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Effectiveness of Bottle Size Variation on the Growth of *Dendrobium striaenopsis* Orchid Plantlets

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Abstract

The production of Dendrobium striaenopsis orchid cultivation in Indonesia has many obstacles including limited seed provision, low seed quality and cultivation techniques that have not been done well, while orchid enthusiasts always increase every year. Propagation of orchid plants by conventional means requires a long time to obtain a large number of plant saplings, therefore alternative cultivation using tissue culture techniques is needed. In vitro tissue culture techniques are widely used as a fast and efficient way to produce D. striaenopsis orchid plants, but not infrequently there are factors that affect the production of orchids, one of which is bottle size. The purpose of this study is to determine the effect of the effectiveness of bottle size variations on the growth of D. striaenopsis plantlets after comparing the difference in bottle volume and knowing the optimum size of bottles used for D. striaenopsis plantlet growth. The study was conducted from May to August 2023 in the Laboratory CV. Candi Orchid, Semarang City. The method used was the observation and experimental method after which it was continued with the One Way Anova test and further test T. In this study using Vacin and Went medium with a size of 60 ml by providing treatment variations in bottle sizes of 250 ml, 500 ml and 750 ml with 4 repeats. The result of this study is that a 750 ml bottle used in the tissue culture technique of D. striaenopsis Orchid is effective in use even though the growth of plantlets does not occur a significant difference, this is due to environmental factors, namely light intensity and duration of irradiation

Keywords: *Bottle size, D. striaenopsis orchid, Effectiveness*

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INTRODUCTION

Dendrobium orchids are most in demand by the public, among other types of orchids. Dendrobium orchids can be found in deserts where temperatures are very hot or very cold, for example in the Himalayan region. There are more than 1300 species of this orchid variety, making it the largest orchid genus (Maitra, 2020). Related to orchid genetic resources that are very important in the development of superior orchids, this species diversity offers enormous potential for orchid development in Indonesia (Ayuningtyas et

al., 2020). Dendrobium orchids are able to adapt to their environment through various means. For example, they can receive direct sunlight without suffering any damage, and they do not need much water in winter (Tuhuteru et al., 2018).

Many people are interested in growing orchid plants *(Orchidaceae)* because of their attractive appearance. Thanks to modernization, orchids are now enjoyed both as edible cut flowers and as ornamental plants. Due to the large number of interesting varieties and flowers, Dendrobium sp. Orchids are among the most sought-after orchids. Plants in the orchid family tend to grow slowly, but this varies greatly from variety to variety . Orchids are (Buruh et al., 2019). widely spread around 6000 species of orchid plants in the world . There are so many pe (Fandani et al., 2018) ople, especially those who are interested in ornamental plants both at home and abroad, who grow orchids because of their beauty. Due to its long lifespan, attractive flower shades and colors, as well as great prospective value, this houseplant can be a good investment. The external appearance of an orchid plant can tell you a lot about its type, including the shape of its flowers, the color of its leaves, the shape of its leaves. Orchids are valued because each variety has its own uniqueness (Shidiqy et al., 2019).

To improve outcomes, it is critical to undertake diverse initiatives that meet consumer demand and support research infrastructure. Orchid propagation can be achieved efficiently through in vitro culture, resulting in higher offspring yields in a very short period of time . In in-vitro culture (Hartati et al., 2019). technique, Mr. Ari Sudibyo as the cultivator of Orchid Plants from CV. Candi Orchid, a bottle that is often used as a place to plant orchid plantlets *D. striaenopsis* is a 500 ml bottle. This is based on a 500 ml bottle that is more efficient to use because of the availability of the number of bottles on the market, the thickness of the media at a 500 ml bottle size is sufficient for the growth of *D. striaenopsis* Orchids. For this study, there is still not much discussion about the effective bottle size for the growth of Dendrobium Orchid plantlets, this greatly affects its growth and development (Sudibyo, 2023). The purpose of this study was to assess the effectiveness of different bottle sizes in the cultivation of Dendrobium Orchid plantlets using VW media (Vacin and Went). The VW medium composition developed by Vacin and Went is widely used for in vitro orchid culture. The research was carried out in the Laboratory CV. Candi Orchid located on Jl. Bukit Unggul Raya No. 17, Bendan Ngisor, Kec. Gajah Mungkur, Semarang City for 3 months. The aim is to identify elements that affect the growth of plantlets in tissue culture (Apriliyania & Wahidah, 2021).

