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The Effect of Legundi (*Vitex trifolia*) Biofungicide Doses Fermented with Trichoderma on Fusarium Wilt Disease in Several Shallot Varieties (*Allium ascalonicum* L.)

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Abstract:- Fusarium oxysporum f.sp. cepae (FoC), the causing agent of Fusarium wilt disease in shallot, is a destructive pathogen and causes serious crop damage and yield loss. To control this disease, legundi leaf extract biofungicide fermented with T. harzianum was applied. This experiment aimed to determine the effect of Trichoderma fermented legundi biofungicide doses (T. harzianum) on Fusarium wilt disease in two local shallot varieties. The experiment was arranged in a completely randomized factorial design (CRD) with tests in a greenhouse. The dose factor of the Trichoderma fermented legundi biofungicide consisted of 5 levels: 0 ml/plant, 2,5 ml/plant, 5 ml/plant, 7,5 ml/plant, and 10 ml/plant. The shallot variety factor consisted of Keta Monca and Bali Karet. The experimental results showed that the application of legundi Trichoderma biofungicide starting from a dose of 2,5 ml/plant was able to reduce the intensity of Fusarium wilt disease in both shallot varieties, with suppression percentages of 12,17-42,73% (Keta Monca) and 19,56-66,57% (Bali Karet), reduced the infection rate and the area under the disease progress curve (AUDPC). The highest disease suppression is obtained by the application of 10 ml/plant legundi Trichoderma biofungicide. Bali Karet showed lower disease incidence (35,40%) and lower AUDPC (222,7) than Keta Monca (68,74% of disease incidence and 1192,912 AUDPC).

Keywords:- *Biological control, fusarium wilt disease on shallot, legundi biofungicide, plant resistant; Trichoderma harzianum.*

I. INTRODUCTION

The development of domestic shallot production is faced with attack constraints and plant diseases that are difficult to control. One of the main diseases often reported attacking shallot plants is Fusarium wilt disease, caused by the pathogenic fungus *Fusarium oxysporum* f.sp. *cepae*. Potential attacks of this disease cause damage and high yield loss, more than 50% even crop failure (Wiyatiningsih et al., 2009; Fitriani et al., 2019). F*usarium oxysporum* f. sp. *cepae* cause damage to plant vascular tissue, resulting in water distribution and inhibited plant nutrients (Bectas and Kusek, 2019). As a result, the plants wither, leave chlorosis and twisting, stunting, and root rot (Sudantha et al., 2020; Sudantha and Suwardji, 2021)

Fusarium wilt disease is relatively difficult to control, even with the use of synthetic chemical fungicide. This is because the fungus *Fusarium oxysporum* f.sp. *capable* of survive in the soil for a long time (up to 8 years) even though zonder plants are hosts (Bennett et al., 2012; Fall et al., 2018; Gordon, 2017). There is a mechanism Chlamydospores make this fungus persistent in the soil as a saprophyte. Control Fusarium wilt disease in the field is still faced with the option of using chemical fungicides systemic synthetic with active ingredient benomyl. However, benomyl has been banned from its use globally because it has a negative impact on the environment and humans, such as has the potential to cause new races of pathogens that are more virulent and resistant, health problems: skin irritation, liver, and reproductive function disorders, and benomyl residues that are difficult to dissolve in the land (Pearson and Miller, 2014).

An environmentally friendly Fusarium wilt control option is the use biofungicide. Amaria et al. (2016) defined biofungicides as protection products plants containing biocontrol agents formulated into carriers certain. One of the most widely involved biocontrol agents in disease-control plants is *Trichoderma harzianum* (Astiko and Muthahanas, 2019). The fungus Trichoderma harzianum can do this parasitization, releasing antibiotic compounds that are toxic to pathogenic fungi and producting hydrolytic enzymes that play a role in plant disease biocontrol activities (Sudantha et al., 2020). Previous experiments reported that *T. harzianum* was capable controlling root rot disease caused by *F. solani* on olive plants (Ben et al., 2017); stem rot disease in corn plants caused by *F. graminearum* (Saravanakumar et al., 2017), a white rot disease of shallots caused by *S. cepivorum* (Elshahawy et al., 2017), Fusarium wilt disease in tomatoes (Bader et al., 2020) and Fusarium wilt disease on shallots (Sudantha et al., 2020).

