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Response of *Balangeran* (*Shorea Balangeran*) Plant Growth to the Application of *Kiambang* (*Salvinia molesta*) Compost on Peatland

Reni Rahmawati*, Sampang Gaman, Eritha K.F, Rosdiana, Yosefin A.S, Untung Darung
Universitas Palangka Raya, Indonesia
Email: renirahmawati@for.upr.ac.id

ABSTRACT

This research aimed to analyze the effect of *Salvinia molesta* compost on the growth of *Shorea Balangeran* planted in peatland. The experiment was conducted on peatland in Manen Kaleka Village, Pulang Pisau Regency, from July to December 2024. A Randomized Block Design (RBD) was applied with three treatments: P0 (no compost), P1 (200 g *Kiambang* compost), and P2 (400 g *Kiambang* compost), each replicated three times. Observed parameters included plant height increment, stem diameter, number of leaves, and survival rate. Data were analyzed using ANOVA at a 5% significance level, followed by Least Significant Difference (LSD) test for mean comparison. Results showed that *Salvinia molesta* compost significantly affected *Shorea Balangeran* growth in the field. The P1 treatment (200 g) produced the highest growth with mean height increment of 9.83 ± 1.15 cm and diameter increment of 1.02 ± 0.09 mm compared to the control. The improvement was attributed to increased nutrient availability (N, P, K) and better soil structure due to organic matter addition from decomposed *Kiambang*. Here, *Salvinia molesta* compost is a promising eco-friendly organic fertilizer for peatland restoration and reforestation efforts.

Keywords: Shorea *Balangeran*, *Salvinia molesta*, compost, peatland, restoration.

INTRODUCTION

The use of peat forest land that focuses solely on felling trees with economic value leaves community-cleared land unmanaged and disregards good forest management principles (Rotinsulu et al., 2016; Setyawati et al., 2023). Therefore, it is necessary to rehabilitate forests and land to maintain and expand forest area adequacy. One alternative solution is sustainable forest and land development through replanting cleared areas to restore ecosystem balance (Khalil et al., 2020).

Balangeran (*Shorea Balangeran*) is a recommended plant species for development in Central Kalimantan, as it provides ecological benefits as an endemic peatland species (Yuwati et al., 2021). It also holds high economic value. Some studies recommend using local varieties, alongside fast-growing species such as Dipterocarpaceae, for rehabilitation activities (Appanah and Weinland, 1996).

Compost enhances soil fertility by providing plant-absorbable nutrients (Che et al., 2024; Moridani et al., 2022; Sahu et al., 2018). Compost from *Kiambang* (*Salvinia natans*) serves as an organic material that boosts *Balangeran* fertility and is readily available near research sites.

Kiambang compost is expected to improve plant growth. This organic matter, derived from decomposed plant residues, enhances soil fertility by repairing physical damage from prolonged excessive use of inorganic (chemical) fertilizers, which degrade soil structure (Adryade et al., 2015).

Kiambang has low economic value. According to Bagun (1986) in Rosani (2002), it grows rapidly and is abundant in rice fields, swamps, lakes, ponds, or puddles. It also contains substantial nutrients: crude protein 15.9%, crude fat 2.1%, crude fiber 16.8%, calcium 1.27%, and phosphorus 0.798% (Rosani, 2002). Jurnal Aquaculture Rawa Indonesia, 1(2): 173-183 (2013) ISSN: 2303-2960.

Previous research highlights the potential of organic matter in supporting plant growth on peatlands. For example, Adinugroho et al. (2024) emphasized nature-based approaches for tropical peat restoration, while Helbert et al. (2024) reported that ectomycorrhizal fungi inoculation promotes *Shorea Balangeran* sapling growth on peat soils. Studies on aquatic weed waste like *Salvinia molesta* compost include Hussain et al. (2018) and Kayarga and Saba (2024), which show it provides macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) to support young plant vegetative growth. However, studies on the specific growth response of *Balangeran* to *Kiambang* compost on peatlands remain limited, so this study aims to fill that gap.

