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Comparative Study of Coffee Wood and Fern Board Planting Media on *Phalaenopsis amabilis* Vegetative Growth in the Seedling Phase

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Abstract

Background: *Phalaenopsis amabilis*, or the moon orchid, is a popular type with high market demand. Planting media is a factor that can be successful in caring for the *Phalaenopsis amabilis*, which is an epiphytic orchid type or attaches to other plants. Most orchid planting techniques have not been adapted to their natural habitat in nature, which is connected to other plants. The planting medium generally used for epiphytic orchids such as *Phalaenopsis amabilis* is fern boards, which are limited in nature. Researchers see the potential for coffee wood. Many can be used as a planting medium for *Phalaenopsis amabilis* because this plant is also found growing naturally in coffee plants. **Methods:** The research used comparative studies between coffee sticks and fern boards as planting media for *Phalaenopsis amabilis* on their vegetative growth according to their natural habitat by attaching to other plants. The analysis results were obtained by statistical tests t–test unpaired) using SPSS. **Results:** The analysis showed $p \leq 0.05$ on the four parameters of *Phalaenopsis amabilis* growth. There are differences in the use of planting media types of coffee logs (M1) and fern boards (M2) on the vegetative growth of *Phalaenopsis amabilis* orchid plants, including the number of leaves, leaf span, leaf width, and root length. **Conclusions:** The vegetative growth on M1 and M2 is significantly different. The fern board planting media (M2) tends to be more recommended for use. After all, it can be optimal in providing vegetative growth consisting of the number of leaves, leaf span, leaf width, and root length because its growth is more stable.

Keywords: Cultivation; growing media; *Phalaenopsis amabilis*

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Introduction

Orchids in the taxonomic classification include Orchidaceae (Isda & Fatonah, 2014). Orchid plants are the most prominent family of flowering plants, with around 43,000 species divided into around 750 genera (Syafira et al., 2022). One type of orchid endemic to Indonesia, namely *Phalaenopsis amabilis*, grows epiphytically and is attached to tree trunks or branches (Ahmad & Setyowati, 2020). The genus *Phalaenopsis amabilis*, often called moon orchids, is a popular type of orchid with high market demand (Indriani et al., 2019). However, the high number of consumers of *Phalaenopsis amabilis* is not accompanied by its abundant availability in nature, so it requires multiplication to meet market demand through cultivation.

One of the most popular orchids cultivation in the community is the *Phalaenopsis amabilis* orchid because the price of its seeds is low. Still, it is susceptible to disease compared to other types of orchids (Nisa et al., 2018). Orchid plants require extra care to grow with beautiful flowers (Monawati et al., 2019). One of the critical factors in cultivating

the *Phalaenopsis amabilis* orchid is selecting the appropriate type of media to support its growth. The press for transplanting orchids must be adapted to the kind of orchid, climate, and availability (Tini et al., 2019).

Planting media is one of the factors that can ensure successful orchid care. The planting medium is organic material derived from components of living organisms (can come from leaves, stems, flowers, fruit, and plant bark), which can provide plant nutrients (Dalimoenthe, 2013). Planting media generally used for orchids are moss sphagnum, ferns, kadaka roots, coconut fiber or cocopit, wood charcoal, broken bricks, or pieces of pine bark, each with its advantages and disadvantages (Erfa et al., 2020). One commonly used planting media is ferns because they have the benefits of holding water, good aeration and drainage, and decaying slowly. Still, the disadvantage is that they only contain a few nutrients (Febrizawati et al., 2014). Erfa et al. (2020) state that fern media is widely used on Dendrobium and Phalaenopsis orchids. This also causes fern demand to increase, so selling prices rise, and ferns become limited (Sudartini et al., 2020). A potential planting medium for cultivating epiphytic orchids is coffee wood stems because *Phalaenopsis amabilis* orchids are found in nature growing on coffee plant hosts (Mardiyana et al., 2019). The advantage of this planting medium is that it has good drainage and aeration and is challenging to rot. However, the drawback is that it is dense and does not bind water well because it contains cellulose, lignin, and hemicellulose compounds (Sudartini et al., 2020).