Using easily degradable materials, such as vegetable extracts as formulations biofungicides, is currently receiving attention (Akhtar and Javaid, 2016). A number of Previous studies reported that the use of *Imperata cylindrica* extract, *Raphanus sativus* and *Acacia nilotica* showed growth inhibition of *Macrophomina phaseolina, Fusarium oxysporum* f. sp. *lycopersici* and *Sclerotium rolfsii* (Javaid

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and Bashir, 2015; Sana et al., 2016; Banaras et al., 2017). The use of dry plant biomass of *W. somnifera* combined with *T. harzianum* effectively controlled *F. oxysporum* f.sp. *cepae* (Akhtar and Javaid, 2016).

One of the potential vegetable substrates to be developed as a biofungicide is legundi leaf (*Vitex trifolia*), because the material is cheap, easy to obtain, and not toxic to humans and plant. Legundi is an aromatic shrub that contains metabolites extensively secondary and fungi toxic against fungal pathogens. Trial Sudantha et al. (2018) reported that legundi biofungicide fermented with Trichoderma can control Fusarium wilt disease up to 72,50-82,39% on shallots of the Keta Monca variety.

However, information on the effectiveness of combined legundi biofungicides is lacking with Trichoderma fungus in controlling Fusarium wilt in some Shallot varieties is still very limited. This study aims to determine the effect of biofungicide application of legundi extract fermented by Trichoderma on various ranges of application doses to control Fusarium wilt in two varieties of shallot.

II. MATERIALS AND METHODS

A. Time and Place of Research

The research was conducted at the Gaharu Greenhouse and the Faculty's Microbiology Laboratory at Mataram University of Agriculture. The experiment was carried out from March to June 2022.

B. Research Materials

The manufacture of biofungicides was carried out according to the Sudantha procedure (2020). Legundi leaves dried in the sun. After drying, grinding it using a blender, powdered biomass was obtained. Biofungicide fermentation is carried out by mixing as much as 300 grams of legundi powder biomass into 3 liters of water solvent. Then ingredients were inoculated with 300 ml of *T. harzianum* SAPRO-07 mother liquor (spore density 1.38 × 10 7). Furthermore, the substrate is added in the form of dextrose as much as 90 grams. Ingredients are anaerobically fermented for two weeks. After fermentation, the material is filtered from the dregs to obtain legundi extract containing Trichoderma spores. Culture The mushrooms used as biocontrol agents are from Prof.'s personal collection. Dr. Ir. I Made Sudantha, MS. Pathogenic fungus *Fusarium oxysporum* isolated from plant tissue sick shallot.

The shallot seeds used were the Keta Monca and Bali Karet varieties from seed growers. The seeds used have passed the period store of two months and have visible growing points on the roots. Before planting, seed tubers shallots are cut at the end about ¼ part.

C. Research Design

The experimental design used is a factorial completely randomized design. The factorial consisted of two factors, namely the dosage factor of Legundi biofungicide and factor shallot varieties. Legundi biofungicide dose factor (D) consists of five levels: d0 = 0 ml/plant (water), d1 = 2.5 ml/plant, d2 = 5 ml/plant, d3 = 7.5 ml/plant, d4 = 10 ml/plant. The shallot varietal factor (V) used consisted of two levels: v1 = Bali Karet, and v2 = Keta Monca. The treatment was a combination of shallot varieties and legundi biofungicide dose with three replications, so a total of 30 were obtained treatment or experimental units.

