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Growth of Dendrobium Oryen Orchids at the acclimatization stage by providing organic materials to the planting media and spraying foliar fertilizer

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Abstract The study's findings indicated that the leaf quantity and breadth variables are influenced by the frequency of foliar fertilizer applications and the addition of organic material to the planting medium. Adding organic material was significantly impacted the root length and leaf count variables, while the other seven were unaffected. The treatment of fertilization frequency did not affect every variable. Fertilizing once every six days with organic material drawn from Moringa leaf litter produced the most leaves while fertilizing once every six days with organic material derived from coffee husks generated the broadest leaves. The longest orchid roots are generated when organic material from Lamtoro leaf litter is placed in an orchid-growing environment.

Keywords: Growth, Organic material, Fertilization

Introduction

Orchids are ornamental plants that are very attractive and have high economic value. This plant has beauty, uniqueness, and long-lasting durability in various shapes and colors. Apart from being ornamental plants, orchids are also used in aromatherapy and medicine. This plant can be used as a cut or potted flower (Latif *et al*., 2020). The market demand for orchids is relatively high, which must be followed by the supply of large quantities of good quality orchid seeds. Orchid propagation is generally performed via tissue culture because it produces orchid seeds in large and uniform quantities. Orchid seeds from tissue culture (in vitro) become rooted plantlets. Plantlets are acclimatized and maintained in their natural environment (Kurniasih *et al*., 2017). Ayuningtyas *et al*. (2020) reported that acclimatization is the final stage of tissue culture. Acclimatization is essential in plantlet transplantation from the in vitro phase to the external environment.

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Orchid seedlings acclimatized are vulnerable to the external environment and require fertilizer to provide nutrients (Ayuningtyas *et al*., 2020). The growth and development of orchid seedlings can be stimulated by a fertilization process containing micro- and macro-nutrients supplied through the roots and leaves (Suradinata *et al*., 2012). The orchid cultivation process requires special handling, especially of the planting media and the provision of nutrients (Putri *et al*., 2022). The medium for transplanting orchids must be adapted to the type, climate, and availability of the orchid. Some materials used as orchid planting media include ferns, coconut fiber, charcoal, and moss (Kartana, 2017). Orchids require a planting medium that can store water, is free from fungi and bacteria, and is easily rotten (Marlina *et al*., 2019). Orchid media must contain the nutrients necessary for growth. Organic materials commonly used in orchid-growing media include moringa leaf litter, Lamtoro leaf litter, and coffee husks. Rahman *et al*. (2017) reported that the Moringa plant contains many compounds that can be used for medicine or plant growth. Moringa leaves contain a lot of energy per 100 grams of ingredients, including 75 g of water, 92 cal energy, 6.8 g of protein, 20 mg of phosphorus, 440 mg of calcium, 7 mg of iron, and 259 mg of potassium (Qomariyah, 2017). The 100-g Lamtoro leaves contain 0.3% phosphorus, 2.15% nitrogen, and 2.8% potassium (Saputra, 2016). The research results showed that the organic C content in the skin of the coffee fruit was 45.3%, nitrogen content was 2.98%, phosphorus 0.18% and potassium 2.26% (Falahuddin *et al*., 2016).

Caring for orchid plants, besides requiring proper planting media, also requires nutrients in the form of fertilizer to meet their needs. Plants more easily absorb fertilizer through leaves to provide the micro- and macronutrients needed during the plant growth phase (Hartati *et al*., 2019). The appropriate frequency of fertilization is required to achieve optimal seedling growth. A spraying frequency that is too infrequent is likely to provide a less significant difference than not spraying, so it becomes ineffective. Several studies have shown that applying liquid organic fertilizer at the right frequency offers optimal results for orchid plants. The research results of Anggoro *et al*. (2019) showed that the interaction of providing super bionic liquid organic fertilizer with a concentration of 1 ml/L of water and a frequency of once every 4 days had the highest influence on increasing leaf length on the growth of Cattleya sp. orchid plants. According to Septirosya *et al*. (2019), a 9-day interval of applying organic Lamtoro leaf fertilizer gave the highest results in increasing plant height, number of leaves, and stem diameter of tomato plants. The research investigation aimed to identify the best type of organic material and frequency of foliar fertilizer spraying for the growth of Dendrobium Oryen orchids at the acclimatization stage.