In previous research on planting media and orchid cultivation, the current media used for cultivating *Phalaenopsis amabilis* is planting in pots. Planting orchids in pots ignores the plant's natural habitat, epiphytes. They stick or ride on other plants but do not harm the host plant. So, planting is easier because it does not require a planting medium. It can be attached to a tree or fern board as a planting medium for sticky orchids (Junedhie, 2014). Planting media must adapt to environmental conditions by considering its availability in the surrounding environment and the effectiveness of the material because it affects plant growth (Angkasa, 2018). Choosing a planting medium that suits nutritional needs is one of the factors that influences the vegetative growth of *Phalaenopsis amabilis* orchid plants. Fern boards and coffee logs are organic planting media that can be used for *Phalaenopsis amabilis* orchids according to their epiphytic character by hanging. Ferns, as a growing medium for *Phalaenopsis amabilis* orchids, usually come from the stems of the fern *Alsophia glaica*, which grows in the forest (Indrawati et al., 2016).

Meanwhile, coffee wood stems are hard and dense, so they have a heavy volume, so many are not used (Driyomartono et al., 2019). However, the *Phalaenopsis amabilis* orchid is an epiphytic orchid that attaches to tree trunks so that coffee logs can be used as an alternative growing medium for these orchids. Therefore, in this research, we will examine the different types of organic planting media that are rich in nutrients and suitable for the native habitat of *Phalaenopsis amabilis*, namely fern boards and coffee logs, on the vegetative growth of the seedling phase.

Methods

This comparative test research used a completely randomized design with two treatments, M1 (coffee wood stem planting medium) and M2 (fern board planting medium), with six replications. The research location in the orchid cultivation environment in the Semarang City Region is CV Candi Orchid Semarang for six weeks in May–July 2023. The tools and materials used in this research are 12 *Phalaenopsis amabilis* orchids in the seedling phase, six coffee wood stem planting media, six fern boards, rope, wire, pliers, Growmore 20-20-20 fertilizer, sprayer, and water. Apart from that, tools were also used, such as a ruler to measure the vegetative growth of the *Phalaenopsis amabilis* orchid plant, a camera for documentation, and writing tools.

Data collection

Data was collected through observation and measurement with the help of measurable and directed observation sheets using observation tables once every week for six weeks. Data collection in the observation table in the form of date and time of observation, environmental conditions in the form of temperature and humidity, number of leaves (pieces), leaf span (cm), leaf width (cm), and root length (cm) was shown in Figure 1. to determine growth vegetative of the *Phalaenopsis amabilis* plant.

Information:

- Leaf span (cm)
- Leaf width (cm)
- Root length (cm)

Figure 1. Description of measurements of leaf span (cm), leaf width (cm), and root length (cm)

Procedure

This research was carried out by preparing the tools and materials used, followed by preparing the planting medium by soaking it in water. The *Phalaenopsis amabilis* orchid plant is tied to the middle of the surface of the planting medium, which has been given a wire as a hanger. Plants are tied using rope labeled according to the treatment. Plants placed in the greenhouse are watered twice daily and fertilized twice weekly. Measurements were carried out once a week for six weeks using an observation sheet and documented. The research results were tested statistically and discussed using related references.

Data analysis

Data analysis is divided into two stages: descriptive statistical analysis and statistical methods to present observation data numerically. Descriptive statistics includes measures of centering (mean) to describe the characteristics of samples or populations that are compared using Microsoft Excel.

The second stage of analysis is a statistical test, namely using SPSS to compare different groups or populations. The statistical test that will be used in this research is the t-test (unpaired). The aim is to identify whether there are significant differences between the compared groups or populations on each research parameter.

