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# Variation of resistance response of orchidsinducedby Rhizoctonia againstthe infection of Odontoglossum ringspot virus (ORSV) based on percentage of disease development

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## ABSTRACT

Orchid is one of the largest groups of flowering plants that are in great demand bysociety. Besides, the various flowers with a long vase life, the price of orchids is also stable and affordable. Phalaenopsis and Dendrobium are the most popular types of orchids. To anticipate this, orchid cultivation needs to be improved. However, orchid cultivation is not always accompanied by the effort of disease prevention, particularly those caused by viruses. The virus that most infects orchids is Odontoglossum ringspot virus (ORSV). Symptoms that appear on the leaves are chlorosis, mosaic with a pattern of lines, circles, and necrotic rings/rings. Control of viral infections can utilize organisms that are able to induce resistance, namely mycorrhizae. Mycorrhizae will penetrate into the root cortex tissue and provide nutrients for the orchid. Mycorrhizae that are quite often found are Rhizoctonia and are applied by induction to orchids. Induction was undertaken by planting orchids in Rhizoctonia inoculum until anatomically a peloton structure (solid coils) was formed on the orchid roots. The aim of this study was to study the response of orchid plants in the form of percentage incidence and intensity of disease and the level of plant resistance to ORSV infection in Phalaenopsis amabilis and Dendrobium discolor which had been induced by Rhizoctonia. This research was conducted at the Laboratory of Botany, Biology, FMIPA, Universitas Lampung, using a factorial completely randomized design (CRD). Factor 1 was the type of orchid and factor 2 was mycorrhizal induction, virus inoculation, and a combination of both with 4 replications. The finding indicated that Phalaenopsis amabilis was more susceptible to ORSV infection than Dendrobium discolor based on a higher incidence and intensity of disease. Mycorrhizal induction and virus inoculation (MAV) in Dendrobium discolor showed the increase of resistance response compared to Phalaenopsis amabilis.

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## INTRODUCTION

Orchid is one of the largest groups of flowering plants that are in great demand by the society since they have a variety of flowers, long vase life and high economic value. The shape and color of the flowers and the unique characteristics of orchids are the main attraction for consumers. The popularity of orchids continues to increase, especially Dendrobium and Phalaenopsis species that dominate the Indonesian market (Bey and Syafii, 2005). To meet the market needs, the cultivation of orchid is needed.

However, there are obstacles in orchid cultivation, namely viral infections, one of which is Odontoglossum ringspot virus (ORSV) with the widest spread in the world. The most common symptoms can be mosaic, necrotic, and chlorotic (Mahfut et al., 2019). Viral infection is highly dependent on the type of virus that infects, the cultivar of the host plant, and environmental conditions. The ORSV infection can inhibit plant growth and resistance, as well as reduce aesthetic value and marketability regularly (Koh et al., 2014). The viral infections can also lead to inhibition or disruption of physiological activities, morphological abnormalities, and can even cause premature death of some or all plants (Agrios, 2005).

One of the biological control efforts against pathogens is to utilize biological agents such as mycorrhizae which aims to increase the plant resistance. One type of biological control is the mechanism of resistance induction. The mycorrhizae that isquite often found includesRhizoctonia applied by induction to orchids. The mechanism of resistance in orchids induced by Rhizoctonia is the formation of peloton structures, peroxidase, and lignification (Soelistijono et al., 2017). The symbiosis between Rhizoctonia and orchid root tissue is carried out in the presence of hyphae that enters through the velamen to the exodermis to form hyphae rolls in which it can penetrate the root cortex tissue (Ningsih et al., 2014).

