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Induction of Rhizoctonia resistance to Odontoglossum ringspot virus (ORSV) infection on orchid leaf organ viability

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ABSTRACT

Orchid plants are in great demand by the public as ornamental plants that have economic value and the beauty of attractive flower shapes and colors, especially *Phalaenopsis* and *Dendrobium*. Related to this, conservation efforts are needed through cultivation. However, these efforts are often hampered by viral infections. One of the viruses that trigger inhibition of orchid cultivation that often appears is ORSV. Control efforts that are relatively safe and efficient can utilize mycorrhizae in orchids which play a role in increasing the absorption of plant nutrients. The use of *Phalaenopsis* and *Dendrobium* with the induction of *Rhizoctonia* sp. against ORSV is a very important alternative biofertilizer and biocontrol agent. The objectives of this study were 1) to determine the effectiveness of orchids induced by *Rhizoctonia* resistance, 2) to determine the viability of orchid leaf organs to ORSV infection, 3) to determine the viability of orchid root organs resulting from *Rhizoctonia* resistance to ORSV infection. This study was conducted in January 2021 – March 2021 at the Botanical 2 Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung. This study employed a completely randomized factorial with 6 treatments and 4 replications. The variable observed in this study was the effectiveness of mycorrhizae, leaf and root length, number of leaves and roots, and leaf width. The data obtained were homogenized using Levene's test and then analyzed by ANOVA and Tukey's further test at the 5% level. The results showed that the effectiveness of mycorrhizae occurred on the

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3rd day of incubation. In leaf organs, *Phalaenopsis amabilis* showed an increased response and *Dendrobium discolor* showed a decreased response in leaf length, width, and number. Meanwhile, in the root organ, *Dendrobium discolor* showed an increased response and *Phalaenopsis amabilis* showed a decreased response in root length and number of roots.

KEYWORDS
Orchids, *Dendrobium discolor, Phalaenopsis amabilis,* ORSV, *Rhizoctonia* sp., Biofertilizer.

INTRODUCTION

Orchids are ornamental plants that are in great demand in the world. Indonesia is a country that has a very large wealth of natural orchids. Schuiteman (2010) mentioned that there are more than 5,000 species of natural orchids in Indonesia. this number can still increase along with the number of islands in Indonesia whose natural orchid wealth has not been explored. Among the species found in Indonesia are *Dendrobium* and *Phalaenopsis*. All *Phalaenopsis* and some *Dendrobium* species are categorized in Appendix II (Khaterine, 2016).

Khaterine (2016) stated that direct and uncontrolled extraction of orchids in their natural habitat, illegal logging, forest fires, conversion of forests to plantations and for transmigration settlements, as well as global warming makes it increasingly difficult to get natural orchids in their natural habitat. Therefore, the preservation of natural orchids including *Dendrobium* and *Phalaenopsis* is very important to do. Currently, conservation efforts that can be done are through cultivation, but orchid cultivation efforts are often hampered by viral infections. One of them is *the Odontoglossum ringspot virus* (ORSV) which is the type of virus that is reported to infect the most and has the widest spread in the world. A previous study (Mahfut, 2021) showed that several natural orchids show variations in symptoms of ORSV induction, namely mosaic, streak, chlorotic, necrotic, and wilting leaf.

The spread of ORSV infection is known to be able to inhibit plant growth and resistance and reduce its aesthetic value periodically (Koh *et al*., 2014 *in* (Mahfut, 2021)). Currently, efforts to control the disease are still using pesticides which cause pollution and environmental damage. One alternative to minimize the environmental impact is biological control (Soelistijono, 2015). Therefore, mycorrhizal *Rhizoctonia* was used as a biological controller.

It is known that mycorrhizae have high activity in producing enzymes that can be used to control pathogens. Supported by previous research (Sutarman et al., 2019) that testing the ability of *Rhizoctonia* as a biofertilizer agent is usually close to its role as a biocontrol agent which explains the interrelationship between the suppression effect of pathogens and the effect of promoting plant growth and the emergence of plant resistance to pathogen attack.