Result

Based on the treatment carried out on *Phalaenopsis amabilis* orchids for six weeks, the observation data were obtained as shown in Table 1. The data in the table above has received the first stage of analysis, namely descriptive statistics in the form of data-centering measures (mean). The data listed in Table 1 is the average of the results of plant measurements with the two different types of planting media on four measurement parameters with six repetitions. Observation results were obtained in two different types of plant media, which had quite significant differences, as shown in Figure 2. The data in Table 1. can also be used as further information regarding the vegetative growth of *Phalaenopsis amabilis* orchids with M1 and M2 for six weeks. Apart from that, six repetitions were carried out to get more accurate data, which are shown in Figure 2 and Figure 3.

Table 1. Average Vegetative Growth of *Phalaenopsis amabilis* on M1 and M2

Parameter	Type of Planting Media	Week -						P (T<=t) 2 tail
		1	2	3	4	5	6	
Number of Leaves (pieces)	M1	4.00	3.84	3.84	3.34	3.17	3.00	0.01
	M2	4.00	4.00	4.00	4.17	4.34	4.50	
Leaf Landscape (cm)	M1	16.99	16.78	16.47	16.25	16.03	15.80	0.001
	M2	16.91	16.81	17.15	17.34	17.54	17.96	
Leaf Width (cm)	M1	4.75	4.68	4.50	4.37	4.25	3.85	0.0006
	M2	4.84	4.90	4.98	5.05	5.07	5.14	
Root Length (cm)	M1	10.67	10.56	10.48	10.38	10.34	10.20	0.03
	M2	10.67	10.98	11.42	11.45	11.70	12.01	

Figure 2. Differences in growth of *Phalaenopsis amabilis* with M1 and M2 for six weeks

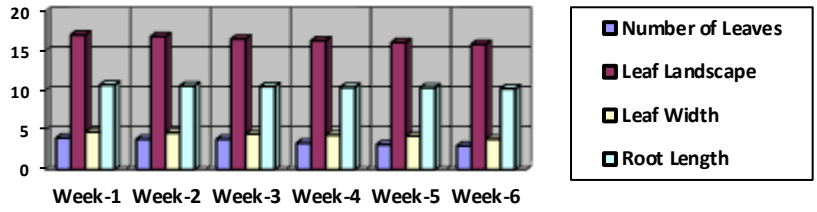

Figure 3. Growth of *Phalaenopsis amabilis* with M2 for 6 weeks.

Discussion

Number of Leaves

The analysis results from the data showed that the number of leaves of the *Phalaenopsis amabilis* orchid during treatment with different types of planting media experienced differences depending on the planting media. On M1, the data obtained tends to decrease the number of leaves. This is shown in the 1st-week data. The number of *Phalaenopsis amabilis* orchid leaves was 4, but decreased in the second week to 3 leaves and lasted until the sixth week. Meanwhile, for the M2 type, the results showed that the number of leaves that was initially uniform, namely 4, lasted for four weeks, then new leaves appeared in the fourth week and lasted until the sixth week. This is supported by Herliana O. et al. (2018) research that the planting medium of ferns and kadaka roots influences the increase in the number of leaves and the highest number of shoots in Dendrobium orchid plants. It is suspected that fern media can prepare a suitable habitat for root growth because the environment contains lots of oxygen and good aeration, does not rot quickly, and contains organic nutrients (Hanik et al., 2020).

A decrease in the number of leaves on *Phalaenopsis amabilis* orchid plants occurred in 5 replications of M1 plants. In general, the reduction in the number of leaves on *Phalaenopsis amabilis* orchid plants with M1 and M2 begins with a decrease in leaf size,

followed by a change in leaf color from dark green to yellow until when measured, the leaves are found to have fallen. According to Indriani et al. (2019), reducing the number of leaves reduces water evaporation in the orchid plants. This is appropriate because the research was conducted in the dry season with 33-48% humidity. Meanwhile, the optimal environment for *Phalaenopsis amabilis* orchids is a temperature range between 15-35°C air humidity of 70-80% (Yasmin et al., 2018). Apart from that, the characteristics of M1, which does not have as good aeration and drainage as M2, can also be a factor in reducing the number of leaves of *Phalaenopsis amabilis* orchid plants.