This research's novelty lies in converting invasive aquatic weeds (*Salvinia molesta*) into organic compost and testing it directly on peat-endemic plants (*Shorea Balangeran*) under field conditions in Manen Kaleka Village. The study not only evaluated growth responses but also identified the optimal dose (200 g) for effective revegetation without negative effects like nutrient saturation or allelopathic compound accumulation. These findings offer a practical, local biomass-based solution for peat restoration aligned with sustainable paludiculture.

This study aims to determine the effect of *Kiambang* (*Salvinia molesta*) compost fertilizer on *Balangeran* (*Shorea Balangeran*) plant growth on peatlands in Manen Kaleka Village. Its benefits include providing information on *Balangeran* cultivation using *Kiambang* compost to enhance seedling growth and improve planting success on peatlands.

MATERIALS AND METHOD

This research is field experiment research using Group Random Design (RAK). The approach used was quantitative to test the effect of *Kiambang* compost treatment on the growth of *Balangeran* plants. The research was conducted on peatland in Manen Kaleka Village, Banama Tingang District, Pulang Pisau Regency, Central Kalimantan in July - December 2024.

The materials used in the study were:

1) *Balangeran* seeds obtained from the Palangka Raya City Watershed Management Center (BPDAS) and the collection of seeds in Tumbang Nusa. The planting of *Balangeran* that is ± 1 year old amounted to 90 seedlings.
2) Mature *Kiambang* compost (composted for 30 days).

The tools used in this study are:

1) Hoe for making planting holes
2) *Ajir* as a marker for plant places
3) Label paper
4) Meters to measure planting distance
5) Bars to measure plant height
6) Markers to mark plants
7) Digital calipers are used to measure plant diameters
8) 50 kg sack as a *Kiambang* compost place or container

9) Bucket for watering plants
10) Pastry Bag

This research was conducted using the purposive sampling method to determine the planting location. According to Yunus Hadi (2016), the purposive sampling mode is a carefully selected sample model by taking a selective research object and having specific characteristics.

The specific characteristics and strata depend on the desire of the researcher.

1) Cleaning the research site using a machete then measuring the planting path and installing the *Ajir*. Digging planting holes using a hoe and making mounds to prevent fertilizer from being contaminated. *Balangeran* planting is carried out simultaneously on the same day so that it is uniform.
2) The planting distance on the land is 2 m x 2 m, *Balangeran* planting is 90 seedlings, and the height, diameter and number of leaves are only carried out when the plants have been given *Kiambang* compost.
3) Data collection was carried out on plant plots that had been made to see the effect of *Kiambang* composting. The number of treatments in this study was 3 treatments and 3 repeats, and 10 *Balangeran* plants for one treatment.
4) *Kiambang* was obtained from a fishpond located in the area where the research was located, then *Kiambang* was put into a 50 kg sack as many as 2 sacks. This composting process was carried out for ± 1 month because it did not use decomposers purchased in the market.
5) The treatment of fertilizer application by making a hole 15 cm deep with a radius of 20 cm from the *Balangeran* plants given is P0 without compost, P1 *Kiambang* compost 200 grams and P2 *Kiambang* compost 400 grams
6) Measurement of diameter, height and number of leaves
7) Maintenance of *Balangeran* plants is weeding or cleaning around the plant, watering the plants is carried out every morning and evening, but if it rains, watering is not carried out and the maintenance of *Balangeran* plants is carried out until this research ends.

The parameters observed were:

1) Addition of plant height (cm), The height of the *Balangeran* plant is measured from the surface of the base boundary with the soil to the growing point of the plant where the young leaves come out. The height measurement of this plant is carried out every 1 month using a bar
2) Addition of plant diameter (cm), The diameter of the *Balangeran* plant is measured at the base of the stem 2 cm above the soil surface and given a permanent marker as a marker and diameter measurement is carried out once every 1 month
3) Number of leaves (strands), Number of leaves counted except for the shoots.