Materials and methods

The study was conducted at Bengkulu University's Green House, Faculty of Agriculture, from June to October 2022. A factorial split plot with a completely randomized design (CRD) was used in this study. The frequency of foliar fertilizer spraying (NPK 20:15:15) is the primary plot and is divided into three levels: F1 = once every 6 days, F2 = once every 3 days, and F3 = once every 2 days. Subplots consist of four levels: B0 = no organic material; B1 = Lamtoro leaf litter; B2 = Moringa leaf litter; and B3 = coffee skin, composed of additional organic material added to the planting media. For a total of sixty experimental units, 12 treatment combinations were repeated five times. Each plantlet comprised an experimental unit.

The 3x4 cm-sized coconut fiber is used as the planting medium. Clean water was used to soak the coconut fiber for two nights, and each day, the water was dumped and replaced with fresh water. Subsequently, a fungicide solution containing 80% mancozeb (2 g L^{-1}, is used to soak the planting medium for a single day. After a week of air drying, the organic materials from coffee husks, Lamtoro leaf litter, and moringa leaf litter were chopped and mineralized for a month. To initiate the mineralization process, finely chopped organic material is placed in a pot containing coconut fiber planting medium, and the pot is covered with plastic for about two weeks. The color of the organic material indicates how well the mineralization process went.

Plantlets derived from in vitro tissue culture findings will be used. Before transferring the Dendrobium Oryen orchid plantlets from the bottle to the acclimatization phase, the old agar medium—still linked to the roots—must be thoroughly cleaned under running water. For 15 min, plantlets are submerged in a 2 g. L^{-1} fungicide solution. Next, the plantlets are raised and placed on paper or tissue that can absorb moisture. Next, the plantlets—one Dendrobium Oryen orchid plantlet per little plastic pot—are placed in the prepared planting medium, which consists of coconut fiber pieces.

The entire surface and underside of the plant leaves were sprayed with fertilizer until thoroughly moist—a dose of 2 g. L^{-1} of foliar fertilizer was administered, and the frequency of fertilizer spraying was determined by therapy. A plastic cup was used to cover the planting media with plantlets. Water should be taken twice daily with a hand sprayer to retain humidity. On the other hand, irrigation is performed only once in overcast conditions. This is because frequent watering will raise the media's humidity, which could encourage the growth of fungi. A robust, compact stem is a sign of an orchid with ample water; the stem shrivels without water (Wijayanti, 2011).

Plant height, leaf count, leaf breadth, leaf length, root length, number of roots, number of shoots, degree of leaf greenness, and stomata density were among the characteristics that were observed. The acquired data were then subjected to a 5% level analysis of variance (ANOVA) F test. Additionally,

the Duncan multiple range test (DMRT) was used to assess variable data at the 5% level, which revealed actual differences.

Results

The findings of this study demonstrated that an interaction between the frequency of foliar fertilizer spraying and the addition of organic material to the planting media influenced the two observation variables. No interaction was found for seven additional factors (Table 1). The length of the roots and the quantity of leaves interact. Adding organic material significantly impacted the number of leaves and root length, whereas the other seven variables were unaffected. Not every detected variable was affected by fertilization frequency treatment.

Table 1. Summary of variance analysis of the influence of spraying frequency foliar fertilizer and application of organic material on the growth of Dendrobium orchids during the acclimatization phase at 12 weeks after planting

No	Variable	F. count			diversity coefficient KK (%)
		Spraying frequency (F)	Organic material (B)	Interaction (BxF)	
1	Plant height	1,64 ns	1,47 ns	2,17 ns	15,09
2	Numbers of leaves	0,80 ns	5,09 *	3,20 *	18,24
3	Leaf length	1,56 ns	1,82 ns	1,58 ns	15,23
4	Leaf width	0,59 ns	2,65 ns	4,72 *	14,02
5	Number of shoots	1,00 ns	0,88 ns	1,29 ns	13,66**
6	Root length	1,10 ns	4,50 *	0,23 ns	25,34
7	Numbers of roots	0,12 ns	0,18 ns	1,16 ns	19,61
8	Greenish leaves	0,86 ns	1,01 ns	1,10 ns	14,69
9	Stomatal density	2,81 ns	0,15 ns	1,01 ns	18,74**
	F table, 5%	4,46	2,87	2,36	

Note : * = significantly affected the F test at the 5% level.
ns = has no significant effect on the F test at 5%
** = transformed diversity coefficient,

Interaction between the frequency of foliar fertilizer spraying and the use of organic materials in orchid growing media