LITERATURE REVIEW

Several previous studies have reported that the results of the infection of *Rhizoctonia* resistance in orchids (Soelistijono, 2014) are known to be effective in inhibiting the development of pathogens with DSI values ranging from 1.2 to 2.3; (Bilia et al., 2014) showed fluctuations in the increase in plant height, several leaves and number of plantlet roots at the 95% level.

METHODS

This study is experimental research, which is looking at the resistance of orchids induced by *Rhizoctonia* to ORSV induction. In this study, *Dendrobium* and *Phalaenopsis* orchid seedlings aged 3-4 months were used. The research design used in this study was a completely randomized design (CRD) arranged in a factorial (2x3) consisting of 6 treatments and 2 controls. Factor 1 is the type of orchid and factor 2 is the mycorrhizal and virus inoculation treatment. Each treatment was repeated 4 times, each replication consisted of 1 seed of *Phalaenopsis amabilis* and *Dendrobium discolor*. Thus, the total number of seeds used was 24. This study was carried out in several stages as follows:

a. Acclimatization of *Phalaenopsis amabilis* and *Dendrobium discolor* orchids.
b. *Rhizoctonia* rejuvenation.
c. Induction of *Rhizoctonia* on both orchids for 3 days.
d. Observation of changes in orchid leaves after being induced by *Rhizoctonia* for 1 week.
e. ORSV inoculation on *Phalaenopsis amabilis* and *Dendrobium discolor* for 1 month.
f. Analysis of the growth of *Phalaenopsis amabilis* and *Dendrobium discolor* orchids in the form of quantitative data based on the length, number, and width of the leaves.

Instrument

The instruments used in this study were a glass cup, magnetic stirrer, hot plate, autoclave, Erlenmeyer, beaker glass, petri dish, scales, freezer, mortar and pestle, gloves, tissue, label paper, disease sample collection data, books, and reference journals.

The materials used in this study were bottled *Phalaenopsis amabilis* plantlet, bottled *Dendrobium discolor* plantlet, *moss Sphagnum* (planting medium), *Potato Dextrose Agar* (PDA) medium powder, *Odontoglossum ringspot virus* (ORSV) inoculum, *Rhizoctonia* inoculum, carborundum, alcohol 70%, phosphate buffer solution, and sterile distilled water.

Data analysis

Data obtained from the growth of *Phalaenopsis amabilis* and *Dendrobium discolor* orchids during the *Rhizoctonia* and ORSV inoculation treatment in the form of quantitative data obtained from each parameter homogenized using the Levene test and then analyzed using analysis of variance at the 5% level of significance and further test with the Tukey test at the level of 5%.

RESULTS

Based on the results of research with mycorrhizal induction and virus inoculation on *Phalaenopsis amabilis* and *Dendrobium discolor* showed significant differences in leaf length, number, and width. The results of the data analysis can be seen in Table 1, Table 2, and Table 3.

Analysis of Leaf Length Tukey Test

Table 1. Categories on leaf length

Week of Observations	**Factor B= species**	**Factor A = Treatment**			***Marginal mean***
		M	V	MV	
0	*Phalaenopsis*	4.145±0.24 ab	4.265±0.36 ab	5.227±0.56 a	4.545a
	Dendrobium	3.302±0.35 b	3.775±0.33 ab	4.422±0.49 ab	3.833b
	Marginal mean	3.723a	4.02b	4.824bc	
	HSD Cell [0.05]	= 1.82 ; colums[0.05]	= 1.03 ; rows[0.05] = 0.69		
1	*Phalaenopsis*	4.24±0.26 ab	4.29±0.35 ab	5.28±0.58 a	4.603a
	Dendrobium	3.21±0.4 b	3.80±0.34 ab	4.60±0.5ab	3.87b
	Marginal mean	3.725 a	4.04 ab	4.94 b	
	HSD Cell [0.05]	= 1.88 ; colums[0.05]	= 1.07 ; rows[0.05] = 0.72		
2	*Phalaenopsis*	3.61±0.7 a	3.6±0.88 a	5.14±0.74 a	4.116 a
	Dendrobium	2.78±0.24 a	2.662±0.16 a	3.722±0.72 a	3.054 a
	Marginal mean	3.195 a	4.931 b	4.431 ab	
	HSD Cell [0.05]	= 2.87 ; colums[0.05]	= 1.63 ; rows[0.05] = 1.09		
3	*Phalaenopsis*	3.57±0.75 a	3.61±0.89 a	5.19±0.73 a	4.123 a
	Dendrobium	2.83±0.27 a	2.66±0.16 a	3.77±0.73 a	1.852 b
	Marginal mean	3.2 a	3.135 a	4.48 a	
	HSD Cell [0.05]	= 2.92 ; colums[0.05]	= 1.65	; rows[0.05] = 1.11	
4	*Phalaenopsis*	3.37±0.65 a	3.61±0.89 a	4.04±0.54 a	3.675 a
	Dendrobium	2.38±0.26 a	2.07±0.44 a	3.35±0.46 a	2.605 b
	Marginal mean	2.877 a	2.842 a	3.701 a	
	HSD Cell [0.05]	= colums[0.05]	= 1.47	; rows[0.05] = 0.98	

