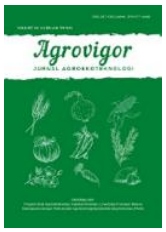
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Article

Effect of Media Composition and Biophosphate LOF on Alligator Avocado Seedling Growth

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ABSTRACT

Avocado cultivation in Indonesia shows strong potential due to increasing national production. Vegetative propagation using grafting techniques is key method for improving plant quality. Following grafting, seedlings must be transplanted into a new planting medium that supports optimal growth. Planting media composed of topsoil, raw husks, and manure as along with the application of Liquid Organic Fertilizer (LOF) derived from goat biophosphate, are crucial for seedling development. This study investigated the effects of planting medium composition and goat biophosphate LOF concentration on the growth of grafted 'Alligator' avocado seedlings. The study was conducted at the Wire House of Jember State Polytechnic from August to October 2023 using two-factor Randomized Block Design (RBD). The factorcs were (1) planting medium composition (P1 = 2:1:1, P2 = 3:1:2, P3 = 2:1:2) and (2) LOF concentration (K1 = 2 ml/L, K2 = 4 ml/L, K3 = 5 ml/L). Data analysis using ANOVA and DMRT at 5% and 1% significance levels, respectively, showed that the planting medium significantly affected the number of leaves (P1 was the most effective). The concentration of LOF significantly affected stem diameter (K3 was the most effective), and the interaction between the two factors significantly influenced plant height and number of leaves at 12 weeks after planting.

INTRODUCTION

Avocado *(Persea americana)* is a high-value horticultural commodity with increasing demand both locally and globally. In recent years, interest in avocado cultivation has continued to increase in Indonesia, among both farmers and agricultural investor (Septiadi and Sudjatmiko, 2023). This market expansion is significantly driven by rising public awareness of the nutritional benefits of avocado, including their healthy fats, fiber, and vitamins. However, alongside this demand, a persistent challenge remains in ensuring a sustainable supply of high-quality planting material capable of supporting consistent avocado production.

One critical aspect of successfull avocado cultivation is the availability of superior seedlings. Vegetative propagation, particularly grafting, has been widely adopted to ensure genetic uniformity and accelarate fruiting. Grafting techniques allow for the combination of desired traits from both rootstock and scion, such as disease resistance, vigor, and fruit quality. Success in grafting is heavily influenced by the level of compatibility between the rootstock and scion, as well as the accuracy of the technique used (Khoerurrahmah, Agustin and Amani, 2024). Crucially, post-grafting care, especially in the nursery phase, plays a vital role in determining ultimate seedling vigor and field performance. During this phase, factors like planting media composition and fertilization become essential components for optimizing seedling growth.

The planting medium is a foundational element in nursery management, providing mechanical support, airation, water, and nutrients required for seedling development (Chatlynbi *et al.*, 2023). Different materials used in planting media, such as topsoil, raw husks, and organic manure, vary in texture, nutrient content, water-holding capacity, and microbial activity. Appropriate combinations of these components can significantly influence root development, nutrient uptake, and overall plant health. Previous research has highlighted that media with a balanced composition of organic and inorganic materials can enhance seedling performance by improving aeration and nutrient availability (Diatta *et al.*, 2024). Moreover, using sustainable and locally available materials can reduce production costs and support environmentally friendly practices. In parallel with media management, nutrient supplementation through fertilization is essential during the seedling stage. Among various fertilization options, Liquid Organic Fertilizer (LOF) has gained attention due to its environmental compatibility and effectiveness in enhancing plant growth. LOF made from goat manure, processed into biophosphate form, is particularly beneficial. Biophosphate fertilizers contain phosphate-solubilizing microorganisms that help convert insoluble phosphates into forms available for plant uptake (Marlina *et al.*, 2024). Goat manure is inherently rich in nutrients, especially phosphorus, which is vital for root development and energy transfer within the plant. Biophosphate based fertilizers can improve nutrient absorption efficiency, stimulate root elongation, and increase biomass production in various horticultural crops (Khairani, S., & Fahri, 2025).