## LITERATURE REVIEW

Soelistijono (2015) reported that the treatment of Rhizoctonia mycorrhiza isolated from Phalaenopsis amabilis affected the attack of Fusarium sp. The treatment without Rhizoctonia mycorrhizae (M0) pointed out a higher intensity of disease attack, with a total of27.77% compared to the preinoculated Rhizoctonia mycorrhizae (M1 and M2), 16.66% and 0.00% respectively. This could be seen that the administration of Rhizoctonia mycorrhiza could reduce the severity of the disease (DSI) and increase the resistance of orchids to pathogens. Jiang et al. (2015) also proved that inoculation of mycorrhizal Rhizoctonia sp. on the orchid Anoectochilus formosanus was proven to provide a 44-91% better seed germination rate than without mycorrhizal Rhizoctonia sp.

## METHODS

The research is descriptive and experimental in naturewhich aimedto provide a clearer overview of a disease symptom and determine the effect of certain treatments within controlled conditions. The study adopteda factorial Completely Randomized Design (CRD) pattern. Factor 1 was the type of orchid and factor 2 was the mycorrhizal induction, virus inoculation, and a combination of both. Each treatment was repeated fourtimes witha total of 24 treatments, each treatment combination consisted of 1 plant Phalaenopsis amabilis and Dendrobium discolor in separate pots. There was an out of design treatment, it consisted of a positive

control of Phalaenopsis amabilis and Dendrobium discolor. This study wascarried out in several stages as follows:

a. Orchid acclimation of Phalaenopsis amabilis and Dendrobium discolor.

b. Rhizoctonia rejuvenation.

c. Induction of Rhizoctonia on both orchids for three days.

d. Observation of orchid leaf changes after being induced by Rhizoctonia for oneweek.

e. The inoculation of ORSV on orchids of Phalaenopsis amabilis and Dendrobium discolor for onemonth.

f. Analysis of disease development (intensity and incidence of disease) and the level of resistance ofPhalaenopsis amabilis and Dendrobium discolor orchids.

## *Instruments*

The study used several tools includingglass cups, magnetic stirrer, hot plate, autoclave, erlenmeyer, beaker glass, petri dish, balance, freezer, mortar and pestel, gloves, tissue, label paper, disease sampling data.

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

## *Data analysis*

1. Disease incidence analysis

$$KP = \frac{a}{b} x\ 100\%$$

(Suradji, 2003)

Description:

a : total infected plants

b : total number of plants

2. Disease intensity analysis

$$I = \frac{\sum ( n \times v )}{z \times N} \times 100\%$$

Description:

I : Disease intensity

n : Number of infected leaf

v : Scale of each infection category

z : Highest scale number (100%)

N : Number of total leaves observed

Rahardjo and Suhardi (2008) reported that this analysis can be undertaken with the following formula:

**Table 1.** Categories of disease severity on leaves

| Scale | Category | Symptoms |
|---|---|---|
| 0 | Healthy Plant | There is no symptom or infection |
| 1 | Very Light | Leaf is infected between> 0% - 10% |
| 2 | Light | Leaf is infected between> 10% - 20% |
| 3 | Severe Enough | Leaf is infected between> 20% - 40% |
| 4 | Severe | Leaf is infected between> 40% - 60% |
| 5 | Very Severe | Leaf is infected between> 60% |

3. Analysis of plant resistance levels

**Table 2.** Plant resistance to the infection of ORSV

| Resistance Level | Host Plant Reaction | |
|---|---|---|
| | Symptom on the leaf | Disease occurrence |
| Very Resistant | There is no symptom | - |
| Resistant | Chlorotic | + |
| Rather Resistant | Light mosaic | + |
| Tolerant | Clear mosaic | ++ |
| Susceptible | Withered leaf | ++ |
| Very Susceptible | Necrotic and roll leaf | ++ |

# RESULTS

## *Analysis of disease development*

Based on the findingswith mycorrhizal induction and virus inoculation on Phalaenopsis amabilis and Dendrobium discolor, it indicates that there were differences in disease incidence and disease intensity. The results of the calculation of disease incidence (KP) in both orchid plants with virus inoculation (AV) and mycorrhizal induction and virus inoculation (MAV) treatments can be seen in Table 3 and the calculation of Disease Intensity (IP) in Table 4.