The study used a Group Random Design (RAK) with three treatments: P0: no compost (control); P1: 200 g of Kimbang compost; P2: 400 g of *Kiambang* compost. Each treatment is repeated three times with 10 plants each.

Data were analyzed using ANOVA (5% level). If there is a noticeable difference, it is followed by the BNT (LSD) test. The normality test was performed with Shapiro–Wilk, and the homogeneity of variance with the Levene test using Microsoft Excel 2021 and SPSS 25 software.

RESULTS AND DISCUSSION

The application of *Kiambang* (*Salvinia molesta*) compost has a real effect on the increase in height and diameter of the Shorea *Balangeran* plant, but it has no real effect on the number of leaves. The results showed that the P1 treatment (200 g compost or 10%) provided the best growth compared to P0 (no compost) and P2 (400 g compost or 20%).

Results of the Analysis of *Balangeran* Plant Height Increase

The results of high observation of *Balangeran* plants in the field on the effect of *Kiambang* fertilizer application after being statistically analyzed with variety fingerprints, showed a very significant effect (Table 1). The average increase in height of *Balangeran* plants on the effect of *Kiambang* fertilizer application can be seen in Figure 1.

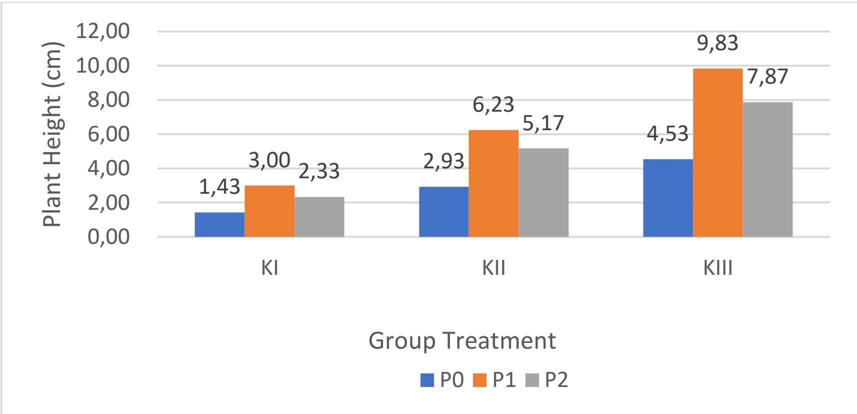

Figure 1. Average stem diagram of height increase of *Balangeran* saplings
Source: Primary Research Data, 2024

Table 1. Fingerprint analysis of the high growth of the *Balangeran* saplings

Miscellaneous Sources	DB	JK	KT	F-Count	P-Value	F-0.05	F-0.01
Group	2	70,2309	35,1154	1,684 tn	0,295	6,944	18,000
Treatment	2	3504,5969	1752,2984	84,029 **	0,001	6,944	18,000
Galat	4	83,4143	20,8536				
Total	8	3658,2420					

Remarks: * = real difference at the real level of 5%; ** = real difference at the real level of 1%; tn = no real difference, KK = 3.09%

Source: ANOVA Results, Research Data 2024

Table 1 shows that the effect of *Kiambang* fertilizer application has a very significant effect on the increase in height of the *Balangeran* plant. so to compare the two average levels of treatment, a follow-up test was carried out with the Smallest Real Difference (BNT) level of 0.05 can be seen in Table 2.

