A: Ratio of Mine Soil to Compost:
   A1: 100% mine soil (control)
   A2: 75% mine soil: 25% compost
   A3: 50% mine soil: 50% compost
   A4: 25% mine soil: 75% compost.

b. Factor B: Liquid Organic Fertilizer (LOF) Dosage from Household Waste:
B1: 0% (no LOF added)

B2: 10% (ratio of 1 liter of LOF to 10 liters of water)
B3: 20% (ratio of 2 liters of LOF to 10 liters of water)
B4: 30% (ratio of 3 liters of LOF to 10 liters of water)
B5: 40% (ratio of 4 liters of LOF to 10 liters of water).
The first factor (factor A) was the ratio of reclaimed soil and compost mixtures, which aimed to determine the optimal proportion of planting media mixtures for improving the physical and chemical properties of post-mining soil. The second factor (factor B) was the dosage of liquid organic fertilizer applied at different concentrations to determine the effectiveness of liquid organic fertilizer in supporting pulai plant growth. The treatment combinations for this study are shown in Table 1.

Table 1. Treatment Combinations

Treatment Code	Factor A; Soil Composition: Compost	Factor B; LOF Dosage
A1B1	100% Mined Soil	0%
A1B2	100% Mined Soil	10%
A1B3	100% Mined Soil	20%
A1B4	100% Mined Soil	30%
A1B5	100% Mined Soil	40%
A2B1	75% Mined Soil: 25% Compost	0%
A2B2	75% Mined Soil: 25% Compost	10%
A2B3	75% Mined Soil: 25% Compost	20%
A2B4	75% Mined Soil: 25% Compost	30%
A2B5	75% Mined Soil: 25% Compost	40%
A3B1	50% Mined Soil: 50% Compost	0%
A3B2	50% Mined Soil: 50% Compost	10%
A3B3	50% Mined Soil: 50% Compost	20%
A3B4	50% Mined Soil: 50% Compost	30%
A3B5	50% Mined Soil: 50% Compost	40%
A4B1	25% Mined Soil: 75% Compost	0%
A4B2	25% Mined Soil: 75% Compost	10%
A4B3	25% Mined Soil: 75% Compost	20%
A4B4	25% Mined Soil: 75% Compost	30%
A4B5	25% Mined Soil: 75% Compost	40%

This study consisted of 20 treatment combinations resulting from the interaction of two factors: the ratio of mine soil and compost (4 levels) and the dosage of liquid organic fertilizer (LOF) from household waste (5 levels). Each treatment combination was replicated 10 times, resulting in a total of 200 experimental units. Each experimental unit consisted of one pulai plant planted in the media according to the treatment combination of factor A and factor B. This experiment used a factorial design involving two treatment factors and was arranged in a Completely Randomized Design (CRD). Data were analyzed statistically using a significant difference test (test of variance) with a significance level of 5% and 1%. Differences in the effects between treatment combinations on the observed variables were further analyzed using the Duncan test.

RESULTS AND DISCUSSION

1. Survival Rate of Pulai Plants

Observations on the survival rate of pulai plants across various growing media treatments showed no difference. All treatments yielded a survival rate of 100%. This indicates that all pulai plants adapted well to both pristine reclaimed soil conditions and to reclaimed soil treated with either compost or liquid organic fertilizer. This finding aligns with Mawazin & Susilo (2016) who stated that pulai is a fast-growing tree species with a high degree of adaptability to less fertile soil conditions, making it suitable for use in reclamation activities. With a survival rate of 100%,

pulai demonstrates significant potential for recommendation as a key species in post-mining land rehabilitation. The survival rate of pulai plants also indicates that the growing media used in all treatments provided supportive environmental conditions for plant survival during early growth. Rahmayuni & Rosneti (2017) stated that the use of compost as a soil conditioner can improve aeration, water absorption, and nutrient availability, thus supporting plant survival on marginal land.

2. Height Increase of Pulai Plants

Plant height growth is a crucial parameter in evaluating plant response to nutrient availability. This parameter reflects the plant's level of adaptation and vitality in absorbing and utilizing nutrients from the growing medium. A significant increase in plant height indicates that the plant is receiving sufficient nutrients to support photosynthesis and cell division. Conversely, stunted growth may indicate nutrient deficiencies or unfavorable environmental conditions. Plant height reflects the accumulated results of physiological processes such as photosynthesis, nutrient uptake, and growth hormone activity. In reclaimed mine soils, which are generally nutrient-poor and poorly structured, compost and liquid organic fertilizer treatments are essential to improve soil fertility and support plant growth.