D. Research Implementation

The planting medium is prepared by mixing garden soil, and manure soil cattle (naturally decomposed) in a ratio of 3:2 (6 kg of garden soil and 4 kg of soil cow dung), then put into a 40x50 poly bag with a capacity of 10 kg. Basic fertilizer application is carried out using Phonska fertilizer at a dose of 50% recommendation (400 kg/ha) or 200 kg/ha or 0.8 g per planting hole or plant (Sudantha et al., 2020). Provision of basic fertilizer is made before planting shallot seeds. Onion planting is done by immersing the bulb in the planting hole until the tuber is flush with the soil surface. Each planting hole planted one tuber. One polybag contains seven plants.

The application of the Trichoderma fermented legundi biofungicide was given after planting with how to inject using a pipette into the rhizosphere of the plant with the concentration that has been determined (2.5 ml/plant, 5 ml/plant, 7.5 ml/plant, and 10 ml/plant). Legundi biofungicide application was carried out 2 times, namely at 7 days after planting (dap) (first application) and on 21 dap (second application). Fusarium inoculation was carried out at the age of 14 dap. A total of 2.5 ml of Fusarium pure suspension was dripped around the plant (rhizosphere) using a pipette.

Plant watering is given every day with an interval of once every day in the morning or afternoon. Follow-up fertilizer is given at the age of 35 dap plants. Follow-up fertilizer Urea is used at a dose of 165 kg/ha (50% recommendation) or 0.33 g/plant.

E. Observation Parameters

- *Fusarium Wilt Disease Incidence*

Disease incidence was observed at 21 dap, 28 dap, 35 dap, 42 dap, 49 dap, 56 dap, and 63 dap. The formula for calculating the incidence of the disease is as follows:

$$I = \frac{x}{N} x\ 100\ \%$$

Description:
x: number of diseased plants
N: total plant population per treatment or polybag

- *Fusarium Wilt Infection Rate*

The infection rate is used to determine the development of Fusarium wilt infection. The infection rate or r (infection rate) is calculated based on the incident data disease. Calculation of the infection rate using the monomolecular formula model according to Van der Plank (1963). The monomolecular formula can be seen below:

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$$r = \frac{2{,}3025}{t2 - t1}\left(\log 10 \frac{1}{1 - Xt} - \log 10 \frac{1}{1 - x0}\right)$$

Description:
r : infection rate
t2 : time of observation next week
t1 : time of observation the previous week
1 : the number that describes the symptoms of an absolute attack (100%)
Xt :proportion of diseased plants the following week
x0 :proportion of diseased plants the week before
2,3025 :the constant number resulting from the conversion of natural logarithms to ordinary logarithms (ln x = 2,3025 log x)

➢ *Area Under Disease Progress Curve (AUDPC)*

Area Under Disease Progress Curve (AUDPC) is used to assess the development of wilt disease Fusarium during the infection cycle. AUDPC calculation is used with the formula below (Sudarjat & Damayanti, 2019):

$$\text{AUDPC} = \sum_{n=1}^{i} \left(\frac{yi + yj}{2}\right)(tj - ti)$$

Description:
yi: previous disease occurrence (e.g. week 1)
yj: disease occurrence next time (eg week 2)
ti: i-th observation time (previous observation time)
tj: next observation time
i: i-th time

➢ *Data analysis*

Data were analyzed by Analysis of Variance at 5% significance level using Costat software version 6.400. Variables that indicate treatment interactions further tested with Tukey's HSD (Honestly Significant Difference) means-tested at a 5% level of significance.

III. RESULTS AND DISCUSSION

A. Incidence of Fusarium Wilt Disease

Application of legundi Trichoderma biofungicide doses succeeded in reducing the intensity of the incident Fusarium wilt disease on both shallot varieties until the end of the observation (63 dap), respectively 12.17-42.73% (Keta Monca) and 19.56-66.57% (Bali Karet) (Table 1). Table 1 shows that the application of legundi Trichoderma biofungicide doses ranging from a dose of 2.5 ml/plant has reduced disease incidence compared to controls (0 ml/plant). The highest incidence of disease was found at a dose of 10 ml/plant, thus causing the lowest incidence of disease.