Recent research has separately investigated the effects of various growing media and organic fertilizers on various crops. Fertilizers derived from livestock and poultry manure are rich in amino acids from feed residues, accelerating the decomposition process by increasing the activity of decomposing microorganisms and increasing nutrient availability (Mustiya *et al.*, 2024). However, research examining the combined effects of growing media composition and POT biophosphate, particularly from goat manure, on avocado seedlings is scarce. Most previous studies have focused on media components or fertilizer concentrations separately, leaving gaps in understanding the interaction between these two factors. Furthermore, research specifically targeting the Alligator avocado variety, known for its rapid growth and commercial potential, is still scarce. This research attempts to address this gap by analyzing the interaction between planting media composition and goat biophosphate LOF concentration on the growth of grafted *Alligator* avocado seedlings. The study hypothesizes that a specific combination of media components and biophosphate LOF levels will synergistically promote optimal seedling development, as measured by plant height, number of leaves, and stem diameter. Identifying such combinations is essential not only for academic understanding but also for providing practical recommendations to avocado nurseries, especially those applying sustainable practices.

The urgency of this research is underscored by the increasing demand for high-quality avocado seedlings and the need for environmentally friendly nursery practices. Chemical fertilizers, though effective, can cause long-term soil degradation and water pollution. The shift toward organic-based inputs not only supports soil health and reduces environmental

risks but also aligns with sustainable agricultural goals. Therefore, the adoption of goat manure-based biophosphate LOF, combined with optimized planting media, can be a viable solution to these challenges. The objective of this study is to determine the most effective combination of planting media and biophosphate LOF concentration in enhancing the growth of *Alligator* avocado seedlings post-grafting. The findings are expected to contribute to better nursery management practices, support sustainable avocado seedling production, and offer practical solutions for smallholder and commercial growers alike.

MATERIALS AND METHODS

This study was carried out from August to October 2023 in the net house at Jember State Polytechnic, East Java, Indonesia, located at an altitude of 89 m above sea level. The experiment was arranged in a two-factor Randomized Block Design (RBD) with three replications, resulting in 27 experimental units.
The first factor was ratio planting media composition, consisting of three levels:

- P1: topsoil : raw rice husk : goat manure (2:1:1)
- P2: topsoil : raw rice husk : goat manure (3:1:2)
- P3: topsoil : raw rice husk : goat manure (2:1:2)

The second factor was the concentration of goat biophosphate liquid organic fertilizer (LOF), consisting of three levels:

- K1: 2 mL/L water
- K2: 4 mL/L water
- K3: 5 mL/L water

Plant Material and Media Preparation

The planting material used was Alligator avocado seedlings produced through grafting onto seedling rootstocks. Topsoil used in this study was collected from agricultural land at a depth of 0–15 cm, cleaned of plant residues and debris, and sieved before being mixed with raw rice husk and goat manure according to the assigned treatment ratios. Raw rice husk was used to improve aeration and drainage, while goat manure served as an organic nutrient source. Media components were weighed and mixed according to treatment ratios, then placed in 15 × 30 cm polybags to approximately 90% of their volume.

Preparation of Goat Biophosphate LOF

LOF was prepared following Safitri et al. (2017) with modifications. Five kilograms of biophosphate fertilizer and 10 kg of goat manure were mixed into 10 liters of water in a plastic container. The mixture was stirred until homogeneous, covered, and incubated for 14 days. After fermentation, the mixture was filtered to separate the liquid LOF from solid residues.

Planting and Maintenance

Seedlings were transplanted into prepared polybags and acclimatized. Goat biophosphate LOF was applied as a soil drench every 14 days according to the assigned concentration treatments. On the days of LOF application, the LOF solution was applied in place of regular watering to avoid excessive moisture and nutrient dilution. Regular watering was resumed on the following day or adjusted according to media moisture conditions. Watering was carried out once daily using a measured volume of water, approximately 200 mL per polybag per day, depending on rainfall and the moisture condition of the planting medium. Watering was controlled using a volumetric method, not by the gravimetric field-capacity method. The water was applied slowly to moisten the medium without producing drainage from the polybag, thereby minimizing excessive waterlogging and nutrient leaching.Weed control was performed manually as needed.

Observed Parameters

Four growth parameters were measured:

1. Plant height (cm) – measured from the base of the stem to the apical bud using a ruler, recorded weekly.
2. Stem diameter (mm) – measured 2 cm above the soil surface using a digital caliper, recorded weekly.
3. Number of leaves – counted for fully expanded leaves, recorded weekly.
4. Number of branches – counted for primary branches, recorded weekly.