Description: The values followed by the same letter are not significantly different at the 5% level.

Based on Table 1, the Tukey test at a 5% significance level was carried out. It can be seen that the *Phalaenopsis amabilis* and *Dendrobium discolor* orchids statistically showed a significant difference. The two orchids showed differences in leaf length parameters. This happened because in week 0 the Mycorrhizal (M), Virus (V), and Mycorrhizal virus (MV) inoculations had not been carried out. These two orchids have non-uniform sizes. In *Phalaenopsis amabilis* tend to have a broad leaf diameter and not so long while *Dendrobium discolor* tends to have narrow and longleaf diameter.

At week 1, the leaves on *Phalaenopsis* showed a higher leaf length of 4.603 compared to that of *Dendrobium* which was 3.87. This shows that mycorrhizae have started to play their role in helping the growth of leaf length. In week 2, it was found that the *Phalaenopsis amabilis* and *Dendrobium discolor* orchids statistically showed a significant difference in the treatment of mycorrhizae and viruses. The effect of virus inoculation (V) was more effective than the administration of mycorrhizal (M) or mycorrhizal virus (MV). Meanwhile, when viewed based on the type of orchid, the two plants did not show a significant difference in leaf length.

Furthermore, in the 3rd week, it can be seen that the *Phalaenopsis* and *Dendrobium* orchids did not statistically show a significant difference in the Mycorrhizal (M) and virus (V), and Mycorrhizal Virus (MV) treatments. Previously, in the 2nd week, the role of the virus was effective, but in the 3rd week, it showed a decrease. This indicates that mycorrhizae have shown their function as biofertilizer agents in the growth of leaf length. Based on the type of orchid, the two plants showed significant differences. *Phalaenopsis amabilis* has more leaf length increase than *Dendrobium discolor*. In the 4th week, it was known that statistically orchid plants did not show any significant differences in the treatment of Mycorrhizal (M) and Virus (V), and Mycorrhizal Virus (MV). This shows that the three treatments at week 4 have not yet shown their effectiveness again. However, there is a significant difference in its type. Between two orchids, *Phalaenopsis amabilis* showed more leaf length increase than *Dendrobium discolor*. The fluctuations in weeks 0 and 4 are directly shown in Figure 1.

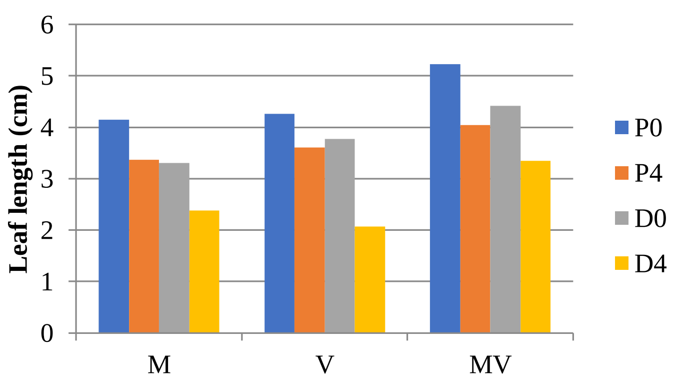

Figure 1. Comparison Graph of *Phalaenopsis* and *Dendrobium*. Description: *Phalaenopsis* week 0 (P0), *Phalaenopsis* week 4 (P4), *Dendrobium* week 0 (D0), *Dendrobium* week 0 (D4).