Table 1:- Interaction of legundi Trichoderma biofungicide doses and shallot varieties against the occurrence of Fusarium wilt disease (Numbers followed by different letters in the column show significance according to the HSD test at the 5% level).

Treatment		Incidence of Fusarium wilt disease (%)						
		21dap	28 dap	35 dap	42 dap	49 dap	56 dap	63 dap
	0 ml/plant	22.20[a]	44.10[a]	57.32[a]	75.19[a]	90.00[a]	90.00	90.00
	2,5 ml/ plant	0.71[b]	0.71[b]	18.40[b]	25.29[b]	33.75[b]	49.46	79.04
Keta Monca	5 ml/ plant	0.71[b]	0.71[b]	11.24[b]	11.24[b]	19.52[b]	30.47	63.33
	7,5 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	14.76[b]	23.07	59.81
	10 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	11.24[b]	19.52	51.54
	0 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71[b]	21.77	55.05
	2,5 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71[b]	14.76	44.28
Bali Karet	5 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71[b]	14.76	30.47
	7,5 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71	28.81
	10 ml/ plant	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71[b]	0.71	18.40
HSD 5%		0.0048	11.39	22.28	28.61	48.92	-	-

The fact that the legundi Trichoderma biofungicide is able to reduce the incidence of wilt Fusarium is caused by legundi leaf extract and consortium *T. harzianum* as the biofungicide active ingredient can inhibit the pathogenicity of *Fusarium oxysporum* f.sp. *cepae* (FoC) in the plant rhizosphere. Sudantha et al. (2021) stated that legundi leaf extract contains secondary metabolite compounds that have antibacterial, and anti-fungal roles and feed for plant pests. Legundi leaf extract contains compounds methanol (saponins, flavonoids, tannins, steroids, alkaloids and terpenoids) which are antimicrobial to *Staphylococcus aurensi*, *Staphylococcus epidermidis*, *E. coli*, and *Klebsiella pneumoniae* (Zulkifli et al., 2021). Isnaini et al. (2021) stated that compounds Antifungals such as flavonoids, saponins and alkaloids have fungistatic properties that play a role in inhibiting vegetative growth of fungi and bacteria.

In addition, the successful reduction of Fusarium wilt occurs simultaneously with the presence of *T. harzianum* fungus consortium contained in biofungicides legundi. Fitriani et al. (2019) stated that mutualist symbiosis between fungi biocontrol with the host could increase growth and host resistance to the pathogen. The fungus *T. harzianum* can control pathogenic fungi through mechanisms of mycoparasites, production of antibiotics and hydrolytic enzymes that are toxic to pathogens, production of secondary

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metabolites that are fungi toxic and competition for nutrients and space quickly by Trichoderma (Howell, 2003).

The average incidence of Fusarium wilt disease in Bali Karet is lower (35.40%) compared to Keta Monca (68.74%) at the end of the observation (63 dap) (Table 1). In the plant resistance category (Table 2), Bali Karet has moderate resistance and Keta Monca has a vulnerable resistance. There is a difference in resistance indicates the role of genetics in controlling the character of plant resistance. Agrios (2005) states that differences in plant resistance characteristics provide different genetic potential responses in the development of defense characters plant morphology and physiology, including structural and biochemical defenses, which contribute to plant resistance. Prakoso et al. (2016) stated that the shape of a large shallot bulb with a thicker bulb wall thickness (multiple tuber epidermal layers), as well as thicker and stronger root tissue, makes it more difficult for pathogens to penetrate, thereby reducing the ability to infect pathogen. Based on visual observations, the Bali Karet shallot variety has a size larger tubers and a thicker layer of tuber walls and root architecture compared to Keta Monca. The thicker epidermal layer makes the penetration of pathogens more difficult becomes more difficult resulting in a longer incubation period and intensity of attacks lower disease (Marlitasari et al., 2016).