Data Analysis

All data were subjected to Analysis of Variance (ANOVA) at 5% and 1% significance levels using IBM SPSS Statistics. When significant differences were detected, the differences among means were analysed by Duncan's Multiple Range Test (DMRT) at the 5% significance level.

RESULTS AND DISCUSSION

The application of different planting media compositions and goat biophosphate liquid organic fertilizer (LOF) concentrations had varying effects on the vegetative growth of Alligator avocado seedlings. The analysis of variance (Table 1) showed that planting media composition significantly influenced the number of leaves at 8, 10, and 12 weeks after planting (WAP), while LOF concentration significantly affected stem diameter at 2 WAP. Furthermore, the interaction between these factors significantly influenced plant height and number of leaves at several observation points, but showed no significant effect on stem diameter and number of branches.

Table 1. Summary of variance analysis results for each observed parameter

No	Observation variables	Sources of Diversity		
		P	K	PxK
1	Plant height 2 WAP	ns	ns	ns
2	Plant height 4 WAP	ns	ns	*
3	Plant height 6 WAP	ns	ns	ns
4	Plant height 8 WAP	ns	ns	*
5	Plant height 10 WAP	ns	ns	*
6	Plant height 12 WAP	ns	ns	*
7	Stem diameter 2 WAP	ns	*	ns
8	Stem diameter 4 WAP	ns	ns	ns
9	Stem diameter 6 WAP	ns	ns	ns
10	Stem diameter 8 WAP	ns	ns	ns
11	Stem diameter 10 WAP	ns	ns	ns
12	Stem diameter 12 WAP	ns	ns	ns
13	Number of leaves 2 WAP	ns	ns	ns
14	Number of leaves 4 WAP	ns	ns	ns
15	Number of leaves 6 WAP	ns	ns	*
16	Number of leaves 8 WAP	*	ns	ns
17	Number of leaves 10 WAP	*	ns	*
18	Number of leaves 12 WAP	*	ns	*
19	Number of branches 2 WAP	ns	ns	ns
20	Number of branches 4 WAP	ns	ns	ns
21	Number of branches 6 WAP	ns	ns	ns
22	Number of branches 8 WAP	ns	ns	ns
23	Number of branches 10 WAP	ns	ns	ns
24	Number of branches 12 WAP	ns	ns	ns

Description: P = composition of planting media, K = concentration of goat biophosphate LOF, P x K = interaction of planting media composition and goat biophosphate LOF concentration, (ns) not significantly different, (*) significantly different, (**) very significantly different.

Effect of Planting Media Composition on Seedling Growth

The number of leaves was the only parameter significantly influenced by planting media composition across multiple observation periods. Treatment P1 (2:1:1 ratio of topsoil, raw rice husk, and goat manure) consistently produced the highest leaf counts, while P3 (2:1:2) recorded the lowest. At 8 WAP, P1 seedlings averaged 18.39 leaves compared to 14.17 leaves in P3, indicating a substantial difference attributable to media composition. Similar trends were observed at 10 and 12 WAP, where P1 maintained a higher leaf number than P3. Although P3 contained a higher proportion of goat manure, the greater amount of organic material did not

necessarily result in better leaf development. The higher leaf number in P1 was likely associated with a more favorable balance between nutrient availability and the physical properties of the planting medium. The combination of topsoil, raw rice husk, and goat manure at a ratio of 2:1:1 may have provided sufficient nutrient supply while maintaining better aeration, drainage, and root-zone moisture. In contrast, the higher goat manure proportion in P3 may have increased water retention and reduced air-filled porosity, which could limit root respiration and nutrient uptake. Therefore, the superior leaf development in P1 should be interpreted not merely as an effect of higher nutrient content, but as a result of a more suitable balance between nutrient availability and medium physical conditions.

Table 2. Average of leafe number of avocado seedling due to the treatment of planting media compositions (P1, P2 and P3) from 2 WAP to 12 WAP

	Number of leaves at ..... WAP					
The Treatment	2	4	6	8	10	12
P1	16.22	17.56	18.44	18.39 a	18.28 a	19.00 a
P2	15.39	16.06	16.61	16.33 ab	16.11 ab	18.61 ab
P3	12.28	14.06	14.61	14.17 b	14.28 b	15.33 b
F count P	2.90 ns	2.41 ns	2.98 ns	4.17 *	4.10 *	3.69 *

Description: P1 = (topsoil: raw rice husk: goat manure (2:1:1)), P2 (topsoil: raw rice husk: goat manure (3:1:2)), P3 (topsoil: raw rice husk: goat manure (2:1:2)), (ns) not significantly different, (*) significantly different based on ANOVA (p = <0.005), WAP: weeks after planting.