Pulai plant height growth showed significant variation between treatments. The optimal average height growth was achieved with the A4B5 treatment combination, at 68.56 cm, while the lowest increase occurred with A1B5, at 7.97 cm. In general, the higher the dose of compost and liquid organic fertilizer applied, the greater the plant height growth. This demonstrates a synergy between compost and liquid organic fertilizer in supporting plant height growth. Compost, as an organic material, has been shown to increase soil cation exchange capacity by up to 2.6% and provide a gradual supply of macronutrients. Liquid organic fertilizers containing endophytic microorganisms and rhizobacteria provide nutrients more quickly and stimulate soil biological activity, accelerating the recovery of degraded soil (Ganestri et al., 2021). The addition of organic materials such as compost and liquid organic fertilizers has been shown to have a positive impact on soil quality. Gayatri et al. (2022) found that the application of liquid organic fertilizers can improve the physical, chemical, and biological properties of degraded sandy soil. These improvements include increased soil structure, nutrient availability, and soil microbial activity. These findings support the view that organic fertilizers have the potential to replace inorganic fertilizers in sustainable cultivation systems, particularly on marginal or post-mining lands.

Data on pulai plant height growth were then subjected to a diversity analysis to determine the effect of treatment on pulai plant height parameters at 4 months. The results of the significant difference test for pulai plant height growth are presented in Table 2.

Table 2. Hasil sidik ragam pertumbuhan tinggi tanaman

Source of diversity	Sum of Squares	Degree of freedom	Median square	F count	Sig.
Treatment					
Compost	51.934,22	3	17.311,41	139,21	.00
LOF	3.915,86	4	978,97	7,87	.00
Replication	5.843,06	12	486,92	3,92	.00
Compost * LOF	21.263,99	171	124,35		
Error	442.550,81	200			

Table 3 shows that the compost and liquid organic fertilizer treatments, as well as their interaction, had a highly significant effect on the growth of pulai plants. The significance value obtained was 0.00, which is lower than the test level of 0.01. This

value indicates a highly significant difference caused by the interaction of the compost and liquid organic fertilizer treatments. This means that the interaction of compost and liquid organic fertilizer applications plays a significant role in significantly increasing the growth of pulai plants.

The results of the diversity test showed a highly significant difference between the compost and liquid organic fertilizer applications on height growth. Therefore, further testing was conducted to determine the best performance. The determination of the further testing method in this study was based on the coefficient of variation value. Based on the calculation of the coefficient of variation, the value for the height growth parameter was 26.4%. The coefficient of variation value was greater than 10%, so further testing was conducted using Duncan's significant distance test (DNTD). The results of the further testing are presented in Table 4.

Table 3 shows that the combination treatments A1B1 (control), A1B2, A1B3, A1B4, and A1B5, all without compost, produced the lowest plant height growth, with an average range of 9.05 to 19.06 cm. This low value is thought to be due to the absence of compost, which plays a role in improving soil physical properties and increasing soil pH. Without compost, the planting medium tends to be denser, thus inhibiting the infiltration and distribution of liquid organic fertilizer throughout the growing medium. As a result, liquid organic fertilizer accumulates in several areas, especially around the root system, which can disrupt root growth and ultimately impact the low growth of pulai plants. The combination treatment of liquid organic fertilizer and compost in A2B5 showed the best plant height growth response, with an average height reaching 73.10 cm at 4 months. These results indicate that compost application with a 1:1 ratio is most effective in supporting nutrient absorption from liquid organic fertilizer by the pulai plant root system. Compost plays a role in improving soil structure and aeration, thus facilitating the even distribution of liquid organic fertilizer around the roots. This combination creates optimal growing conditions for root growth and nutrient absorption, ultimately significantly boosting plant growth.