The effect of applying organic material to the planting media on the variable number of leaves and frequency of foliar fertilizer spraying interact (Table 2). The interactions demonstrated that the number of orchid leaves varied according to the frequency at which foliar fertilizer was sprayed. Organic materials were added to the planting media. The maximum average number of leaves was obtained by planting in a medium devoid of organic material and applying foliar fertilizer every three days; this frequency did not differ significantly from spraying every two and six days. The planting

medium that produced the maximum average number of leaves was made of organic material from Lamtoro leaf litter and was sprayed with leaf fertilizer every 3 days. When applying organic Moringa leaf litter, the frequency of foliar fertilizer spraying every six days resulted in the most significant average number of leaves; nevertheless, this frequency did not differ substantially from that of spraying every two and three days. The highest average number of leaves was obtained by adding organic coffee skin material to the planting medium and spraying it once every six days. The frequency of spraying differed significantly from that of spraying once every two days but not significantly from that of spraying once every three days.

Table 2. The amount of leaves two weeks after planting at a frequency of foliar fertilizer spraying and organic material used for planting

Spraying Frequency	Organic Material			
	B0 (without organic material)	B1 (Lamtoro leaf litter)	B2 (Moringa leaf litter)	B3 (Coffe skin)
F1 (every 6 days)	2,67 ab	2,47 b	3,34 a	3,27 a
	A	AB	A	A
F2 (every 3 days)	3,33 a	3,13 ab	3,33 a	2,53 b
	A	A	A	B
F3 (every 2 days)	3,27 a	2,4 b	3,07 a	2,07 b
	A	B	A	B

Note: In the DMRT follow-up test, numbers in the same column and after the same capital letter did not differ significantly at the 5% level. If two numbers are on the same line followed by the same lowercase letter, then there is no significant difference at the 5% level in the DMRT follow-up test.

Leaf width was influenced by the frequency of foliar fertilizer spraying and the addition of organic material to the planting media (Table 3). The interactions revealed various patterns in the number of leaves according to the application frequency of organic material and foliar fertilizer spraying.

The best average leaf width results were obtained by planting media devoid of organic material and applying foliar fertilizer every two days; this frequency differed considerably from spraying every three or six days. The best average leaf width results were obtained by planting media containing organic material from Lamtoro leaf litter and sprayed with leaf fertilizer every three days. However, this frequency of spraying was not significantly different from that of spraying every two days or once every six days. The most excellent average leaf widths were obtained by planting media supplemented with organic material from Moringa leaf litter and applying fertilizer every six days; nevertheless, these practices did not differ significantly from applying fertilizer every two and three days. The best average leaf width results were obtained by planting media treated with

organic coffee skin material and sprayed with leaf fertilizer every six days; this frequency was significantly different from spraying fertilizer every two days but not substantially different from spraying fertilizer once every three days.

Table 3. Effects of leaf width variables 12 weeks after planting frequency of foliar fertilizer spraying and organic fertilizer material to the planting media

Spraying Frequency	Organic material			
	B0 (without organic material)	B1 (Lamtoro leaf litter)	B2 (Moringa leaf litter)	B3 (Coffe skin)
F1 (every 6 days)	1,81 ab	1,53 b	1,84 ab	2,01 a
	B	B	A	A
F2 (every 3 days)	1,89 a	2,04 a	1,83 a	1,74 a
	B	A	A	AB
F3 (every 2 days)	2,36 a	1,86 b	1,71 b	1,63 b
	A	A	A	B

Note: In the DMRT follow-up test, numbers in the same column and after the same capital letter did not differ significantly at the 5% level. If two numbers are on the same line followed by the same lowercase letter, then there is no significant difference at the 5% level in the DMRT follow-up test.

Impact of organic materials on dendrobium orchid growth in plant media

The plant height, leaf length, leaf breadth, number of shoots, shoot height, number of shoot leaves, number of roots, and number of stomata were not significantly affected by adding organic materials to the growing medium of Dendrobium orchid plants. Leaf and root counts significantly influence the amount of organic material available.

Table 4. shows the average value of adding organic material to the planting medium for Dendrobium orchids, taking into account the root length and leaf count at 12 weeks after planting

Treatment	Numbers of leaves (sheet)	Root length (cm)
B0 (without organic material)	3,09 a	4,10 ab
B1 (lamtoro leaf litter)	2,67 b	4,41 a
B2 (moringa leaf litter)	3,24 a	3,33 c
B3 (coffee skin)	2,66 b	3,40 bc

Note: In the DMRT test, numbers that are not significantly different at the 5% level are indicated by the same letter followed by the number in the same column.