**Table 3.** Calculation of disease incidence on Phalaenopsis amabilis and Dendrobium discolor

| Repetition | Disease Occurrence (%) of Each Treatment | | | |
|---|---|---|---|---|
| | $A_1V$ | $MA_1V$ | $A_2V$ | $MA_2V$ |
| 1 | 40 | 50 | 66 | 66 |
| 2 | 66 | 33 | 25 | 20 |
| 3 | 50 | 50 | 33 | 40 |
| 4 | 66 | 33 | 40 | 20 |
| Total | 222 | 166 | 164 | 146 |
| Average (%) | 55,5 | 41,5 | 41 | 36,5 |

Description : A1 : Phalaenopsis amabilis, A2 : Dendrobium discolor, V : Virus, MV : Mycorrhizal virus

Table 3 illustrates that the average incidence of disease in the treatment of virus inoculation (AV) and minoriza virus (MAV) inoculation from each replication. In the treatment of virus inoculation (A1V) of 55.5%; mycorrhizal induction and inoculation and virus (MA1V) treatment of 41.5%; Virus inoculation (A2V) treatment is 41% and mycorrhizal induction treatment and virus inoculation (MA2V) is 36.5%. The highest disease incidence is found in Phalaenopsis amabilis without mycorrhizal treatment and the lowest disease incidence is in mycorrhizal-induced Dendrobium dyscolor.

**Table 4.** Calculation of disease intensity on Phalaenopsis amabilis and Dendrobium discolor

| Repetition | Disease Intensity (%) of Each Treatment | | | |
|---|---|---|---|---|
| | $A_1V$ | $MA_1V$ | $A_2V$ | $MA_2V$ |
| 1 | 50 | 60 | 60 | 25 |
| 2 | 80 | 67,5 | 20 | 30 |
| 3 | 65 | 50 | 40 | 50 |
| 4 | 77,5 | 65 | 30 | 10 |
| Total | 272.5 | 242,5 | 150 | 115 |
| Average (%) | 68,125 | 60,63 | 37,5 | 28,75 |

Description : A1 : Phalaenopsis amabilis, A2 : Dendrobium discolor, V : Virus, MV : Mycorrhizal virus

Based on Table 4, it can be seen that the average disease intensity in the viral inoculation (AV) treatment and mycorrhizal induction and virus inoculation (MAV) treatment from each replication. In the treatment of virus inoculation (A1V) of 68.125%; mycorrhizal induction and virus inoculation (MA1V) treatment is 60.63%; Virus inoculation (A2V) treatment is 37.5% and mycorrhizal induction treatment and virus inoculation (MA2V) is 28.75 %. The results of the calculation of disease intensity show a similar pattern, the highest value is found in Phalaenopsis amabilis without mycorrhizal treatment (A1V) and the lowest in Dendrobium dyscolor given mycorrhiza (MA2V). The disease progression based on the calculation of disease incidence and disease intensity is presented in Figure 1.

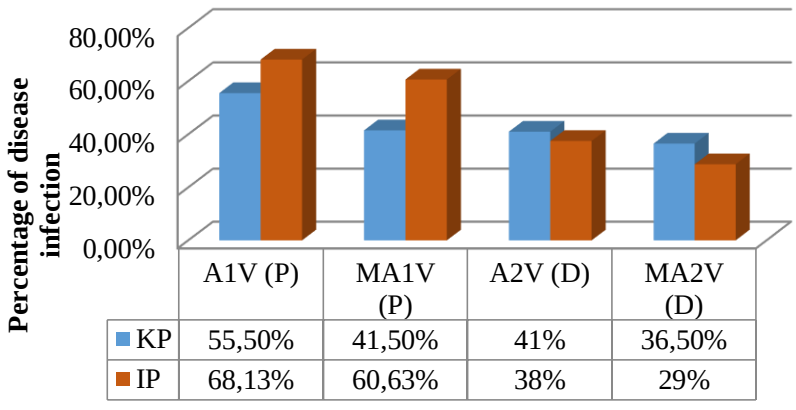


**Figure 1.** Observation of disease development on Phalaenopsis amabilis and Dendrobium discolor orchidsinfected with ORSV