Table 2:- Criteria for the resistance of shallot plants to Fusarium wilt (Anisti, 2022).

Disease percentage (%)	Resistance category
0-10	Very resistant
>10-30	Resistant
>30-40	Fairly resistant
>40-50	Somewhat vulnerable
>50-70	Vulnerable
>70-100	Very vulnerable

B. Fusarium Wilt Infection Rate

In addition to reducing the incidence of disease, the application of legundi Trichoderma biofungicide doses was also able to reduce the infection rate of Fusarium wilt up to 63 dap (Table 3), although based on analysis of variance, it is not significant. Fusarium wilt infection rate is presented in Table 3 below.

Table 3:- The infection rate of Fusarium wilt in both shallot varieties Legundi Trichoderma biofungicide dose treatment (Digits followed by letters are not the same in the column indicates significance according to further tests with HSD at the 5% level. Description of Treatment: d0 (0 ml/plant), d1 (dosage 2.5 ml/plant), d2 (dosage 5 ml/plant), d3 (dosage 7.5 ml/plant), d4 (dosage 10 ml/tan); v1 (variety Keta Monca), v2 (Bali Karet variety).

Treatment	Infection rate (units per week)						
	r1 (28 dap)	r2 (35 dap)	r3 (42 dap)	r4 (49 dap)	r5 (56 dap)	r6 (63 dap)	r7 (70 dap)
d0v1	0.049[a]	0.036	0.095	0.111	0.000	0.000	0.000
d1v1	0.000[b]	0.029	0.014	0.022	0082	0.108	0.069
d2v1	0.000[b]	0.018	0.000	0.021	0.069	0.066	0.152
d3v1	0.000[b]	0.000	0.000	0.026	0.027	0.113	0.60
d4v1	0.000[b]	0.000	0.000	0.018	0.021	0.105	0.182
d0v2	0.000[b]	0.000	0.000	0.000	0.036	0.117	0.174
d1v2	0.000[b]	0.000	0.000	0.000	0.026	0.058	0.242
d2v2	0.000[b]	0.000	0.000	0.000	0.026	0.082	0.218
d3v2	0.000[b]	0.000	0.000	0.000	0.000	0.052	0.275
d4v2	0.000[b]	0.000	0.000	0.000	0.000	0.029	0.298
HSD 5%	0.03	-	-	-	-	-	-

Based on Table 3 above, the highest average infection rate is found in control plants on both shallot varieties up to 63 dap. Treatment d0v1 (Keta Monca + Control) experienced the highest and fastest infection rate, which occurred at 49 dap with an infection rate 0.111 (11 plant units per week). The high of infection rate in the d0v1 treatment (Keta Monca + Control) indicates infection with *Fusarium oxysporum* f.sp. *cepae* very fast on This treatment causes the death of the plant population in a short time. This can be seen in the data on the incidence of disease at the age of 49, 56 and 63 dap (Table 1), with a very high intensity of disease incidence, reaching 90% (plants totally dead). The highest infection rate and the fastest population death were in the d0v1 treatment caused by the absence of antagonistic microbial inhibition. Fitriani et al. (2019) state that antagonistic microbes associated with plants can increase plant growth and resistance, thereby enabling the plant to resist infection pathogens. The absence of association with antagonistic microbes makes the pathogen *Fusarium oxysporum* f.sp. *cepae* more actively develop and infect plants.