Analysis of Tukey's test number of leaves

Table 2. Categories on the number of leaves

Week of Observations	**Factor B= Type**	**Factor A = Treatment**			***Marginal mean***
		M	V	MV	
0	*Phalaenopsis*	4.75±1.03 a	4.75±0.63 a	4.75±0.75 a	4.75 a
	Dendrobium	5.75±0.63 a	3.75±0.48 a	4.75±0.63 a	4.75 a
	Marginal mean	5.25 a	4.25 a	4.75 a	
	HSD Cell [0.05]	= 3.21 ; colums[0.05]	= 1.82	; rows[0.05] = 1.22	
1	*Phalaenopsis*	4.75±1.03 a	4.75±0.63 a	4.75±0.75 a	4.75a
	Dendrobium	5.75±0.63 a	3.75±0.48 a	4.75±0.63 a	4.75a
	Marginal mean	5.25a	4.25a	4.75a	
	HSD Cell [0.05]	= 3.21 ; colums[0.05]	= 1.82	; rows[0.05] = 1.2	
2	*Phalaenopsis*	3.5±0.65 a	3.5±0.65 a	4.5±0.65 a	3.833 a
	Dendrobium	5.0±0.41 a	4.25±0.48 a	4.5±0.65 a	4.583 a
	Marginal mean	4.25 a	3,875 a	4.5 a	
	HSD Cell [0.05]	= 2.64 ; colums[0.05]	= 1.5	; rows[0.05] = 1.01	
3	*Phalaenopsis*	3.25±0.63 a	3.5±0.65 a	4.5±0.65 a	3.75 a
	Dendrobium	5.0±0.41 a	4.25±0.48 a	4.5±0.65 a	4.583 a
	Marginal mean	4.125 a	3,875 a	4.5 a	
	HSD Cell [0.05]	= 2.63 ; colums[0.05]	= 1.49	; rows[0.05] = 1	
4	*Phalaenopsis*	4±0.41 a	4±0.41 a	3±0 a	3.66 a
	Dendrobium	4±0 a	3±0 a	4±0 a	3.66 a
	Marginal mean	4a	3.5 a	3.5 a	
	HSD Cell [0.05]	= 1.06 ; colums[0.05]	= 0.6	; rows[0.05] = 0.4	

Description: The values followed by the same letter are not significantly different at the 5% level.

Based on table 2 on the Tukey test at a 5% significance level which was carried out in week 0, it can be seen that the *Phalaenopsis amabilis* and *Dendrobium discolor* orchids did not show statistically significant differences. The two orchid plants did not show a significant difference in the number of leaves. This happened because, in week 0, the Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV) inoculations had not been carried out. These two orchid plants have almost the same size. *Phalaenopsis* and *Dendrobium* tend to have the same number of leaves ranging from 4-5 strands.

In the 1st week, it was found that the *Phalaenopsis amabilis* and *Dendrobium discolor* orchids did not show statistically significant differences. The two orchid plants did not show a significant difference in the number of leaves. This happened because only mycorrhizal (M) inoculation was carried out and no virus (V) was given. At 2nd week, it was found that *Phalaenopsis* and *Dendrobium* did not show statistically significant differences. The two plants did not show a significant difference in the number of leaves. This indicates that the administration of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV) did not significantly increase the number of leaves.

Furthermore, in the 3rd week, it was known that the *Phalaenopsis* and *Dendrobium* orchids did not statistically show any significant differences. The two orchid plants did not show a significant difference in the number of leaves. This indicates that the administration of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus

(MV) did not significantly increase the number of leaves. In the 4th week, it was found that *Phalaenopsis* and *Dendrobium* orchids did not statistically show any significant difference in the number of leaf parameters. This shows that the administration of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV) did not have a significant effect on the increase in the number of leaves. Direct fluctuations in the number of leaves in week 0 and week 4 are presented in Figure 2.