Based on Figure 1, it is clearthat the highest incidence of disease and disease intensity is in Phalaenopsis amabilis (A1V) with a KP of 55.5% and an IP of 68.13%,followed by Phalaenopsis amabilis (MA1V) with a KP of 41.5% and an IP of 60 ,63%. Further, in Dendrobium discolor (A2V) orchids with a KP of 41% and an IP of 38%, the lowest KP and IP percentages found in Dendrobium discolor (MA2V)was 36.5% and 29% respectively. It can be seen that Phalaenopsis amabilis is more infected with ORSV than Dendrobium discolor since it has the highest calculation value, both in terms of disease incidence and disease intensity.

## *Analysis of plant resistance levels*

Based on the analysis of the level of plant resistance, it is discovered that the Phalaenopsis amabilis and Dendrobium discolor orchids show different variations in response. The overall level of resistance in both orchids can be seen in Table 5 and Table 6.

**Table 5.** Resistance levels of Phalaenopsis amabilis on ORSV infection

| Treatment | Leaf | Resistance Level | Disease Occurrence |
|---|---|---|---|
| **$A_1VU_1$** | **V1** | Tolerant | ++ |
| | **V2** | Very Susceptible | ++ |
| **$A_1VU_2$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$A_1VU_3$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$A_1VU_4$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$MA_1VU_1$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$MA_1VU_2$** | **V1** | Tolerant | ++ |
| | **V2** | Very Susceptible | ++ |
| **$MA_1VU_3$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$MA_1VU_4$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |

Description : - : no disease incidence, + : disease incidence 0%< x 40%, ++ : disease incidence 41% x < 100%

Table 5 indicates that Phalaenopsis amabilis shows a very susceptible level of resistance in almost all treatments and the tolerant resistance response is merely found in the virus inoculation (V1 A1VU1) and

mycorrhizal virus (V1 MA1VU2) treatment. This indicates that all of these orchids have disease incidence values in the range of 41 - 100% and are categorized as ++.

**Table 6**. Resistance levels of Dendrobium discolor on ORSV infection

| Treatment | Leaf | Resistance Level | Disease Occurrence |
|---|---|---|---|
| **$A_2VU_1$** | **V1** | Very Susceptible | ++ |
| | **V2** | Very Susceptible | ++ |
| **$A_2VU_2$** | **V1** | Tolerant | ++ |
| | **V2** | Very Resistant | - |
| **$A_2VU_3$** | **V1** | Rather Resistant | + |
| | **V2** | Very Susceptible | ++ |
| **$A_2VU_4$** | **V1** | Tolerant | ++ |
| | **V2** | Rather Resistant | + |
| **$MA_2VU_1$** | **V1** | Resistant | + |
| | **V2** | Very Susceptible | ++ |
| **$MA_2VU_2$** | **V1** | Very Susceptible | ++ |
| | **V2** | Sangat Tahan | - |
| **$MA_2VU_3$** | **V1** | Very Susceptible | ++ |
| | **V2** | Toleran | ++ |
| **$MA_2VU_4$** | **V1** | Agak Tahan | + |
| | **V2** | Sangat Tahan | - |

Description : - : no disease incidence, + : 0% disease incidence < x 40%, ++ : disease incidence 41% x < 100%