Discussion

Orchid plants grow slowly, requiring unique treatments to stimulate their growth. Intensive maintenance with fertilization and the use of appropriate planting media can be achieved (Bakrie, 2008). The average orchid height increase 12 weeks after planting for all treatments ranged from 3.58 cm to 5.23 cm. The average increase in the number of leaves was 2.07–3.33 pieces. The average growth rate in the number of shoots was 0.33–0.80. The average increase in root length was 2.85–4.54 cm. The average increase in the number of roots was 5.00–6.33 strands. The average level of leaf greenness is 36.41-46.52. The average stomatal density is 5.59-7.27/mm2. According to Andalasari *et al.* (2014), Dendrobium orchids can thrive on charcoal, ferns, sawdust + husk with Gandasil or Hyponex leaf fertilizer, coconut tree bark, acacia tree bark, and sawdust.

The optimal average growth rate of the quantity of leaves for different foliar fertilizer spraying frequencies was achieved by including organic material derived from Moringa leaf litter in the planting medium. This is attributed to the high nitrogen content of moringa leaves, which is the primary ingredient required for plant growth. Moringa contains 4.02% nitrogen, 1.17% phosphorus, 1.80% potassium, 12.3% calcium, 0.10% magnesium, and 1.16% sodium; thus, it can successfully produce biofertilizer (Susilo, 2021).

The best average leaf number (3.34 leaves) was obtained by adding organic material from Moringa leaf litter and sprinkling leaf fertilizer once every six days. In the meantime, the highest yield, 3.33 pieces, was obtained when foliar fertilizer was sprayed once every three days on a growing substrate devoid of organic ingredients. According to Indarto (2011), orchid plants' leaves will burn from excessive fertilizer. According to Dwiyani's (2012), the most significant average number of leaves—5.13 pieces per plant—were obtained by spraying foliar fertilizer once every 10 days. According to Indriani *et al*. (2019), fertilizer application through leaves should be performed at the right time intervals and at a concentration that is not too high.

Planting medium containing organic coffee skin material exhibited the highest average increase in leaf width (2.01 cm) in the treatment involving a six-day leaf fertiliser spraying interval. Additionally, the planting media received organic material from Lamtoro leaf litter once every three days, which produced the best average leaf width (2.04 cm). The availability of nutrients and water affects the speed at which leaves develop and grow in size (Khemisesa, 2021). According to Suryani and Sari (2019), coffee compost media meet the requirements for orchid plant growth, including the capacity to hold water well, aeration and water drainage, and sufficient nutrients. According to Falahuddin *et al*. (2016), magnesium and nitrogen impact leaf width expansion. One nutrient that is involved in the production of

chlorophyll is magnesium. In particular, 3.84% N, 0.2% P, 2.06% K, 1.31% Ca, and 0.33% Mg are found in lavatory leaves (Widyaningrum, 2019). In addition, Lamtoro leaves have more magnesium than coffee and Moringa leaves. Furthermore, planting media lacking organic components produced the best average leaf breadth (2.36) when foliar fertilizer was sprayed every two days. Almost identical to the variable number of leaves, orchid plants benefit from leaf fertilizer sprayed every two days if organic material is not added to the planting media.

The organic material types of planting media have a noticeable impact on factors related to root length. The most significant average increase in root length was observed when organic material from Lantoro leaf litter was added. This increase was 4.41 cm, which is considerably different from adding organic material from coffee husks and Moringa leaf litter but not significantly different from planting soil without organic material. Applying organic material from Lamtoro leaf litter resulted in the lowest average root length development of 3.33 cm. Phosphorus promotes root and cell growth (Pratiwi *et al*., 2019). When phosphorus is applied to plant roots, auxin activity is released, which maximizes root growth and aids in forming chlorophyll from nitrogen nutrients (Faizin *et al*., 2015). According to Saputra (2016), 100 g of lamtoro leaves contains 0.3% phosphorus, 2.15% nitrogen, and 2.8% potassium. According to Qomariyah (2017), 100 g of moringa leaves contains 75 g of water, 6.8 g of protein, 70 mg of phosphorus, 440 mg of calcium, 7 mg of iron, and 259 mg of potassium. This result demonstrates that organic elements from Lamtoro leaf litter should be provided to achieve the greatest root length outcomes. In conclusion, the orchids with the highest leaf count (3.34 pieces) during acclimatization were sprayed with foliar fertilizer once every six days and given organic material from Moringa leaf litter in the planting media. Additionally, the orchids that received foliar fertilizer spraying every six days and had organic coffee husk material added to the planting medium showed the greatest growth in leaf width (2.01 cm. Providing organic material from Lamtoro leaf litter produced the best results for various root quantities.

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