In the M2 type, the growing leaves are small and dark green with a red leaf surround. The leaf number parameter was taken because the appearance of new leaves indicates optimal absorption of nutrients in the planting medium, which supplies nutrients to the body of the *Phalaenopsis amabilis* orchid plant. The increasing number of leaves can indicate that the plant can optimize photosynthesis to support the transition process towards the reproductive phase (Putra et al., 2016). The increase in the number of leaves on the *Phalaenopsis amabilis* orchid plant is caused by cell division events, which dominate at the top of the plant. According to Febrizawati et al. (2014), leaf formation begins with cell division near the crown apex, forming the leaf primordial.

Leaf Landscape

Based on the observations, it was found that the leaf span, namely the total length of 2 leaves of the *Phalaenopsis amabilis* orchid, decreased from 16.98 cm to 15.8 cm in the sixth week for M1. Meanwhile, the orchids on M2 tended to increase in leaf span over six weeks, from 16.91 cm to 17.97 cm. In the measurement results, *Phalaenopsis amabilis* orchid plants with M1 tended to decrease while those on M2 tended to increase. Leaf span is a vegetative growth parameter influenced by the nitrogen content in each orchid growing medium. The findings show that the number of leaves also decreased in M1, followed by an increase in the size of the leaf span. According to Tini et al. (2019), orchid plants shed their leaves to produce photosynthate, which the plant uses to expand the leaf area. Therefore, it was found that leaf span tends to increase because ferns store water very quickly and contain a lot of the nutrient element magnesium, which is needed for the formation of chlorophyll and supports photosynthesis and vegetative growth of plants, one of which is the length and width of the leaves and does not quickly become moldy (Hanik et al., 2020). This was also explained by Damanhuri et al. (2022) that apart from nitrogen, the element magnesium also plays a role as a constituent of chlorophyll to help the rate of plant photosynthesis and as an activator of various enzymes in respiration photosynthesis and the formation of RNA and DNA.

Leaf Width

The results of measuring the width of the leaves of the *Phalaenopsis amabilis* orchid plant during six weeks of observation showed an increase and decrease in the size of the leaf width. This can be seen from the size of the leaf width in the first week of M1, which was 4.75 cm to 3.85 cm in the sixth week. Meanwhile, on M2, the leaf width was 4.83 cm in the first week and 5.13 cm in the sixth week. The increase in leaf width of *Phalaenopsis amabilis* orchid plants using fern board media (M2) is supported by the content of sugar compounds, amino acids, aliphatic acids, and esters, which are orchids. Ferns also do not rot quickly, so plants get nutrients for a long time (Marlina et al., 2019). Amino acid compounds are believed to play a role in helping increase the amount of chlorophyll and supporting the photosynthesis process so that the vegetative growth of plants so that the intake of photosynthetic materials is met and leaf width also increases (Fatma, 2017).

Meanwhile, the leaf width decreases because coffee wood stems are hard and dense (Driyomartono et al., 2019). Hence, the porosity level is unsuitable for the vegetative growth of *Phalaenopsis amabilis* orchid plants. The decrease in leaf width is also influenced by the poor binding capacity of coffee wood stems because they contain

cellulose, lignin, and hemicellulose compounds, so the leaf width decreases (Sudartini et al., 2020).