According to Table 6 above, it can be seen that the Dendrobium discolor shows a fairly varied resistance response compared to Phalaenopsis amabilis orchids. Dendrobium discolor orchid leaves in the treatment of virus inoculation (V1 and V2 $A_2VU_1$, V2 $A_2VU_3$) and mycorrhizal induction treatment and virus inoculation (V2 $MA_2VU_1$, V1 $MA_2VU2$, and V2 $MA_2VU_3$) has a disease incidence value of more than 40%, it indicates that it is a very susceptible resistance response. Furthermore, the leaves treated with virus inoculation (V1 $A_2VU_2$, V1 $A_2VU_4$) and mycorrhizal induction treatment and virus inoculation (V2 $MA_2VU_3$) have a disease incidence value of more than 40%,however, it is not as severe as the previous six leaves so that it shows a tolerant resistance response.

The next resistance response is plants that are somewhat resistant and resistant. Moderately resistant plants have disease incidence values ranging from 1 - 40%, namely on the leaves of orchids in virus inoculation treatment (V1 $A_2VU_3$ and V2 $A_2VU_4$) and mycorrhizal induction and virus inoculation treatment (V1 $MA_2VU_4$). Whereas, the response of resistant plants is found in the leaves of orchids treated with mycorrhizal induction and virus inoculation (V1 $MA_2VU_1$). The last resistance response is very resistant with a disease

incidence value of 0% or there is no disease incidence in three leaves, namely one leaf of virus inoculation treatment (V2 $A_2VU_2$) and two leaves of mycorrhizal induction treatment and virus inoculation (V2 $MA_2VU_2$, and V2 $MA_2VU_4$).

## DISCUSSION

### *Disease development*

In the analysis of disease development was undertaken through two calculations, namely the incidence of disease and the intensity of the disease. Based on the average calculation for each treatment, it was found that the Phalaenopsis amabilis orchid inoculated with the virus had the highest disease incidence and disease intensity. This showed that Phalaenopsis amabilis orchids were more infected with ORSV than Dendrobium discolor orchids, thus it is in accordance with the research of Mahfut et al. (2016) who reported that the suitable host plant and the most susceptible to ORSV infection is Phalaenopsis sp.

Hull (2002) argues that the susceptibility and severity of disease symptoms in plants to pathogen infection is influenced by the genetic composition of the host-virus plant and environmental conditions. Besides, the age of the plant also greatly determines the relationship of subsequent infection, after the virus comes into plant cells. According to Walkey (1991), when the virus comes into a plant cell, the elicitor on the virus will associate with the receptor on the plant cell to determine the relationship of subsequent infection. If the reaction is not compatible so then all parts of the plant will give a systemic resistance reaction when it is infected with a virus so that the virus cannot multiply and cause symptoms. On the other hand, if the interactions are compatible, the virus can infect the host plant.

Orchid of Phalaenopsis amabilis and Dendrobium discolor inoculated with mycorrhizal and virus (MAV) orchids showed different results from those were not induced by mycorrhizae (AV). Both mycorrhizal and virus inoculated (MAV)-induced orchids both showed a lower percentage of disease incidence and disease intensity than those without mycorrhizal induction (AV). This can be seen from the comparison of the difference in disease outcomes between Phalaenopsis amabilis with mycorrhizae ($MA_1V$) and Phalaenopsis amabilis without mycorrhizae ($A_1V$) is 14% and Dendrobium discolor with mycorrhizae ($MA_2V$) and Dendrobium discolor without mycorrhizae ($A_2V$) is 4.5%. The difference of disease intensity results also indicates that Phalaenopsis amabilis with mycorrhizae ($MA_1V$) and Phalaenopsis amabilis without mycorrhizae ($A_1V$) are 7.5% adrift and Dendrobium discolor with mycorrhizae ($MA_2V$) and Dendrobium discolor without mycorrhizae ($A_2V$) are 9%. Based on the description above, it can be seen that Rhizoctonia is able to reduce the severity of the disease.