Referring to Table 3, the application of legundi Trichoderma biofungicide doses successfully reduced the infection rate in both shallot varieties. Application of

biofungicide dosage legundi Trichoderma starting from 2.5 ml/plant is capable and effective in inhibiting infection with *Fusarium oxysporum* f.sp. *cepae* on plants. This fact shows that Legundi Trichoderma biofungicide used was effective in reducing the pathogenicity of FoC up to 63 dap. This is thought to be due to the content contained in legundi biofungicide capable of inhibiting the development of FoC in plants. Sudantha et al. (2021) stated that legundi leaf extract contains metabolite compounds secondary synergistically with *T. harzianum* antagonism is able to control the disease Fusarium wilt. Zulkifli et al. (2021) stated that methanol extract (saponins, flavonoids, tannins, steroids, alkaloids, and terpenoids) in legundi leaves are able to show inhibition to *Staphylococcus aurensi*, *Staphylococcus epidermidis*, *E. coli*, and *Klebsiella pneumoniae*. Akhtar and Javaid (2016) reported that methanol compounds (saponins) extracted from the leaves of *W. somnifera* effectively reduced the growth of *Fusarium oxysporum* f.sp. *cepae* in-vitro scale. Phytochemical compounds contained in plant extracts can act as an antimicrobial that can disrupt the permeability of the cell wall, thus resulting in the destruction of microbial cells (Isnaini et al., 2021).

In addition, the presence of *T. harzianum* associated with after-plants applied biofungicides are thought to be able to induce plant resistance so that make plants more resistant to FoC infection. The mushroom *T. harzianum* is able to stimulate plants to produce plant defense enzymes, such as peroxidase, polyphenols oxidase, chitinase, oxidative compounds, phenylpropanoid, PR-protein, and hormonal status in plants so as to make plants resistant to pathogenic infections (Ben et al., 2017; Elshahawy et al., 2017). Sudantha's experiment (2007) reported that fungal inoculation Endophytic Trichoderma on vanilla seedlings is able to make vanilla plants not infected by *F. oxysporum* f.sp. *vanilla.*

Bali Karet variety reacts more resistant to FoC infection than Keta Monca. Thing This can be seen in Table 3 where infection has not appeared in this variety until age 49 dap (0.000) and an increase in the rate of infection began to appear at 56 dap. This indicates that there are differences in the resistance of the two varieties. Allegedly the resistance of Bali Karet is caused by the presence of structural defense mechanisms, namely the morphology of the epidermis and thicker root tissue. Prakoso et al. (2016) stated that shallots with larger tubers, thicker epidermal layers, and root tissue provide a physical barrier that it is difficult for pathogens to penetrate, resulting in disease development is slower and lower than shallots with smaller tubers and thinner tuber epidermis. The onion plant has a defense structure in the form of a thicker epidermal layer, and stomata that are thicker fewer are more able to demonstrate resistance to pathogen infection (Marlitasari et al., 2016).

At the end of the observation (70 dap), the infection rate increased in all combinations treatment. In Table 3 it can be seen that the infection rate is relatively high at 70 dap with a range of 0.152-0.298 (15-29 plant units per week). The high rate of infection in This period is due to the proportion of healthy plants in all treatments available sufficient to provide host tissue for FoC pathogens to infect, especially when environmental conditions favor infection of the pathogen. This matter is also in line with Manengkey and Senewe (2011), which stated that the infection rate can occur, caused by the available pathogen inoculum quite a lot, healthy host tissue is still abundant enough to be infected, and environmental factors trials supporting infection. It is known that the fungus *F. oxysporum* develop more optimally at temperatures of 25-30°C, spore germination is more intensive at temperatures warm (28°C) and moist soil (Soesanto, 2013).

C. Area Under Disease Progress Curve (AUDPC)

Application of legundi fermented Trichoderma biofungicide doses was able to reduce widespread under the development curve of Fusarium wilt in both shallot varieties compared to controls. The area under the Fusarium wilt disease curve is shown in Table 4.