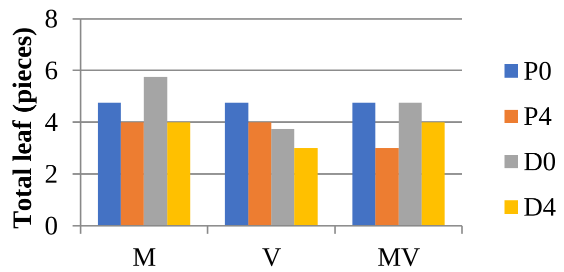

Figure 2. Comparison Graph of *Phalaenopsis* and *Dendrobium* Leaf Numbers. Description: *Phalaenopsis* week 0 (P0), *Phalaenopsis* week 4 (P), *Dendrobium* week 0 (D0), *Dendrobium* week 0 (D4).

Analysis of leaf width tukey test

Table 3. Categories on leaf width

Week of Observations	**Factor B= Type**	**Factor A = Treatment**			***Marginal mean***
		M	V	MV	
0	*Phalaenopsis*	1.54±0.26 a	1.8±0.09 a	2.02±0.24ab	1.78 a
	Dendrobium	0.78±0.09 b	0.85±0.09 b	1.05±0.04 b	0.89 b
	Marginal mean	1.16a	1.325a	1.53a	
	HSD Cell [0.05] = 0.71; colums[0.05] = 0.4 ; rows[0.05] = 0.27				
1	*Phalaenopsis*	1.57±0.26 a	1.81±0.09 a	2.04±0.24ab	1.8 a
	Dendrobium	0.83±0.09 b	0.85±0.09 b	1.14±0.04 ab	0.94 b
	Marginal mean	1.2 a	1.33 a	1.59 a	
	HSD Cell [0.05] = 0.72; colums[0.05] = 0.41 ; rows[0.05] = 0.28				
2	*Phalaenopsis*	1.51±0.33 ab	1.27±0.37 ab	2.04±0.27 a	1.60 a
	Dendrobium	0.83±0.05 b	0.71±0.07 b	1.03±0.08 b	0.85 b
	Marginal mean	1.17 a	0.99 a	1.53 a	
	HSD Cell [0.05] = 1.14 ; colums[0.05] = 0.65 ; rows[0.05] = 0.44				
3	*Phalaenopsis*	1.51±0.36 ab	1.6±0.25 a	1.99±0.23 ab	1.7 a

	Dendrobium	0.87±0.07 b	0.80±0.05 b	1.07±0.09 b	0.91 b
	Marginal mean	1.19 a	1.2 a	1.53 a	
	HSD Cell [0.05] = 0.94 ; colums[0.05] = 0.53 ; rows[0.05] = 0.36				
4	*Phalaenopsis*	1.54±0.36 a	1.2±0.32 a	1.71±0.4 a	1.48 a
	Dendrobium	0.72±0.06 a	0.72±0.06 a	1.02±0.1 a	0.82 b
	Marginal mean	4.26 a	0.96 b	1.36 b	
	HSD Cell [0.05] = 1.17 ; colums[0.05] = 0.66 ; rows[0.05] = 0.45				

Description: The values followed by the same letter are not significantly different at the 5% level.

Based on Table 3 on Tukey's test at a 5% significance level which was carried out in week 0, it was known that the *Phalaenopsis amabilis* and *Dendrobium discolor* statistically showed a significant difference. The two orchid plants showed differences in leaf width parameters. However, based on the interaction in week 0, mycorrhizae (M), virus (V), and mycorrhizal virus (MV) had not been inoculated. These two orchid plants had non-uniform sizes. *Phalaenopsis* tends to have a wider diameter while *Dendrobium* tends to have a narrow diameter.

In the 1st week, it was found that the *Phalaenopsis amabilis* and *Dendrobium discolor* orchids did not show statistically significant differences. The treatment of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV) did not show any difference, because only mycorrhizal inoculation was performed. This shows that the role of mycorrhizae has not been seen at week 1. However, the real difference can be seen based on the type. Among the two orchids, *Phalaenopsis* maintains the growth of leaf width more than *Dendrobium.* In the 2nd week, it was found that the *Phalaenopsis* and *Dendrobium* orchids did not show statistically significant differences in the treatment of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV), there was no significant difference. This shows that mycorrhizae do not play an effective role in playing their functions. However, based on the type between the two orchids, *Phalaenopsis* maintained the growth of leaf width more than *Dendrobium*.