Table 2. Real Difference Follow-Up Test (BNT) Level 0.05

Treatment	Average						Notation
P2	5,12						a
P1	6,35	1,23	*			b	b
P0	2,96	3,39	*	2,14	*	*	

Source: Research Data 2025

The highest increase in height of the *Balangeran* plant was found in the P1 treatment (200 g of *Kimbang* fertilizer) which was 9.83 cm, while the lowest increase in the height of the *Balangeran* plant was found in the P0 treatment (Without kimbang fertilizer) which was 1.43 cm. Based on the standard description of the height of 1-year-old *Balangeran* plants with an average height of ± 100 cm, the difference between the application of *Kiambang* fertilizer to the increase in height of *Balangeran* plants compared to the control (without *Kiambang* fertilizer), it is suspected that because nutrients are available for plant growth so that the apical meristems at the top of the *Balangeran* plant are so actively processed. Wahyudi et al. (2022) stated that growth is formed due to the process of dividing apical meristem tissue. The elongated growth caused by the activity of the apical meristem tissue is commonly called primary growth.

Results of Analysis of Increase in Diameter of *Balangeran* Plants

The results of measuring the increase in the diameter of the *Balangeran* plant during 4 months of observation were carried out 4 times and 3 treatments, data on the increase in diameter as in Figure 2 as follows.

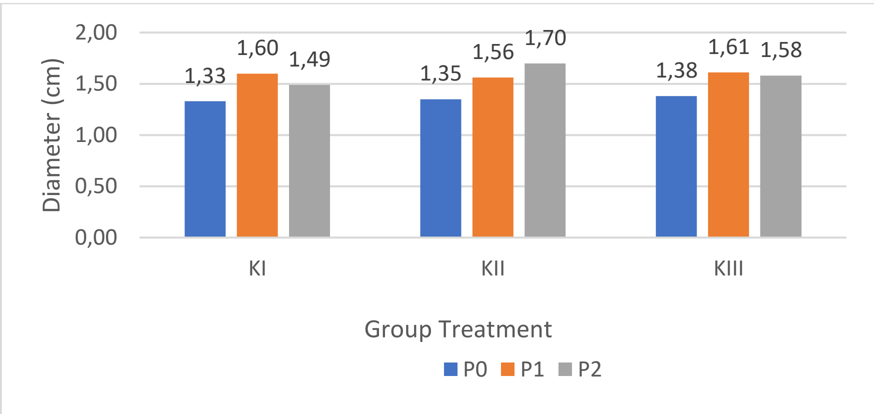

Figure 2. Average rod diagram of the increase in the diameter of *Balangeran* tillers

Source: Primary Research Data, 2024

Based on Figure 2, it can be seen that the results of the measurement of the average increase in diameter for 4 months are (P0) of 1.35 cm while (P1) and (P2) are 1.59 cm. The largest average increase in diameter in the treatment of *Kiambang* fertilizer (P1) and (P2).

The effect of treatment on the growth of the diameter of the *Balangeran* plant can be determined by conducting Variety. The results of the Fingerprint Analysis of the diameter of the *Balangeran* plant can be seen in Table 2.

Table 3. Analysis of the growth of the diameter of the *Balangeran* plant

Sumber Ragam	DB	JK	KT	F-Hitung	Nilai-P	F-0,05	F-0,01
Kelompok	2	0,0067	0,0033	0,736 tn	0,534	6,944	18,000
Perlakuan	2	0,1120	0,0560	12,325 *	0,019	6,944	18,000
Galat	4	0,0182	0,0045				
Total	8	0,1369					

Keterangan: * = berbeda nyata pada taraf nyata 5%; ** = berbeda nyata pada taraf nyata 1%; tn = tidak berbeda nyata
KK = 4,46%

Source: ANOVA Results, Research Data 2024

The results of the Fingerprint Analysis in Table 3 show that the treatment is significantly different. This is as shown by the value of F calculated to be greater than the F of the table at a confidence level of 5% so that a follow-up test is presented in Table 4.