Table 3. Results of further analysis of growth test of pulai plant height

Treatment	Average	Symbol
A2B5	73.1	g
A2B4	61.56	f
A4B4	58.33	ef
A4B5	55.57	de
A3B4	55.02	de
A3B5	53.12	de
A2B3	52.3	de
A2B2	50.02	cde
A4B3	49.49	bcde
A3B2	47.97	bcde
A3B3	47.75	bcde
A2B1	45.06	bcd
A3B1	43.65	bcd
A4B2	39.84	bc
A4B1	37.92	b
A1B1	19.06	a
A1B3	17.22	a
A1B2	16.7	a
A1B4	12.3	a
A1B5	9.05	a

Compost treatments with higher doses, such as ratios of 1:2 and 1:3, did not show optimal growth responses. This is thought to be due to the high concentration of nutrients from the compost and liquid organic fertilizer, which causes a nutritional imbalance in the root zone. Excessively high nutrient concentrations can inhibit efficient nutrient absorption by the roots. This finding aligns with the opinion of Imansyah et al. (2023) who stated that the combination of compost and liquid organic fertilizer can indeed increase plant growth, including seedling height, by increasing nutrient availability and improving soil structure. However, its effectiveness is highly dependent on the correct dosage to prevent nutrient accumulation, which actually inhibits growth.

3. Leaf Increase in Pulai Plants

Leaf increase is an important indicator for measuring the vegetative growth of plants, including pulai plants. An increased leaf number indicates optimal plant physiological activity, particularly in photosynthesis and nutrient absorption. Therefore, this parameter provides an indication of the effectiveness of the treatments applied in this study. A significant increase in leaf number reflects that the plants responded well to the treatment, both in terms of nutrient availability and growing medium conditions.

The results showed that the A3B5 treatment resulted in the highest increase in leaf number, at 22. This treatment was followed by A2B5 with 17.2 leaves and A4B5 with 17.1 leaves. These results indicate that the combination of A3 compost and B5 liquid organic fertilizer provided the strongest synergistic effect in promoting vegetative plant growth, particularly in leaf formation. This increase in leaf number reflects optimal nutrient availability and growing medium conditions that support the overall physiological processes of the plants. Meanwhile, the A1B5 combination produced the lowest leaf increase, at only 2.6 leaves. These results indicate that applying high doses of liquid organic fertilizer is not always effective without the addition of solid compost to support the structure and quality of the planting medium. Reclaimed soil without compost tends to be dense and less porous, resulting in suboptimal distribution and absorption of nutrients from liquid organic fertilizer.

These results align with the findings of Muryati et al. (2022), who stated that adding compost to reclaimed soil significantly increased the vegetative growth of Octomeles sumatrana seedlings, including leaf number. This study demonstrated that compost can improve soil structure and fertility, thus supporting optimal nutrient uptake by plants.

Increased leaf number is an indirect indicator of soil fertility. Leaves are the primary organs involved in photosynthesis, so their number is significantly influenced by nutrient availability in the soil. Fertile soil generally has adequate macro- and micronutrient content, good structure, and supportive biological activity, thus encouraging vegetative plant growth, including leaf formation. Syahadat & Aziz (2013) stated that leaf growth reflects plant health and adaptability to the surrounding environment because it shows a positive relationship with other growth parameters such as plant height and number of branches. In other words, the more leaves formed, the better the overall vegetative growth performance of the plant.

Leaf number is an important variable for assessing the effectiveness of initial growth treatments and predicting future plant productivity (Irmadamayanti et al., 2020). The combination of compost and liquid organic fertilizer in this study demonstrated a similar synergistic effect, particularly in encouraging leaf increase, an early indicator of successful pulai plant growth in less fertile media. Therefore, leaf number can be used as a relevant indicator in evaluating the success of a treatment in supporting plant growth.

After obtaining data on pulai plant leaf increase, an analysis of variance was conducted to determine the extent to which the treatments significantly affected these growth parameters. This analysis aimed to test the main effect of compost and liquid organic fertilizer, as well as the interaction between the two factors, on leaf increase. The results of the statistical tests are presented in Table 4.

Table 4. Hasil sidik ragam pertambahan jumlah daun tanaman pulai

Source of diversity	Sum of Squares	Degree of freedom	Median square	F count	Sig.
Treatment					
Compost	4.044.02	3	1.348.00	42.95	.00
LOF	544.93	4	136.23	4.34	.00
Replication	407.38	9	45.26	1.44	.17
Compost * LOF	790.23	12	65.85	2.09	.01
Error	5.365.82	171	31.37		
Total	82.670.00	200			

Table 4 shows that the interaction between compost and liquid organic fertilizer treatments had a value of 0.01. This value indicates that the interaction between the two treatments significantly affected leaf increase. This indicates that compost and liquid organic fertilizer applications play a significant role in significantly increasing the growth of pulai plants.