This is in accordance with the research of Soelistjiono (2014) who asserts that orchids treated with Rhizoctonia pre-inoculation can reduce the disease severity index value. Soelistijono (2015), also reports that preinoculation of Rhizoctonia can increase the resistance of orchids to pathogenic infections due to the ability of orchids to produce secondary metabolites in the form of total phenolic compounds. Secondary metabolites are compounds thatproduced or synthesized by cells at a certain growth rate or stress. These compounds are merely produced in small amounts and it is not continuous to defend themselves from their habitat.

Lakani et al. (2015) also elucidates that plants naturally have the capacity to recognize and activate

defenses against viral infections. The defense reaction of each individual of the same orchid species to ORSV shows differences, it can be seen from the incidence of disease ranging from 40-100%. Based on observations, it is known that the average disease incidence in Phalaenopsis amabilis orchids is higher than that of Dendrobium discolor orchids. However, the difference in the average incidence of disease between the two orchids is not too much, which is around 0-20%. In a previous study, Syahierah (2010) reported that the Phalaenopsis sp. and Dendrobium sp. both infected with ORSV , it showed that the percentage of disease incidence ranging from 0 – 40% and 41 – 100%.

## *Plant resistance levels*

Based on the analysis of the level of plant resistance, the resistance response variations of Phalaenopsis amabilis and Dendrobium discolor were obtained, namely very resistant, resistant, moderately resistant, tolerant, and very susceptible.

Most of the Phalaenopsis amabilis orchids treated with virus inoculation ($A_1V$) and mycorrhizal induction and virus inoculation ($MA_1V$) showed a very susceptible resistance response and some were tolerant. This is in accordance with the research of Minarni and Mahfut (2021) who report that the Phalaenopsis amabilis orchid has a very susceptible resistance response. Previous research Lakani et al. (2015) also reported that Phalaenopsis amabilis inoculated with ORSV pointed out that a susceptible response with a disease incidence value was 61.54% (D. nindii, D. kyosimori, D. liniae, D. schulerii, P. amabilis, P. tiny white red). lip x white red lip, G. scriptum, and C. black lucky man x C. black lijinan pearl).

The results of the analysis indicatedthat the induction of Rhizoctonia in Phalaenopsis amabilis has shown an insignificant increase in plant response. Based on the results of the analysis, between the treatment of viral inoculation ($A_1V$) and mycorrhizal induction and virus inoculation ($MA_1V$), it was obtained that the ratio of the level of resistance was the same, namely very susceptible (7): tolerant (1). Even so, there were differences between orchids that were highly susceptible to the treatment of virus inoculation ($A_1V$) with the treatment of mycorrhizal induction and virus inoculation ($MA_1V$), namely: the symptoms of the disease and the incidence of mycorrhizal-induced Phalaenopsis amabilis was lower than that of non-mycorrhizal-induced Phalaenopsis amabilis. It shows that the visible symptoms are not as severe as the orchids treated with virus inoculation and mycorrhizae still have a role in suppressing pathogens in Phalaenopsis amabilis orchids.

Based on observations, it indicated that mycorrhizal induction on Phalaenopsis amabilis orchids did not have a significant effect on the resistance response of these orchids. This can be caused by the anatomical structure or morphology of the leaves of Phalaenopsis amabilis which led to be more virulent viral infections. Hossain (2011) argues that the content of chemical compounds in Phalaenopsis sp. is assumed to have a very important role in the process of genome replication and viral development. This is due to two reasons, namely 1) there are polypeptide compounds containing nitrogen, such as growth regulators and phenol compounds. These compounds are typically encoded by viral genes and play an important role in systemic symptoms as a result of virus-host interactions, and 2) the presence of metabolic products of Phalaenopsis sp. very abundant so that it is very effective for viral synthesis.