METHOD

Time and place of research

This study as a whole uses observation methods and experiments conducted from May to August 2023 in the Laboratory CV. Candi Orchid, Jalan Bukit Unggul Raya No. 17, Bendan Ngisor, Gajah Mungkur District, Semarang City.

Material and Tools

The materials used during the research process were *D. striaenopsis* Orchid Planlet with code 153B with the name *D. striaenopsis* Donny Rizal around the age of 4 - 6 months,

and the planting media used were mixed media between Vacin & Went, sugar 20 gram/liter, coconut water 150 gram/liter, and bananas 150 gram/liter size 60 ml per bottle with Ph 5,8. Then the tools used are 4 bottles of 250 ml, 4 bottles of 500 ml, and 4 bottles of 750 ml as well as other supporting tools such as stationery, ruler measuring instruments, books, tweezers, saucers, label paper, and cameras.

Research Methods

A total of sixty plantlets studied in this experimental study used Group Randomized Design (RAK) with three treatments and four repeats each. Treatment I consist of four bottles measuring 250 ml, Treatment II as many as five bottles measuring 500 ml, and Treatment III as many as seven hundred and seventy-five ml bottles.

Procedure

Put Dendrobium sp orchid seedlings into sterile media. Orchid seedlings (*D. striaenopsis* Dony Rizal) are packaged in one bottle of cultivation. A well-lit room with a temperature of about 21 °C is ideal for storing culture (Karimah et al., 2022). Using a ruler, measure the length of the roots of each plantlet from the base to the longest point. The experiment ended with a measurement of the length of the plantlet leaves. Rulers are used to measure the length of the longest leaves of the plantlet, starting from the base to the tip. During cultivation, there are three leaves on each plantlet. At the end of the experiment, we counted the number of leaves on each bottle to examine the plantlets (Nurana et al., 2017).

Parameters

To collect information about plant development, first determine the initial conditions, then measure the variables of root length growth every three months, leaf length increase, and leaf count increase (Herliana et al., 2018). Analysis of the length of the roots and the length of the leaves of the plantlets is carried out quantitatively using a ruler. Both the roots and leaves of the plantlet are measured in centimeters, starting from the base to the longest point. The number of leaves on the plantlet is measured by looking at the longest and healthiest leaves (Ambarwati et al., 2021). Each measurement, plants are taken 5 plant samples and then averaged to get results.

Data Analysis Techniques

The data of this study were analyzed with SPSS using the *One Way Anova* test. If the test results are significant, further test T will be continued to test the correctness of the hypothesis (Kartiman et al., 2018).

RESULTS AND DISCUSSION

In this study, not much was discussed about the effect of the growth of *D. striaenopsis* orchid plantlets on the size of culture bottles used by orchid cultivators or other tissue culture activities. However, there will be an effect, although the results are not significant and tend to be the same, on the growth of root length, leaf length and number

of leaves. The following table 1 is presented regarding the data of *D. striaenopsis* Orchids before the study and the results of the analysis regarding the average of each variable.