The results of the diversity test showed that the interaction between compost and liquid organic fertilizer applications significantly differed on leaf increase. Therefore, further testing was conducted to determine the best performance. The determination of the further testing method in this study was based on the coefficient of variation value. Based on the coefficient of variation calculation, the value for leaf increase was 29.6%. If the coefficient of variation value was greater than 10%, further testing was conducted using the Duncan's nearest significant distance (DNTD). The results of the further testing are presented in Table 6.

Table 5 shows that the treatment combinations A1B1 (control), A1B2, A1B3, A1B4, and A1B5 produced the lowest leaf increase, with an average range of 8.90 to 13.10 leaves. This low value is thought to be due to the lack of compost, which plays a role in improving the physical properties of the soil. Reclaimed soil without compost tends to be denser, hindering the infiltration and distribution of liquid organic fertilizer throughout the growing medium. Consequently, liquid organic fertilizer accumulates in several areas, particularly around the root system, which can disrupt root growth and result in low leaf growth in pulai plants.

The combination of liquid organic fertilizer and compost in A3B5 demonstrated the best response in terms of leaf growth, with an average of 27.80 leaves at 4 months. These results indicate that applying compost in a 1:2 ratio was most effective in supporting nutrient absorption from the 40% liquid organic fertilizer by the pulai plant's root system. This combination creates optimal growing conditions for root growth and nutrient absorption, ultimately driving significant leaf growth.

Table 5. Results of further test analysis of the increase in the number of leaves of pulai plants

Treatment	Average	Symbol
A3B5	27.8	h
A2B5	25.3	g
A4B5	25.3	g
A4B4	23.1	fg
A2B4	22.5	fg
A3B3	21.8	efg
A3B4	21.5	efg
A4B3	21.4	efg

A3B2	20.4	efg
A2B3	20.1	efg
A2B2	19.7	efg
A3B1	19.6	efg
A4B2	19.2	ef
A2B1	17.8	def
A4B1	16.9	cde
A1B1	13.1	bcd
A1B2	12.7	bc
A1B3	11.8	ab
A1B4	9.3	a
A1B5	8.9	a

These results align with the opinion of Maftuah & Hayati (2019), who stated that the synergy between solid and liquid compost improves soil fertility and provides sufficient nutrients to support vegetative plant growth. This is in line with research by Imansyah et al. (2022), which showed that the combination of liquid organic fertilizer and NPK fertilizer significantly increased photosynthetic activity and vegetative growth in seedlings, including leaf number, compared to the single NPK treatment.

4. Increase in Stem Diameter of Pulai Plants

Stem diameter increase is an important parameter in assessing the response of vegetative plant growth to specific treatments. This parameter reflects biomass accumulation and the strength of the plant's structure to support continued growth, including crown and root system development. Increased stem diameter indicates that the plant is able to optimally allocate photosynthetic output to support woody tissue growth and strengthen its body structure (Puspadini et al., 2021).

The highest increase in pulai plant diameter was found in the A4B5 combination treatment, with a value of 9.56 cm, followed by A3B5 (9.29 cm), and A2B5 (9.26 cm). Meanwhile, the lowest diameter increase was found in the A1B5 combination (1.71 cm) and A1B4 (2.50 cm). This reflects the effectiveness of the different compost and liquid organic fertilizer treatments on plant growth. Treatments A3 and A4 generally showed higher results than A1, indicating that higher compost doses affected stem diameter increase. According to Minardi et al. (2011), compost application can increase soil availability and plant uptake, which impacts overall plant growth.

After obtaining the pulai plant diameter increase data in Appendix 4, an analysis of variance was conducted to determine the extent to which the treatments significantly affected these parameters. This analysis aimed to test the main effect of compost and liquid organic fertilizer, as well as the interaction effect between the two factors, on diameter increase. The results of the statistical tests are presented in Table 6.