Furthermore, in the 3rd week, it was found that the *Phalaenopsis* and *Dendrobium* orchids did not statistically show any significant differences. In the treatment of Mycorrhizal (M), Virus (V), and Mycorrhizal Virus (MV), there was no significant difference. This shows that mycorrhiza (M) and virus (V) have not seen their effective role at week 3. However, based on the type between the two orchids, *Phalaenopsis* maintained the growth of leaf width more than *Dendrobium*. In the 4th week, it was known that the *Phalaenopsis* and *Dendrobium* orchids statistically showed a significant difference. In the treatment of Virus (V) and Mycorrhizal Virus (MV), the higher value was 0.96 and 1.36 compared to the Mycorrhizal (M) treatment, which was 4.26. This shows that mycorrhizae are not able to play their function if given Mycorrhizal Virus (MV) the effectiveness of these mycorrhizae might be clearly visible when there is a viral infection. Based on the type between the two orchids, *Phalaenopsis amabilis* maintained leaf width growth more than *Dendrobium discolor*.

Directly fluctuations in leaf width at week 0 and week 4 are shown in Figure 3.

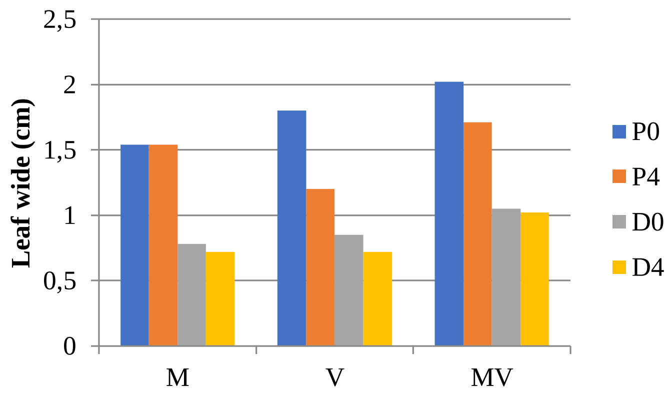

Figure 3. Comparison Graph of *Phalaenopsis* and *Dendrobium* Leaf Width. Description: *Phalaenopsis* week 0 (P(0), *Phalaenopsis* week 4 (P), *Dendrobium* week 0 (D0), *Dendrobium* week 0 (D4).

DISCUSSION

Leaf length

Root length observation data at week 0 and week 4 showed a significant difference in leaf length that had been treated. At week 0 when compared to week 4, there was a decrease in leaf length. It is expected that the decrease in the average leaf length occurred due to 2 factors, namely 1) shrinkage caused by virus inoculation and 2) morphological genetics.

The leaves inoculated with the virus experience shrinkage; this causes there to be no place for the leaves to continue to carry out the photosynthesis process. Thus, no glucose is produced for respiration as a result the cells are unable to regenerate. Cells that do not regenerate over time might die and fluid might come out of the cell wall. Thus, the leaf organ shrinks.

Lakani (2015) suggested that at the beginning of ORSV infection, it would cause a hypertensive reaction (HR) which is known that cells experiencing HR might collapse by showing changes in the membrane. Early indications that are interpreted as the occurrence of membrane dysfunction are electrolyte leakage and loss of cell function resulting in plasmolysis.

Gunawan (1992) explains that carbohydrates are one of the components needed by various kinds of plants to fulfill their carbon and energy needs. Glucose is a carbon source that is often used. Glucose plays a role in producing energy in the respiration process. Moreover, glucose plays an important role in plant vegetative growth which includes the development of new roots, leaves, and stems. This happens because at the time of cell division large amounts of carbohydrates are needed to build cell walls containing protoplasm and cellulose (Fajar et al., 2019).

Based on the species, Phalaenopsis showed an increase in leaf length compared to Dendrobium. This is presumably due to the influence of morphology. Phalaenopsis leaves have a thicker texture and surface area while Dendrobium leaves have a thinner texture and narrow surface. (Tienpont et al., 2000) suggests that the larger the leaf surface area, the faster the photosynthesis and transpiration process to produce more food. The food is used to increase plant growth.