Table 1. The average of each variable *D. striaenopsis* Orchids before the study

No	Bottle 250 ml			Bottle 500 ml			Bottle 750 ml		
	Root Length (cm)	Leaf Length (cm)	Number of Leaves	Root Length (cm)	Leaf Length (cm)	Number of Leaves	Root Length (cm)	Leaf Length (cm)	Number of Leaves
1	2	2	3	1,7	2	3	1,5	4	1,7
2	1,5	2	3	1,5	1,5	4	2	3	2
3	1,5	2	3	1,4	2	6	2,5	3	2
4	1,5	2	4	1,5	1,7	5	1,5	3	2,5
5	1,5	2,4	2	2	2,5	3	1,6	3	2,6
6	2,5	2	3	1,5	1,5	3	1,5	3	2,4
7	1,5	2,5	4	1,5	1,5	2	0,8	5	1,5
8	3	2	5	1,4	1,3	3	1,8	3	2,5
9	0,5	2	4	0,8	1,8	3	0,9	3	2
10	1,5	1,5	2	1,5	1,5	3	1	3	3
11	1,3	1,8	3	1,5	2	3	1,5	4	1,5
12	1,9	2,8	3	2,4	1,4	3	2	3	2
13	1,8	2,3	2	1,5	1,5	4	1,5	3	2,2
14	1	2,3	2	1,5	2,5	3	1,6	4	2
15	1,5	1,8	3	2	1,9	3	1,5	3	2,5
16	2	2	3	1,7	2,3	3	1,8	3	2,5
17	1,5	2,4	3	1,5	2,5	3	2	2	2,5
18	2	3	3	2,2	2,5	3	3	2	2
19	2,5	2,3	2	1,8	2,7	3	1,5	3	2,4
20	2	2,2	3	2	3	3	1,3	3	2
Average	2	2	3	2	2	3	2	3	2

Based on the data in the table, the typical root length is 2 cm, the average leaf length is 2 cm, and in a 250 ml bottle there are 3 leaf blades. The average root length is 2 cm, the average leaf length is 2 cm, and in a 500 ml bottle there are 3 leaves. The average root length is 2 cm, the average leaf length is 3 cm, and there are 2 leaves in a 750 ml container. Furthermore, each bottle was treated and the development of each bottle was observed and the data on the results after treatment were described in the description below. The analysis carried out includes descriptive analysis, normality test, homogeneity test, ANOVA test, and T test. The following table is presented regarding the data of *D. striaenopsis* orchids after treatment.

Table 2. Data after treatment that has been obtained will be analyzed using the help of the SPSS program

No	Bottle 250 ml			Bottle 500 ml			Bottle 750 ml		
	Root Length (cm)	Leaf Length (cm)	Number of Leaves	Root Length (cm)	Leaf Length (cm)	Number of Leaves	Root Length (cm)	Leaf Length (cm)	Number of Leaves
1	2	2	6	4	3	6	3	4	6
2	1	1	7	2	1	6	5	7	8
3	3	3	4	3	2	6	5	3	8
4	2	2	6	4	3	6	2	3	7
5	4	4	3	5	6	8	4	4	10
6	4	4	6	1	1	6	6	6	8
7	2	1	5	5	3	5	6	4	8
8	5	5	6	3	3	4	6	7	9
9	3	5	4	2	4	6	4	2	8
10	1	2	5	2	2	6	7	5	7
11	3	3	7	4	4	7	6	4	10
12	1	2	5	3	4	7	5	3	6
13	3	4	3	5	5	5	5	4	8
14	2	1	4	6	6	5	5	5	8
15	3	3	5	2	2	8	6	6	9
16	3	3	5	5	5	6	4	3	7
17	5	2	6	1	3	7	2	4	8
18	4	2	5	5	4	7	6	4	9
19	3	3	4	4	5	5	3	5	8
20	3	3	4	2	4	4	5	4	7

The data obtained will be analyzed based on the same type of each bottle. In order, the analysis to be carried out is the length of the roots, the length of the leaves, and the number of leaves. The following are presented the results of analysis and interpretation results.

Table 3. Descriptive Analysis of Root Length (cm) of *D. striaenopsis* Orchid After Treatment.

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
bottle 250	20	2.8500	1.18210	.26433	2.2968	3.4032	1.00	5.00
bottle 500	20	3.4000	1.50088	.33561	2.6976	4.1024	1.00	6.00
bottle 750	20	4.7500	1.40955	.31519	4.0903	5.4097	2.00	7.00
Total	60	3.6667	1.56948	.20262	3.2612	4.0721	1.00	7.00

The average length of the roots on a 250 ml vial is 2.85. The average length of the roots on a 500 ml vial is 3.40. While the average length of roots in a 750 ml bottle is 4.75. Based on the results of the descriptive analysis, the highest average root length was obtained from a 750 ml bottle. The results showed that the average value of plantlet root length varied between treatments. This is because each plantlet has a unique bottle size. The volume of the bottle is used to determine the treatment that shows optimal growth. *D. striaenopsis* orchid seedlings are able to thrive in this environment because the medium is moist and the substrate is thick. The ability of plants to take nutrients from the soil is proportional to the quantity and length of their root system (Irsyadi, 2021; Latifah et al., 2017).