Table 6. Results of variance analysis of diameter increase of pulai plants

Source of diversity	Sum of Squares	Degree of freedom	Median square	F count	Sig.
Treatment					
Compost	1.261.60	3	420.53	189.24	00
LOF	62.43	4	15.60	7.02	00
Replication	25.47	9	2.83	1.27	25
Compost * LOF	106.68	12	8.89	4.00	00
Error	379.99	171	2.22		
Total	13.430.03	200			

Table 7 shows that the compost and liquid organic fertilizer treatments and the interaction between the two had a value of 0.00. This value indicates that the

interaction between compost and liquid organic fertilizer had a highly significant effect, with a significance value of 0.00, lower than the test level of 0.01. This indicates that the interaction between compost and liquid organic fertilizer played a significant role in significantly increasing the diameter increase of pulai plants.

The results of the diversity test showed that the interaction between compost and liquid organic fertilizer significantly affected diameter increase. Therefore, further testing was conducted to determine the best performance. The determination of the further testing method in this study was based on the coefficient of variation value. The coefficient of variation calculation (Appendix 9) indicated that the value for the diameter increase parameter was 19.6%. If the coefficient of variation value was greater than 10%, further testing was conducted using the nearest significant distance/Duncan's distance (JNTD). The results of further tests are presented in Table 8.

Table 7 shows that the combination treatments A1B5, A1B4, A1B3, A1B2, and A1B1 (control), all of which did not include compost, produced the lowest plant diameter increase, with an average range of 1.99 to 3.84 mm. This low value is likely due to the absence of compost, which plays a role in improving the physical properties of the soil. As a result, liquid organic fertilizer accumulates in several areas, particularly around the root system, which can disrupt root growth and ultimately impact low plant diameter increase.

The combination treatment of compost and liquid organic fertilizer A2B5 showed the best response in plant diameter increase, with an average height reaching 10.85 mm at 4 months. These results indicate that applying compost at a 1:1 ratio is most effective in supporting nutrient absorption from the 40% liquid organic fertilizer by the pulai plant root system. Compost plays a role in improving soil structure and aeration, thus facilitating the even distribution of liquid organic fertilizer around the roots. This combination creates optimal growing media conditions for root growth and nutrient absorption, ultimately significantly boosting plant growth.

Table 7. Results of further analysis of pulai plant diameter increase

Treatment	Average	Symbol
A2B5	10.85	f
A2B4	10.33	e
A4B4	10.19	e
A4B5	10.15	e
A3B4	9.94	de
A3B5	9.9	de
A2B2	8.96	cde
A4B3	8.61	cd
A2B3	8.43	c
A2B1	8.34	c
A3B3	8.31	c
A3B2	8.28	c
A4B2	8	c
A4B1	7.94	c
A3B1	7.72	c
A1B2	3.84	b
A1B1	3.84	b
A1B3	3.78	b
A1B4	2.95	ab
A1B5	1.99	a

The use of higher compost ratios, such as 1:2 and 1:3, did not produce an optimal response in diameter increase. This is likely due to the high nutrient concentrations from

the compost and liquid organic fertilizer, resulting in a nutrient imbalance in the root zone. Excessively high nutrient concentrations can inhibit efficient nutrient uptake by the roots.

This finding aligns with research by Indriyani & Darlis (2024), which found that applying a high dose of compost (75%) significantly increased the stem diameter of sengon seedlings by up to 2.66 mm, through improved soil structure and increased nutrient availability. This diameter increase indicates a positive response from the plants to more fertile and supportive growing conditions.

5. Treatment Combinations for Pulai Plants

Of all the treatments applied to 4-month-old pulai plants, several combinations yielded the best growth results. These treatment combinations were proven to support increased plant height, leaf number, and stem diameter. This indicates that appropriate treatment can optimize physiological processes in the early growth phase, potentially accelerating the adaptation and survival of pulai plants in the field.

The optimal treatment combination was obtained based on the results of further analysis of each plant growth parameter. From these test results, the three highest values for each parameter were selected. The treatment combination that fell into the top three categories demonstrated a better growth response than the other treatments and can therefore be recommended as an effective treatment for supporting the initial growth of pulai plants at four months of age. The optimal treatment combination is presented in Table 8.