The physical and chemical conditions of the growing medium are important factors determining the successful formation of vegetative organs, including leaves. A medium with a porous structure, good aeration, adequate water retention capacity, and high organic matter content will increase soil microbial activity, maintain root zone moisture, and accelerate nutrient uptake (Ali *et al.*, 2025). All of this supports leaf meristem activity and cell expansion in leaf tissue. Growing medium structure directly influences root and soil microbial growth, which significantly contributes to the continuity of nutrient supply and water balance around the roots (Dohare *et al.*, 2025). A well-aerated medium will also support root respiration, thereby increasing the efficiency of nutrient uptake for leaf growth. Goat manure provides essential micronutrients like Fe, Mn, and Zn (Mbatha *et al.*, 2021) which act as cofactors for various enzymes essential for metabolic processes, particularly protein synthesis and photosynthesis. These elements promote chlorophyll formation, improve photosynthesis, and enhance chlorophyll synthesis and support active leaf tissue expansion. Furthermore, LOF also contains phosphorus (P), which strengthens the root system, enabling plants to absorb nutrients more efficiently from the growing medium. Nitrogen (N), present in organic compounds, also accelerates leaf elongation and cell division, especially during the active vegetative phase (Yulianto, 2023).

Additionally, the relatively lower goat manure proportion in P1 may have prevented excessive nitrogen release, which can sometimes lead to elongated, weak shoots rather than robust vegetative structures. In contrast, although P3 contained a higher proportion of goat manure, this did not necessarily result in better leaf development. A higher proportion of organic manure may increase water retention and alter the air–water balance of the planting medium. Previous studies have shown that high compost or organic amendment proportions may reduce aeration and drainage in container substrates, while excessive moisture can limit oxygen availability, root respiration, and nutrient uptake (Luo *et al.*, 2024). Therefore, the lower leaf number in P3 may be associated with less favorable physical conditions of the root zone rather than nutrient supply alone. Moreover, high organic matter content can sometimes lead to nutrient imbalances, particularly if decomposition rates are slow, delaying nutrient mineralization (Hartatik, Husnain and Widowati, 2015). While plant height, stem diameter, and number of branches were not

significantly affected by planting media composition, P1 generally showed numerically higher means for these parameters. This suggests that the advantages of balanced aeration and nutrient supply in P1 may not always produce statistically significant differences but still contribute to overall seedling vigor.

Effect of LOF Concentration on Seedling Growth

The only parameter significantly influenced by LOF concentration was stem diameter at 2 WAP. K3 (5 mL/L) showed the numerically highest stem diameter (7.92 mm), but it was not significantly different from K2 (4 mL/L; 7.35 mm). However, K3 was significantly higher than K1 (2 mL/L; 7.03 mm). This early growth response may be due to the higher availability of soluble phosphorus in K3, promoting cell division and vascular tissue development. As the seedlings matured, differences in stem diameter among treatments diminished, possibly because root systems became sufficiently established to access nutrients from the media, reducing dependence on exogenous phosphorus.

Table 3. Average of stem diameter of avocado seedling due to the treatment of LOF Concentrations (K1, K2, and K3) from 2 WAP to 12 WAP

The Treatment	2	4	6	8	10	12
K1	7.03 b	7.37	7.52	7.89	8.29	8.55
K2	7.35 ab	7.52	7.84	8.23	8.47	8.75
K3	7.92 a	8.06	8.29	8.53	8.74	8.92
F count K	4.85 *	3.20 ns	3.25 ns	2.16 ns	1.02 ns	0.70 ns

Description: K1 (the LOF Concentration at 2 mL/L), K2 (the LOF Concentration at 4 mL/L), K3 (The LOF Concentrationat 5 mL/L), (ns) not significantly different, (*) significantly different based on ANOVA (p= <0.005), WAP: weeks after planting.