Table 4. Normality Test of Root Length (cm) of *D. striaenopsis* Orchid After Treatment.

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Bottle	**Statistic**	**Df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Root Length	bottle 250	.200	20	.034	.918	20	.090
	bottle 500	.175	20	.112	.922	20	.110
	bottle 750	.220	20	.012	.908	20	.057

From Table 4, the significance value of root length in the three bottles > 0.05, based on the results of decision making, because the significance value > 0.05, the data is normally distributed.

Table 5. Homogenesis Test of Root Length (cm) of *D. striaenopsis* Orchid After Treatment.

Levene Statistic	**df1**	**df2**	**Sig.**
1.471	2	57	.238

The significance value of the root length > 0.05 was obtained, based on the results of decision making, because the significance value > 0.05, the variants of the three bottles compared were the same or homogeneous.

Table 6. Anova Test Root Length (cm) of *D. striaenopsis* Orchid After Treatment

	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	38.233	2	19.117	10.174	.000
Within Groups	107.100	57	1.879		
Total	145.333	59			

Based on Anova's output, a significance value of < 0.05 was obtained, so it can be concluded that the average root length of the three bottles is significantly different. Because the results differ markedly between the three root length measures, there is a difference in bottle size and allows environmental factors to begin to follow, such as humidity (Indriani et al., 2019). Different root lengths will affect the growth of orchid plantlets which is the main factor of plant growth.

Table 7. Descriptive Analysis of Leaf Length (cm) of *D. striaenopsis* Orchid After Treatment

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
bottle 250	20	2.7500	1.20852	.27023	2.1844	3.3156	1.00	5.00
Bottle 500	20	3.5000	1.46898	.32847	2.8125	4.1875	1.00	6.00
bottle 750	20	4.3500	1.34849	.30153	3.7189	4.9811	2.00	7.00
Total	60	3.5333	1.47828	.19085	3.1515	3.9152	1.00	7.00

The average length of leaves on a 250 ml bottle is 2.75. The average length of leaves on a 500 ml bottle is 3.50. While the average length of leaves on a 750 ml bottle is 4.35. Based on the results of the descriptive analysis, the highest average leaf length was obtained from a 750 ml bottle. Due to the varying response to the growth of *D. striaenopsis* Orchid plantlets due to different treatments, changes in leaf length in the plantlets only begin to appear the next day. (Takatsuka et al., 2018) explain how, in addition to stretching of cell walls, microtubule reorganization, and vacuole growth also contribute to cell elongation.

Table 8. Normality Test of Leaf Length (cm) of *D. striaenopsis* Orchid After Treatment.

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Bottle	Statistic	Df	Sig.	Statistic	Df	Sig.
Leaf Length	bottle 250	.183	20	.079	.919	20	.095
	Bottle 500	.133	20	.200*	.948	20	.345
	bottle 750	.252	20	.002	.914	20	.074

The significance value of leaf length in the three bottles was obtained > 0.05, based on the results of decision making, because the significance value > 0.05, the data was normally distributed.

Table 9. Homogeneity Test of Leaf Length (cm) of *D. striaenopsis* Orchid After Treatment

Levene Statistic	df1	df2	Sig.
.446	2	57	.642

The significance value of leaf length > 0.05 was obtained, based on the results of decision making, because the significance value > 0.05, the variants of the three bottles compared were the same or homogeneous.

Table 10. Anova Test Orchid Leaf Length (cm) *D. striaenopsis* After Treatment

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	25.633	2	12.817	7.072	.002
Within Groups	103.300	57	1.812		
Total	128.933	59			

Based on Anova's output, a significance value of < 0.05 was obtained, so it can be concluded that the average leaf length of the three bottles is significantly different.