Table 4. Real Difference Follow-Up Test (BNT) Level 0.05

Treatment	Average					Notation
P2	1,59					
P1	1,59	0	*			a
P0	1,35	0,24	*	0,24	*	b

Source: Research Data 2025

Based on Table 4, the treatment of applying *Kiambang* fertilizer gave a different diameter growth with the control, namely with an average diameter increase of 1.59 cm. According to Wiranto (2006), the increase in stem diameter is influenced by several things, namely the crown surface, climate and soil conditions, humidity and root system. Temperature changes will affect the rate of transpiration which is characterized by a decrease in relative air humidity. If this thing lasts for a long time, it can cause the water balance of plants to be disturbed and can reduce plant growth, including the diameter of the seedlings.

Results of Analysis of the Increase in the Number of Leaves of *Balangeran* Plant

The results of the measurement of the increase in the number of leaves of the *Balangeran* plant during 4 months of observation were carried out 4 times and 3 treatments, data on the increase in the number of leaves was obtained as in Figure 3 as follows.

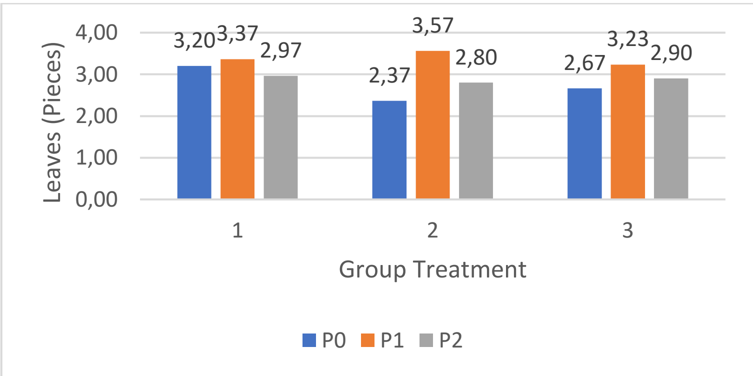

Figure 3. Average stem diagram of the leaf growth of *Balangeran* plants

Source: Primary Research Data, 2024

Based on Figure 3, it can be seen that the results of the measurement of the average increase in the number of leaves for 4 months are (P0) of 2.74 sheets, (P2) of 2.89 sheets and (P1) of 3.39 sheets. The average increase in the number of leaves was largest in the peat planting medium treatment (P1) and the average increase in the lowest number of leaves with the control treatment (P0). In accordance with Mulyani, S (2006) stated that leaf growth is controlled by genetic factors, but also influenced by environmental conditions.

The effect of treatment on the increase in the number of leaves of the *Balangeran* plant can be found by conducting Variety. The results of the Fingerprint Analysis of the number of leaves of the *Balangeran* plant can be seen in Table 5.

Table 5. Analysis of the growth of the number of leaves of the *Balangeran* saplings

Miscellaneous Sources	DB	JK	KT	F-Count	P-Value	F-0,05	F-0,01
Group	2	546,2917	273,1458	44,403 **	0,002	6,944	18,000
Treatment	2	7,7187	3,8594	0,627 tn	0,579	6,944	18,000
Galat	4	24,6058	6,1515				
Total	8	578,6163					

Remarks: * = real difference at the real level of 5%; ** = real difference at the real level of 1%; tn = no real difference, KK = 3.70%

Source: ANOVA Results, Research Data 2024

Based on Table 3, it shows that the treatment has no real effect. This is as shown by the value of F calculated < F table in the 1% or 5% confidence window so that no follow-up test is carried out. There is no real difference allegedly due to the results of observation on the number of leaves that are not much different, so the number of leaves of each plant is also not too significant. The results of Dimas Ramadhan's (2017) research show that leaf formation is closely related to the increase in plant height, leaves are formed on the stem books so that the increase in plant height is also followed by an increase in the number of leaves. According to Lakitan B, (1996) the rate of leaf formation (number of leaves per unit of time) is relatively constant if the plant is grown at relatively constant temperature and light intensity.