The other possibility is in the initial phase, the nutrients contained in LOF, particularly potassium (K), calcium (Ca), and nitrogen (N) in soluble form, can be directly absorbed by young roots due to their liquid nature and easy solubility in the soil. Potassium plays a crucial role in cell expansion (Haerani *et al.*, 2025) and osmotic pressure regulation, while calcium supports cell wall strengthening and meristematic tissue formation.

Nutrients supplied through LOF may contribute to early stem development by supporting cell expansion, cell wall formation, and vascular tissue development. Stem diameter growth is closely related to the formation of transport tissue (xylem and phloem), which requires sufficient and balanced nutrients (Asra and Silalahi, 2020). When nutrient supply is no longer optimal or unbalanced, the growth of the transport tissue will slow, resulting in stagnation in stem diameter growth (Pandjaitan *et al.*, 2024). Furthermore, the balance between vegetative growth (height and leaves) and structural growth (stem and branches) is heavily influenced by the regulation of plant hormones such as auxins and gibberellins, which in many cases are also influenced by the plant's nutritional status (Nurita & Yuliani, (2023). However, over time, plant roots develop deeper and wider, allowing them to absorb nutrients from a larger volume of soil. In this study, goat biophosphate LOF was reapplied every 14 days as a soil drench according to the assigned concentration treatments; therefore, the reduced effect of LOF concentration after the early growth stage was not due to the absence of reapplication. Under these conditions, the growing medium may have begun to play a greater role as a medium- to long-term nutrient provider through the decomposition of organic matter and the gradual release of nutrients.

The non-significant effects of LOF concentration on plant height, leaf number, and branch number suggest that under the experimental conditions, nutrient availability from the planting media was adequate to support vegetative growth, and additional nutrients from LOF did not markedly enhance these parameters. Nevertheless, the early increase in stem diameter observed under K2 and K3 may be beneficial for seedling structural development, as both treatments showed statistically similar stem diameter values at 2 WAP. From a practical perspective, K2 may be considered a more efficient LOF concentration because it produced a stem diameter comparable to K3 while using a lower LOF concentration. Previous studies

(Elhaissoufi *et al.*, 2022) have emphasized that organic fertilizers enriched with phosphate-solubilizing microorganisms can enhance nutrient uptake efficiency. However, the magnitude of the effect often depends on initial soil fertility, organic matter content, and microbial activity in the rhizosphere. In this study, the relatively fertile planting media may have moderated the response to LOF application.

The Effects of Interaction between Composition of Planting Media and Concentration of Goat Biophosphate LOF

The interaction between the composition of the planting media and the concentration of the LOF significantly affected plant height and leaf number, but not on stem diameter nor branch number. The highest numerical plant height at 12 WAP was observed in the P1K3 combination, consisting of topsoil, raw rice husk, and goat manure at a ratio of 2:1:1 with 5 mL/L LOF, with an average height of 52.40 cm. However, this value was not significantly different from some other treatment combinations, including P1K1. This indicates that increasing LOF concentration did not consistently result in a statistically higher plant height, suggesting that plant height response was influenced by the interaction between media composition and LOF concentration rather than by LOF concentration alone. This indicates that the combination of growing medium type and goat biophosphate fertilizer concentration plays a significant role in influencing plant height. This combination likely offers a synergistic supply of macro and micronutrients required by plants for cell elongation and tissue formation.

The goat manure-based biophosphate LOF used in this study may contribute to nutrient supply for seedling growth, including macronutrients such as N, P, and K. Nevertheless, because the nutrient composition of the LOF was not chemically analyzed, this explanation should be interpreted as a possible mechanism rather than a direct conclusion from nutrient analysis. In liquid form, nutrient is readily available in the soil solution and easily absorbed by the roots. Nitrogen availability may have originated from both the planting media and the goat manure-based biophosphate LOF, which in turn increases the rate of photosynthesis and terminal shoot growth.

Furthermore, the physical structure of the planting medium determines the ability of roots to spread and penetrate the medium, which affects the efficiency of nutrient absorption, especially in the early growth phase (Sari and Suryanti, 2022). According to Tirta *et al.* (2025), plant height is influenced by nutrient availability and the capacity of the growing medium to support root development. In this study, the combination of planting media and goat manure-based biophosphate LOF may have supported root expansion and nutrient uptake, thereby contributing to shoot elongation during the vegetative growth stage. A good planting medium will support nutrient absorption, while goat manure-based biophosphate LOF may contribute several essential nutrients, including N, P, and K, which collectively support root system development, nutrient uptake, and shoot elongation, thereby increasing nutrient absorption from the planting medium.