Table 11. Descriptive Analysis of *D. striaenopsis* Orchid Leaf Count After Treatment

					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
bottle 250	20	5.0000	1.16980	.26157	4.4525	5.5475	3.00	7.00
bottle 500	20	6.0000	1.12390	.25131	5.4740	6.5260	4.00	8.00
bottle 750	20	7.9500	1.09904	.24575	7.4356	8.4644	6.00	10.00
Total	60	6.3167	1.66206	.21457	5.8873	6.7460	3.00	10.00

The average number of leaves on a 250 ml bottle is 5.00. The average number of leaves on a 500 ml bottle is 6.00. While the average number of leaves in a 750 ml bottle is 7.95. Based on the results of the descriptive analysis, the highest average number of leaves was obtained from a 750 ml bottle. When photosynthesis is functioning properly, plants are able to produce sufficient amounts of oxygen and carbon dioxide, which in turn allows the development of new leaves (Saepudin et al., 2020). Plant media affects the equation of changes in the number of leaves of orchid plantlets *D. striaenopsis* Despite this according to studies, the number of leaves remains constant during treatment.

Table 12. Normality Test of Number of Leaves (cm) of *D. striaenopsis* Orchid After Treatment

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Bottle	Statistic	Df	Sig.	Statistic	Df	Sig.
Number of Leaves	bottle 250	.154	20	.200*	.929	20	.150
	bottle 500	.200	20	.035	.925	20	.126
	bottle 750	.232	20	.006	.914	20	.075

The significance value of the number of leaves in the three bottles > 0.05, based on the results of decision making, because the significance value > 0.05, the data is normally distributed.

Table 13. Test of Homogeneity of *D. striaenopsis* Orchid Leaf Count After Treatment

Levene Statistic	df1	df2	Sig.
.165	2	57	.849

The significance value of the number of leaves > 0.05 was obtained, based on the results of decision making, because the significance value > 0.05, the variants of the three bottles compared were the same or homogeneous.

Table 14. Anova Test Number of *D. striaenopsis* Orchid Leaves After Treatment

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	90.033	2	45.017	35.174	.000
Within Groups	72.950	57	1.280		
Total	162.983	59			

Based on Anova's output, a significance value of < 0.05 was obtained, so it can be concluded that the average number of leaves from the three bottles is significantly different. Based on the analysis above, the results of the analysis can be summarized in the following table 15.

Table 15. the results of the analysis based on 3 parameter

Parameters	Bottle 250 ml	Bottle 500 ml	Bottle 750 ml
Root Length	2,85 cm	3,40 cm	4,75 cm
Leaf Length	2,75 cm	3,50 cm	4,35 cm
Number of Leaves	5,00	6,00	7,95

These table presented above displays the average values obtained from each bottle. The order of ascending average order size is as follows: 250 ml bottles, followed by 500 ml bottles, and finally 750 ml bottles. From this it can be concluded that the difference in bottle size has a significant influence on the growth of *D. striaenopsis* Orchid plantlets. Based on these findings, the research hypothesis has been validated. Light is an environmental component that can affect the growth and development of *D. striaenopsis* orchids during in vitro culture. The quality, intensity, and duration of radiation have a significant impact on various physiological processes in plants (Yuniardi, 2020). The observed increase in plant height, number of leaves, and number of saplings indicates the capacity of the plantlets to grow and develop on the diverse planting substrates used. Utilizing VW media (Vacin and Went) in general results in a more pronounced growth response and increase in leaf count compared to other media. According to (Rosanti & Widianjaya, 2018) Orchid plantlets have underdeveloped roots, small stature, and fine root hair, so the thickness of the planting media used greatly affects its growth.

CONCLUSION

Based on the results of the discussion, it can be concluded that a 750 ml bottle with a VW media size (Vacint and Went) of 60 ml used in the tissue culture technique of *D. striaenopsis* Orchid is very effective to use even though the growth of plantlets does not occur significant differences, but within 3 months the plantlets of *D. striaenopsis* Orchids can grow in terms of root length, leaf length and number of leaves. Explant growth media can be influenced by environmental elements such as light, temperature, pH, humidity, thickness of solid media, as well as the position of bottles and containers.

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