Root Length

Based on the results of measuring the length of the roots on M1 for six weeks, the roots of the *Phalaenopsis amabilis* orchid plant decreased sequentially, namely from 10.67 cm to 10.2 cm. Meanwhile, *Phalaenopsis amabilis* plants with M2 for six weeks experienced an increase in root length from 10.67 cm in the first week to 12.01 cm in the sixth week. The above shows that M2 is better at supplying the nutrients *Phalaenopsis amabilis* orchid plants need, so vegetative growth tends to increase compared to M1. This is supported by research by Hanik et al. (2020) that fern media and peanut shell media are both media that have high porosity, which supports root growth because media with low porosity can inhibit root growth even though the water holding capacity may be better than that light media. Therefore, root growth on M2 from the observation results is more optimal. Apart from that, it is known that fern media also contains amino acid compounds, which can help increase the amount of chlorophyll and the photosynthesis process so that the vegetative growth of plants using this media is more optimal (Fatma, 2017).

Based on the observation data, a comparison test was carried out on the M1 and M2 treatment results data. It was found that the two types of planting media had significant differences in 4 parameters, namely, number of leaves, leaf width, leaf width, and root length. This can be seen from the p-value ≤ 0.05 results for the four parameters in each treatment. The characteristics of the planting media used influence the differences in results from each type of planting media. In measuring and collecting data, it can be seen that M2 can produce more optimal vegetative growth of *Phalaenopsis amabilis* orchid plants than those using M1. This is supported by research by Arthagama et al. (2021) that using fern media and liquid organic fertilizer affected the highest plant height, number of leaves, and number of tillers in Dendrobium plants. Apart from that, in research by Suharman & Nurhabesar (2021), it was discovered that the combination of fern + charcoal was able to increase vegetative growth (plant height, root length, and wet weight) of Dendrobium Orchid Plants.

Fern plants that have been processed into fern boards and used as planting media for epiphytic orchids, namely *Phalaenopsis amabilis*, have characteristics consisting of stiff fibers that form a small air gap (aeration) which makes it easier for plant roots to grow in all directions and excess water in the media can also be used. Easily flows downwards (drainage) (Hanik et al., 2020). This causes the planting medium not to get wet and waterlogged quickly because it has cavities for good drainage and aeration for *Phalaenopsis amabilis* orchids. The characteristics of this fern board planting medium also support the growing conditions for orchids that are bred in high-temperature environments. The ideal air temperature for the growth of *Phalaenopsis amabilis* orchids is below 29℃, while this research was conducted in an environment with an average daily air temperature of 33℃. High air temperatures will increase the evaporation process in orchid plants. Ferns contain organic nutrients needed for the growth of *Phalaenopsis amabilis* (Hanik et al., 2020). Based on the parameters observed, namely the increase in the number of leaves, leaf span, and leaf width, leaf chlorophyll can also influence it to carry out the photosynthesis process in an environment that matches its natural characteristics. Environmental factors that also affect the vegetative growth of *Phalaenopsis amabilis* orchids, namely temperature, need to be controlled with planting media that can maintain orchid humidity, such as fern boards.

The planting medium for coffee wood stems (M1) used in this research was less than optimal in supporting the vegetative growth of *Phalaenopsis amabilis* orchid plants with their natural habitat attached to trees. Coffee tree trunks generally have a solid and complex texture with bark containing lignin, making it challenging to utilize the nutrients to supply the nutritional needs of orchid plants. Apart from that, coffee logs have a solid,

non-porous surface, making it difficult to store water and poor aeration due to the potential for high watering to make the coffee logs rot quickly. This can cause the vegetative growth results of *Phalaenopsis amabilis* orchid plants to be less than optimal if planted in coffee wood stem (M1) planting media.

Conclusions

Based on the results and discussion above, it can be concluded that the optimal vegetative growth of the *Phalaenopsis amabilis* orchid is fern board planting media (M2) compared to coffee wood stem planting media (M1). The vegetative growth of the *Phalaenopsis amabilis* orchid using coffee wood stem and fern board planting media experienced significant differences in growth parameters in the following parameters: number of leaves, leaf span, leaf width, and root length in the form of a more optimal fern board planting medium (M2).

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Declaration statement

The authors reported no potential conflict of interest.

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