Table 4. Average of plant height of avocado seedling due to treatment of the interaction of the medium composition (P1, P2, and P3) and the LOF concentration (K1, K2, and K3) at 4 and 8 WAP

Concentration LOF	Composition of Types of Planting Media					
	4 WAP			8 WAP		
	P1	P2	P3	P1	P2	P3
K1	48,65 b A	45,85 b B	48,02 a A	49,03 b A	46,48 b B	48,25 a AB
K2	46,15 c B	49,72 a A	47,47 a B	46,80 c B	50,05 a A	48,70 a A
K3	51,25 a A	47,72 b B	47,95 a B	52,05 a A	49,13 a B	48,57 a B

Description: P1 = (soil: rice husk: manure; 2:1:1), P2 (soil: rice husk: manure; 3:1:1), P3 (soil: rice husk: manure; 2:1:1), K1 (the LOF Concentration 2 mL/L), K2 (the LOF Concentration 4 mL/L), K3 (The LOF Concentration 5mL/L). Numbers followed by the similar lowercase letter in the similar row are not significantly different based on DMRT at the 5% level. Numbers followed by the similar capital letter in the similar column are not significantly different based on DMRT at the 5% level

Table 5. Average of plant height of avocado seedling due to treatment of the interaction of the medium composition (P1, P2, and P3) and the LOF concentrations (K1, K,2, K3) at 10 and 12 WAP

LOF Concentrations	Composition of Types of Planting Media											
	10 WAP						12 WAP					
	P1		P2		P3		P1		P2		P3	
K1	49.03	b A	46.90	b A	48.48	a B	49,48	b A	47,47	b B	49,23	a AB
K2	46.95	c A	50.20	a A	48.72	a B	47,55	b B	51,62	a A	49,12	a B
K3	52.28	a A	49.20	a A	48.57	a B	52,40	a A	49,78	a B	49,45	a B

Description: P1 = (soil: rice husk: manure; 2:1:1), P2 (soil: rice husk: manure; 3:1:1), P3 (soil: rice husk: manure; 2:1:1), K1 (the LOF Concentration 2 mL/L), K2 (the LOF Concentration 4 mL/L), K3 (The LOF Concentration 5mL/L). Numbers followed by the similar lowercase letter in the similar row are not significantly different based on DMRT at the 5% level. Numbers followed by the similar capital letter in the similar column are not significantly different based on DMRT at the 5% level

Table 6. Average of leaf number of avocado seedling due to treatment of the interaction of the medium composition (P1, P2, and P3) and the LOF concentrations (K1, K,2, K3) at 6 and 10 WAP

Concentration of Goat Biophosphate LOF	Composition of Planting Media											
	6 WAP						10 WAP					
	P1		P2		P3		P1		P2		P3	
K1	22,50	a A	13,83	ab B	13,83	ab B	22,17	a A	13,67	b B	14,50	a B
K2	15,83	b B	19,50	a A	13,33	b B	16,33	b AB	19,17	a A	13,33	a B
K3	17,00	b A	16,50	ab A	16,67	a A	16,33	b A	15,50	b A	15,00	a A

Description: P1 = (soil: rice husk: manure; 2:1:1), P2 (soil: rice husk: manure; 3:1:1), P3 (soil: rice husk: manure; 2:1:1), K1 (the LOF Concentration 2 mL/L), K2 (the LOF Concentration 4 mL/L), K3 (The LOF Concentration 5mL/L). Numbers followed by the similar lowercase letter in the similar row are not significantly different based on DMRT at the 5% level. Numbers followed by the similar capital letter in the similar column are not significantly different based on DMRT at the 5% level

Table 7. Average of leaf number of avocado seedling due to treatment of the interaction of the medium composition (P1, P2, and P3) and the LOF concentrations (K1, K,2, K3) at 12 WAP

LOF Concentration	Composition of Planting Media					
	12 WAP					
	P1		P2		P3	
K1	22,83	a A	15,67	b B	15,83	ab B
K2	18,17	b B	22,50	a A	13,50	b C
K3	16,00	b A	17,67	a A	16,67	a A