The improved height growth of the *Balangeran* plant at the 200 g treatment indicates that the availability of nutrients is at an optimal level to support the physiological activity of the plant. *Kiambang* compost contains macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) which play an important role in the formation of new tissues, cell enlargement, and stem lengthening. Nitrogen plays a role in the formation of chlorophyll and proteins, thus supporting the process of photosynthesis and cell division in the apical meristem region. According to Hussain et al. (2018) and Kayarga & Saba (2024), decomposition *Salvinia molesta* compost yields an N concentration of about 1.5–2%, P of about 0.8%, and K of about 1%, which is enough to support the vegetative growth of young plants. At a dose of 200 g, these nutrients are optimally absorbed by the roots without causing environmental stress such as increased temperature or excessive soil salt levels. At higher doses (400 g), growth height and diameter are slightly reduced. This can be caused by excess organic matter that has not been fully decomposed, which has the potential to increase organic acid levels and lower the pH of the soil around the roots. These conditions can inhibit the absorption of nutrients and root respiration. According to Saba & Kayarga (2025), the use of too high doses of Salvinia compost can increase the concentration of residual phenolic compounds from aquatic plant tissues that have not fully decomposed, such as tannins and lignins, which are toxic to young roots. In addition, an increase in excess organic matter levels can also decrease soil oxygen due to high microbial activity of decomposers, so vegetative growth is inhibited. These findings are in line with Helbert et al. (2024) who reported that in S. *Balangeran* plants, the administration of organic matter in moderate amounts (10–15%) increased the growth rate by up to two times compared to controls, but higher doses (>20%) actually decreased the efficiency of nutrient absorption.

The increase in stem diameter at a dose of 200 g is thought to be due to increased secondary cambium activity stimulated by the availability of sufficient nutrients and water. The element potassium (K) in compost plays a role in the translocation of photosynthesis results and the formation of reinforcing tissues, while phosphorus (P) supports cell division in cambium tissue. The loose peat soil structure rich in organic matter from *Kiambang* compost also improves aeration and micro-drainage around the roots, so that the root system can develop better. Healthier roots will increase the supply of water and nutrients to the stem and leaves, which directly affects the increase in diameter.

Although the growth height and diameter increase significantly, the number of leaves did not differ significantly between treatments. It can be explained that the formation of new leaves is not a direct indicator of increased nutrient status, since leaves have a relatively fast life cycle (young, mature, deciduous). The number of leaves is more influenced by the balance between leaf growth and fall (leaf turnover) than the availability of nutrients. In addition, Shorea *Balangeran* is a species with a flushes (wavy) growth pattern — that is, leaf growth does not take place continuously, but in a short period of time followed by a resting phase. According to Tata et al. (2022) and Lampela et al. (2017), fluctuations in leaf growth in peat swamp species often do not align with increases in height or diameter. Therefore, the increase in nutrients from compost is more reflected in morphometric parameters such as height and stem diameter than in the number of leaves. These results suggest that the use of *Kiambang* compost in moderate doses (200 g or 10%) can be an effective strategy in restoring nutrient-poor peatland fertility, without causing the accumulation of toxic compounds. This practice is in line with the sustainable paludiculture approach, where invasive aquatic plant waste such as *Kiambang* is reused into productive organic matter to support the revegetation of local species such as *Balangeran*

CONCLUSION

This study demonstrates that *kiambang* (*Salvinia molesta*) compost significantly enhances *Balangeran* (*Shorea balangeran*) growth on peatlands, particularly in stem height and diameter increments, with the P1 treatment (200 g compost) yielding optimal results compared to the control (P0) or higher dose (P2), indicating balanced nutrient availability without saturation or medium disruption. Leaf number showed no significant differences across treatments, likely due to the plant's gradual leaf development physiology. Overall, *kiambang* compost emerges as a promising, eco-friendly organic amendment for *Balangeran* cultivation and peat ecosystem restoration. Future research could investigate long-term effects of repeated applications on soil microbial communities and *Balangeran* survival rates under varying peat moisture conditions to refine sustainable paludiculture practices.

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