Table 8. The optimal combination of treatments for the growth of pulai plants

Parameter	Optimal Combinations		
	1	2	3
Height	A2B5	A2B4	B4
Leave number	A3B5	A4B5	B5
Diameter	A2B5	A2B4	B4

Table 9 shows that the A2B5 treatment combination provided the best results in supporting the vegetative growth of pulai plants at 4 months of age. Treatment A2 was a planting medium mixture with a 1:1 ratio of reclaimed soil and compost, while B5 was a treatment with 40% liquid organic fertilizer. The A2B5 combination demonstrated optimal growth performance, demonstrated by increased plant height, leaf number, and stem diameter. This indicates that a good balance of planting medium and the application of liquid organic fertilizer at the appropriate concentration can synergistically enhance the initial growth of pulai plants.

The selection of treatment combinations for field application can be tailored to the specific objectives or needs of the planting activity. Based on the analysis, the A2B5 combination demonstrated optimal performance in promoting growth in height and stem diameter of pulai plants. Meanwhile, for increasing leaf number, the A3B5 combination provided the best results. These findings indicate that plant growth responses can differ depending on the combination of planting medium and concentration of liquid organic fertilizer used, so treatment selection should be tailored to the desired target. According to Djana et al. (2024) found that the combination of solid and liquid organic fertilizers significantly increased soil N and K content and improved pH and cation exchange capacity, directly impacting the number and quality of leaves.

CONCLUSIONS

The survival rate of pulai plants for all treatment combinations in this study was 100%. The combination of reclaimed soil, compost, and liquid organic fertilizer significantly affected the height and diameter of four-month-old pulai plants, while the increase in leaf number was significantly affected. The A2B5 treatment combination (a 1:1 mixture of ex-mining soil and compost as a growing medium and 40% liquid organic fertilizer) demonstrated

optimal performance in increasing plant height, leaf number, and stem diameter. This study recommends further research extending the observation period to the advanced growth phase (more than four months) to determine the consistency of the treatment's effect on pulai plant growth. The effectiveness of the A2B5 treatment combination is necessary under broad and varied field conditions, such as differences in rainfall, light intensity, and soil type, to obtain more applicable results.

Declaration by Authors

Acknowledgement: None
Source of Funding: None
Conflict of Interest: No conflicts of interest declared.