Number of leaves

Observation data on the number of leaves at week 0 and week 4 showed a significant difference in the number of leaves that had been treated. At week 0, compared to week 4, there was a decrease in the number of leaves. This happens because there is a lack of water supply from the root organs which affects the photosynthesis process. As a result, there is no glucose formation that enables the cells to experience shrinkage (plasmolysis). Long-term shrinkage might cause the leaf organs to dry up and die, thus affecting the average number of leaves. It is suspected that the water absorption in the root organs is low. Thus, it can affect the formation of new leaf blades. This little water absorption can be attributed to the presence of virus inoculation treatment on leaf organs which causes damage to the chloroplast which results in the photosynthesis process not going well. Thus, the plant does not have glucose to carry out the respiration process. This is in accordance with the statement of (Takahashi et al., 2019) that plants that have been infected with ORSV might affect the quality and power of plant growth.

The number of leaves is one indicator of plant growth that can be used as supporting data to explain the growth process that occurs (Hartati, 2010). According to Mengel and (Mengel & Kirkby, 1978) suggesting that the availability of water is too low might cause plants to be unable to absorb nutrients and can cause stress because they cannot carry out photosynthesis properly.

Leaf growth is often associated with the process of developing a plant. Good growth is usually followed by leaves that undergo photosynthesis smoothly. One of the important elements is that there is a lot of H_2O to help the formation of carbohydrates. If the carbohydrate needs are met, the cell division process will run well too. This is in accordance with the opinion of (Lemoine et al., 2013) who stated that water is needed by plants for the formation of carbohydrates, maintaining hydration of protoplasmic water (turgor), and tools for plant translocation and nutrient translocation. Lack of water can cause reduced cell division and cell elongation. Therefore, plant growth is disrupted.

Leaf width

Leaf width observation data at week 0 to week 4 showed a significant difference in leaf width that was treated. At week 0, when compared to week 4, there was a decrease in the average leaf width. This happens because of rotten leaves. It is suspected that the humidity in the sterile moss media is very high, causing a humid place. This is in accordance with (Huber et al., 2012) who stated that damage to plants such as leaf fall or wilting is not a result of plasma administration but is due to unsuitable environmental conditions. Orchid leaves can shrivel or rot due to temperature, humidity, or an inappropriate growing location.

However, if the type between the two orchids indicates that Phalaenopsis amabilis is better at maintaining leaf width growth than Dendrobium discolor. It is expected that there is a morphological influence on each species. (Sitompul & Guritno, 1995) suggested that leaf morphology can provide important information for the process of photosynthesis. One of the morphological properties that has received much attention is related to the reception of the quantity of solar radiation. The amount of radiation quantity is usually interpreted as a limiting factor for plant growth.

Phalaenopsis has a wider leaf width while Dendrobium has a narrow leaf volume. This is thought to be related to the process of photosynthesis that occurs on the leaf surface. Photosynthesis can occur when there are nutrients, light, and H2O. This H2O is obtained from the absorption of the root system in a plant. The increase in H2O in plants requires large amounts of water to maintain greater growth and help the process of greater evaporation of moisture.

Sitompul (1995) explains that there is a change in the volume of certain plants or plant organs due to changes in their water content in accordance with the daily cycle of environmental changes. Environmental conditions can change from time to time. The body space of a plant after a long period of lack of water might not be the same as that which gets enough water.

In addition to H2O, orchids also need to pay attention to the distribution of light for the needs of photosynthesis to run well. Sitompul (1995) suggested that the distribution of light in the plant canopy is determined by the canopy architecture which includes the shape, position angle, and leaf distribution pattern. Plants with narrow or curled leaves, erect and scattered will receive more light than plants with other leaf shapes and positions.

CONCLUSION

Based on the results of the research that has been done, it can be concluded that the leaf organ viability of *Phalaenopsis amabilis* leaves has increased in leaf length of 4.2 cm, leaf width of 1.6 cm, and a number of leaves of 4. Meanwhile, *Dendrobium discolor* has a decrease in leaf length of 3.0 cm, leaf width of 0.8 cm, and the number of leaves of 4.

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