Description: P1 = (soil: rice husk: manure; 2:1:1), P2 (soil: rice husk: manure; 3:1:1), P3 (soil: rice husk: manure; 2:1:1), K1 (the LOF Concentration 2 mL/L), K2 (the LOF Concentration 4 mL/L), K3 (The LOF Concentration 5mL/L). Numbers followed by the similar lowercase letter in the similar row are not significantly different based on DMRT at the 5% level. Numbers followed by the similar capital letter in the similar column are not significantly different based on DMRT at the 5% level

Meanwhile, the tended highest number of leaves was consistently achieved with the P1K1 treatment, at 22.83 leaves at 12 WAP. The P1 planting media combination (soil: manure: rice husk = 2:1:1) proved to provide the best results, possibly because the porous rice husk improves aeration and hence nutrient absorption by the roots. In general, the addition of goat manure and goat manure-based biophosphate LOF may

improve the growing medium not only by supplying primary macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), but also by contributing secondary nutrients, micronutrients, organic matter, and biologically active organic compounds. These components may collectively support vegetative growth by improving nutrient availability, microbial activity, root-zone conditions, and nutrient uptake efficiency (Septian *et al.*, 2024). Nitrogen plays a role in plant tissue formation, phosphorus aids root development, and potassium strengthens plant tissue and increases disease resistance (Tarjiyo & Elfis, 2023).

However, based on observed parameters indicating interaction, it was evident that the P1 planting medium consistently yielded the best results. Rice husks are porous, meaning they offer good drainage and aeration, which in turn supports root nutrient absorption, especially when combined with the addition of manure in a 1:1 ratio to rice husks (Jayanti, 2021). This is supported by research by Susilawati, Ammar, M., & Mu'arif. (2018), that found that a medium composition of 60% soil to 40% manure significantly impacted plant vegetative growth, particularly plant height and leaf number.

Using a good planting medium will increase nutrient uptake by plant roots (Rosdiana *et al.*, 2025). Adding manure and goat biophosphate fertilizer (POC) at various concentrations will increase the nutrient content of the growing medium, particularly macronutrients such as nitrogen (N), phosphorus (P), and potassium (K). The use of goat manure and goat manure-based biophosphate LOF may contribute organic matter and various nutrients to the growing medium, especially during vegetative growth, such as in plant height, leaf number, stem diameter, and branch number (Aldi R. and Baharuddin, 2024). Nitrogen is a component of protein, a building block for tissue in living organisms, and in soil, N plays a crucial role in plant growth. Increased plant height results from the formation of new cells and cell elongation in the apical meristem, which influences the supply of carbohydrates synthesized from the green parts of the plant. In addition to nitrogen, phosphorus and potassium are also essential for plant growth. Phosphorus is the most important nutrient for plants after nitrogen. Phosphorus compounds also play a role in cell division and stimulate early root growth. Potassium, on the other hand, plays a role in the formation of proteins and carbohydrates, hardening the woody parts of the plant, and increasing plant resistance to pests and diseases (Kurniawan E. and Dewi R., 2022).

CONCLUSION

Based on the results of the study "The Effect of Planting Media Composition and Goat Biophosphate Liquid Solution Concentration on the Vegetative Growth of Avocado Seedlings," it can be concluded that:

1. The composition of the planting medium has a significant effect on the number of leaves, while liquid biophosphate fertilizer only has a significant effect on the stem diameter at the start of growth.
2. The interaction between planting media composition and goat biophosphate liquid solution concentration had a significant effect on plant height in weeks 4, 8, and 12, and leaf number in weeks 6, 10, and 12. However, there was no significant effect on stem diameter or branch number.

AUTHORS CONTRIBUTIONS

AZNR and RF designed and planned the experiment. AZNR and SDR conducted seedling preparation, planting, and data collection in the field. ES supervised experimental implementation and ensured methodological accuracy. FYUA assisted in data tabulation, statistical analysis, and preparation of figures and tables. RF interpreted the results and drafted the manuscript. All authors contributed to revising the manuscript, provided critical feedback on the research flow, data analysis, and interpretation, and approved the final version of the article for submission.

CONFLICT OF INTEREST

Declare conflicts of interest or state "The authors declare no conflict of interest."

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