REFERENCES

1. Alkatiri, A., Handayani, R. T., Rosa, O., Bahruna, M. A., & Arum, D. P. 2024. Pembuatan Pupuk Organik Cair (POC) Dari Limbah Rumah Tangga Sebagai Solusi Ramah Lingkungan Untuk Pertanian Berkelanjutan Pada Desa Klurak Candi Sidoarjo. *Jurnal Pengabdian Kepada Masyarakat*, 4(2), 360-367.
2. Djana, M. W., Ilahude, Z., & Gubali, H. 2024. Pengaruh Pemberian Pupuk Organik Padat dan Organik Cair Terhadap Sifat Kimia Tanah dan Pertumbuhan Tanaman Pakcoy *(Brassica rapa* L.*)*. *Jurnal Lahan Pertanian Tropis* (JLPT), 3(1), 166-173.
3. Erfandi D. 2017. Pengelolaan lansekap lahan bekas tambang: pemulihan lahan dengan pemanfaatan sumberdaya lokal (in-situ). *Jurnal Sumberdaya Lahan*, 11(2), 55-56.
4. Fajri, M., & Garsetiasih, R. 2019. Komposisi jenis vegetasi lahan pascatambang Galian C di Khdtk Labanan, Kabupaten Berau. *Jurnal Penelitian Sosial dan Ekonomi Kehutanan*, 16(2), 101-118.
5. Ganestri, R. G., Winarso, S., & Asyiah, I. N. 2021. Efektivitas Pupuk Organik Dan Pupuk Hayati Cair Terhadap Pemulihan Tanah Terdegradasi Di Desa Sucopangepok. *Jurnal Tanah dan Iklim*, 45(2), 175-185.
6. Gayatri, L. A., Santi, R., & Pratama, D. 2022. *The giving of liquid organic fertilizer (LOF) for growth and yield of the peanut (Arachis hypogaea L.) in sandy tailing post-tin mining*. Prosiding Seminar Nasional Lahan Suboptimal ke-10 (hal. 327–336). Palembang: Universitas Sriwijaya.
7. Imansyah, A., Titiaryanti, N. M., & Suryanti, S. 2023. Pengaruh Kombinasi Pupuk NPK dan Pupuk Organik Cair terhadap Pertumbuhan Bibit Kelapa Sawit *(Elaeis guineensis Jacq.) di* Pre Nursery. Agritech: *Jurnal Fakultas Pertanian Universitas Muhammadiyah Purwokerto*, 25(1), 1-8.
8. Indriyani, S., & Darlis, V. V. 2024. Pengaruh pemberian pupuk kompos terhadap pertumbuhan semai sengon (Falcataria moluccana) pada media tanam bekas tambang emas. *Ulin: Jurnal Hutan Tropis*, 8(2), 281-285.
9. Irmadamayanti, A., Muchtar, M., R. R., Erwin, E., Syafruddin, S., & Padang, I. S. 2020. Pengaruh Aplikasi Pupuk Cair terhadap Pertumbuhan Bibit Kelapa dalam Varietas Buol ST-1. *Jurnal Envisoil*, 2(1), 28-35.
10. Maftuah, E., & Hayati, A. 2019. Pengaruh persiapan lahan dan penataan lahan terhadap sifat tanah, pertumbuhan dan hasil cabai merah (Capsicum annum) di lahan gambut. *Jurnal Hortikultura Indonesia*, 10(2), 102-111.
11. Mawazin, M., & Susilo, A. 2016. *Pertumbuhan tanaman pulai (Alstonia scholaris) pada lahan bekas tambang batubara di Kalimantan Timur*. In Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia Vol. 2, No. 2 ISSN: 2407-8050 (hal. 237-242). Bogor: Pusat Penelitian dan Pengembangan Hutan.
12. Minardi, S., Syamsiyah, J., & Sukoco, S. 2011. Pengaruh Kompos dan Pupuk Fosfor terhadap Ketersediaan dan Serapan Fosfor pada Andisols dengan Indikator Tanaman Jagung Manis (Zea mays saccharata strurt). *Sains Tanah - Journal of Soil Science and Agroclimatol*, 23-29.
13. Muryati, S., Rahmatia, C., Mansur, I., & Budi, S. W. 2022. Pengaruh Pemberian Pupuk Kompos terhadap Pertumbuhan Bibit *Octomeles Sumatrana* Miq. pada Media Tanah Bekas Tambang. *Jurnal Informatika, Sistem Informasi dan Kehutanan* (FORSINTA), 1(2), 41-47.
14. Pala, G. N., Seran, W., & Pellondo'u, M. 2022. The role of various organic planting media compositions on the growth of Red

Jabon *(Anthocephalus macrophyllus)* seedlings. *Wana Lestari*, 6(01), 12–21.
15. Puspadini, A., Soendjoto, M. A., Nisa, K., & Perdana, Y. P. 2021. Riap diameter tumbuhan berkayu di area revegetasi perusahaan tambang batubara di Provinsi Kalimantan Selatan, Indonesia. *Jurnal Sylva Scienteae*, 4(6), 1041–1047.
16. Rahmayuni, E., & Rosneti, H. 2017. Kajian beberapa sifat fisika tanah pada tiga penggunaan lahan di Bukit Batabuh. *Jurnal Agrosains dan Teknologi*, 2(1), 1-12.
17. Syahadat, R. M., & Aziz, S. A. 2013. Hubungan jumlah bunga, jumlah daun, jumlah anak daun, jumlah cabang, dan tinggi tanaman terhadap pertumbuhan bibit tanaman kemuning *(Murraya paniculata* (L.) Jack). *Jurnal Lanskap Indonesia*, 5(1), 23-25.
18. Yudha, H. E., Prabu, K., & Delya, V. 2022. *Analisis Pembentukan Tanah Dari Batuan Penutup Overburden Pada Area Reklamasi PT Borneo Indobara Guna Mendukung Keberhasilan Reklamasi Secara Berkelanjutan*. *Indonesian Mining Professionals Journal*, 4(2), 123-134.

How to cite this article: Dedisoni Rahmanto, Yusanto Nugroho, Basir Achmad. Engineering reclaimed soil media using compost and liquid organic fertilizer from household waste for the growth of Pulai plants (*Alstonia scholaris*). *International Journal of Research and Review*. 2026; 13(8): 221-233. DOI: *https://doi.org/10.52403/ijrr.20260823*

******