In Dendrobium discolor, the determination of the resistance response with a total of sixteen treatment

leaves, it was found that six orchid leaves showed a very susceptible resistance response, three leaves showed a tolerant response, three leaves were moderately resistant, one leaf showed a resistant response, and three leaves showed a resistance response that was very resistant. Minarni and Mahfut (2021) stated that the Dendrobium Salaya Fancy orchid showed a tolerant level of resistance with a fairly severe variation of symptoms but it was not as severe as the symptoms of infection in Phalaenopsis amabilis. This indicates that the Phalaenopsis amabilis orchid is more susceptible to ORSV infection than Dendrobium Salaya Fancy.

When it is compared with Phalaenopsis amabilis orchids, the resistance response of Dendrobium discolor orchids are more varied and the resistance level is quite high. This can be seen from the number of resistance responses that are very susceptible less than Phalaenopsis amabilis orchids and there is a very resistant resistance response to Dendrobium discolor while there is no Phalaenopsis amabilis orchid. This is in accordance with the research of Minarni and Mahfut (2021) who reported that the Dendrobium Salaya Fancy orchid has a higher level of resistance to ORSV infection than Phalaenopsis amabilis.

The results of the analysis of determination of the resistance response have been shown that mycorrhizal induction treatment on Dendrobium discolor showed a significant increase in resistance response. The comparison of the number of resistance responses between mycorrhizal-induced and non-mycorrhizal-induced orchids can be explained as follows: in the virus inoculation ($A_2V$) treatment, the resistance responses included: very susceptible (3), tolerant (2), moderately resistant (2), and very resistant ( 1) whereas in mycorrhizal induction and virus inoculation ($MA_2V$) treatment the resistance response is better which included: very susceptible (3), tolerant (1), moderately resistant (1), resistant (1), and very resistant (2). This proves that the induction of Rhizoctonia on Dendrobium discolor orchids increases the response of plant resistance.

Lakani et al. (2015) explainthat the different symptoms shown in each orchid plant shows the differences in the level of plant response to ORSV infection. Symptoms in susceptible plants can be seen in inoculated leaves and in uninoculated leaves (systemic) while in resistant plants, symptoms are seen only in inoculated leaves. The pathogen recognition system by the host begins when the pathogen penetrates the plant surface. Vorwerk et al. (2004) argue that plant cell wall polysaccharides play a role in disease resistance and it is not only as a barrier but also as a sensor for the entry of infection. DAMPs molecules in the host are then released during infection in which it is assumed as endogenous signals from injured tissue and trigger an immune response.

Based on observations, it indicated that Dendrobium discolor orchids were more resistant to ORSV infection than Phalaenopsis amabilis orchids. Previous research Lakani et al. (2015) stated that testing the level of resistance on the Phalaenopsis amabilis orchid showed a susceptible resistance response while the Dendrobium woxin orchid showed a tolerant response. This is also in accordance with the research of Minarni and Mahfut (2021) who report that the resistance response of Phalaenopsis amabilis orchids is very susceptible, while the response of Dendrobium discolor orchids is tolerant.

Based on the description of the results of observation of disease symptoms, the level of disease development which includes the incidence and intensity of the disease and also observations on the resistance response of the two orchids, it is discovered that the Phalaenopsis amabilis orchid shows more

disease symptoms, the value of disease development is higher, and the resistance response is dominated by very susceptible compared to other orchids. on the orchid Dendrobium discolor. This indicated that mycorrhizal induction in ORSV-infected Dendrobium discolor shows a significant increase in resistance response compared to Phalaenopsis amabilis. Whereas, the effectiveness of Rhizoctonia induction on Phalaenopsis amabilis does not have a significant effect compared to Dendrobium discolor orchids.

## CONCLUSION

The induction of Rhizoctonia in Phalaenopsis amabilis and Dendrobium discolor could reduce the percentage of disease progression. Phalaenopsis amabilis had a higher incidence and intensity of disease than Dendrobium discolor.

Phalaenopsis amabilis and Dendrobium discolor induced by Rhizoctonia showed a higher resistance response to ORSV infection than orchids that were not induced by Rhizoctonia. The increase on the resistance response of Dendrobium discolor was higher and seen than Phalaenopsis amabilis.

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## REFERENCES

Agrios, G. N. (2005). Plant Pathology. 5th ed. California: Elsevier

Bey, Y., dan Syafii, W. (2005). Pengaruh pemberian giberelin pada media vacin dan went terhadap perkecambahan biji anggerik bulan (*Phalaenopsis Amabilis* Bl) secara in vitro. *Jurnal Biogenesis*, 1(2), 57-61.

Hossain, M.M. (2011). Review therapeutic orchids: Traditional uses and recent advances-an overview. *Fitoterapia*. 82, 102–40.

Hull, R. (2002). *Matthews' plant virology* (4th ed.). New York: Academic Press.

Jiang, J. H., Lee, Y. I., Cubeta, M. A., and Chen, L. C. (2015). Characterization and colonization of endomycorrhizal *Rhizoctonia* fungi in the medicinal herb *Anoectochilus formosanus* (Orchidaceae*). Mycorrhiza*, 25(6),431–445.

Koh, K.W., Lu, H.C., and Chan, M.T. (2014). Virus resistance in orchids. *Plant Science*, 228, 26−38.

Lakani, I., Suastika, G., Damayanti, T.A., dan Mattjik, N. (2015). Respons ketahanan beberapa spesies anggrek terhadap infeksi *odontoglossum ringspot virus*. *Jurnal Hort,* 25(1), 71-77.

Mahfut dan Daryono, B.S. (2014). Deteksi *odontoglossum ringspot virus* terhadap anggrek alam di hutan wonosadi, gunung kidul. *Biogenesis*, 2(2), 101-108.

Mahfut, Daryono, B.S., Joko, T., dan Susamto, S. (2016). Survei *Odontoglossum Ringspot Virus* (ORSV) yang Menginfeksi Anggrek Alam Tropis di Indonesia. *Jurnal Perlindungan Tanaman Indonesia*, 20(1), 1-6.

Mahfut. (2019). Indonesia darurat konservasi: sudah amankah kebun raya kita?. *Prosiding Seminar Nasional Biodiversitas Indonesia*, 1-6.

Minarni, I.Y., dan Mahfut. (2021). Seleksi ketahanan tanaman anggrek (orchidaceae) terhadap *odontoglossum ringspot virus* (orsv). *Jurnal Teknosains,* (Submitted).

Ningsih, R., Sri, A., dan Denofia. (2014). Peranan jamur *rhizoctonia* sp. asal taman nasional rawa aopa watumohai sulawesi tenggara terhadap keberhasilan aklimatisasi dan laju pertumbuhan planlet anggrek macan (*Grammatophyllum scriptum* BL.). *Jurnal Biologi*, 7(2), 58-68.

Soelistijono, R. (2015). Kajian efektifitas *rhizoctonia* sp. mikoriza dataran rendah dan sedang pada tingkat keparahan penyakit (dsi) anggrek *phalaenopsis amabilis* terhadap *fusarium* sp. *Biosaintifika*, 7(2), 112-119.

Soelistijono, R., Utami, D.S., dan Priyatmojo, A. (2017). Identifikasi *Rhizoctonia* Mikoriza dan *Fusarium* pada Anggrek *Ascocentrum miniatum*. *Biota,* 2(1), 7−13.

Syahierah P. (2010). Respon berbagai jenis anggrek (Orchidaceae) terhadap infeksi *Cymbidium mosaic virus* (CymMV) dan *Odontoglossum ringspot virus* (ORSV). *Skripsi*. Bogor: Institut Pertanian Bogor.

Vorwerk, S., Somerville, S., dan Somerville, C. (2004). The role of plant cell wall polysaccharide composition in disease resistance. *Trend Plant Sci*. 9, 203.

Walkey, D.(1991). *Applied Plant Virology (2nd ed.).* London: Chapman and Halls