Giving a dose of 10 ml/plant provides the highest disease suppression, so it is widespread below the disease progression curve. This fact is due to the success of legundi Trichoderma biofungicide in controlling pathogens *Fusarium oxysporum* f.sp. *cepae*. The success of this reduction is thought to be due to the active ingredients contained in the biofungicide effectively suppresses the disease. Sudantha et al., (2021) stated that the fungus *T. harzianum* was able to control Fusarium wilt disease Through the mycoparasite mechanism, the production of antibiotics that are toxic to pathogenic fungi and rhizosphere competition that makes pathogenic fungi unable to compete with fungi Trichoderma. In addition, Sudantha et al. (2021) added that the metabolite extract secondary antibacterial and antifungal properties contained in legundi leaves synergistically able to control Fusarium in the soil. This is supported by Trials Zulkifli et al., (2021) where the methanol extract of legundi leaves such as terpenes, alkaloids, steroids, tannins, flavonoids, and saponins have shown successful inhibition of gram-positive pathogenic bacteria. Flavonoid compounds derived from plant extracts (betel red betel and green betel) are fungistatic against the pathogenic fungus S. rolfsii, namely can damage the integrity of the fungal cell wall thereby inhibiting the vegetative growth of the fungus pathogens (Isnaini et al., 2021).

ISSN No:-2456-2165

Table 4:- Effect of legundi Trichoderma biofungicide doses and shallot varieties on the area under the development curve of Fusarium wilt.

Treatment	AUDPC	
	Keta Monca	Bali Karet
0 ml/plant	3122.07	374.885
2,5 ml/ plant	1179.85	288.120
5 ml/ plant	872.91	239.785
7,5 ml/ plant	498.99	135.625
10 ml/ plant	420.56	99.190

The Bali Karet variety shows the average area under the disease progression curve much lower (222.7) than Keta Monca (1192.912). Area under the curve disease development of both varieties is shown in Figure 1.

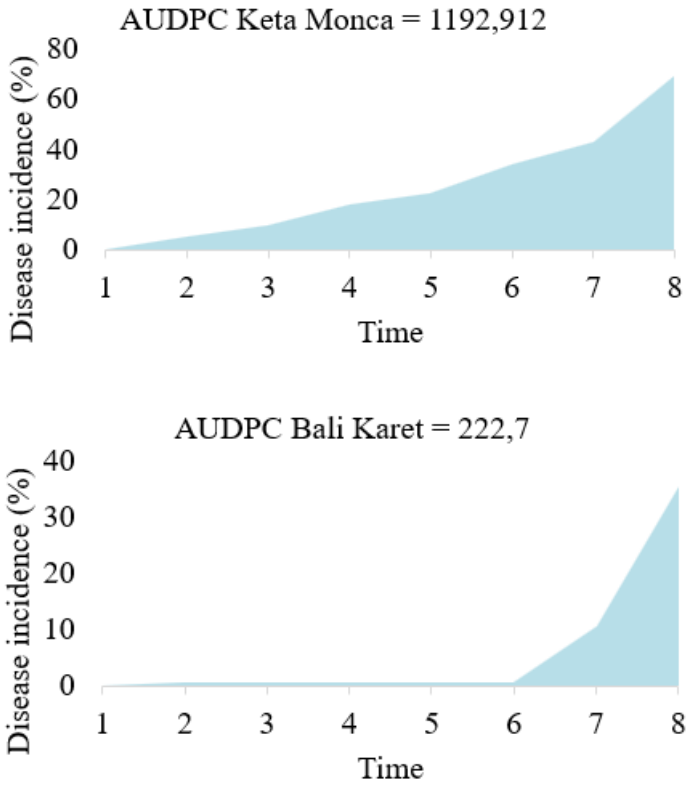

Fig 1:- Area under the development curve of Fusarium wilt on two varieties of shallot

The narrower the area of disease development, the more resistant the plant is. Figure 1 shows that Bali Karet is a more resistant variety Fusarium wilt attacks. The larger morphology of the Bali Karet tuber, more tuber layers, and more vigor root tissue make Bali Karet more resistant and difficult to infect by pathogens. This is in line with the opinion of Prakoso et al. (2016), which state that the epidermal cells are thick and strong-walled or have a tuber layer which will make the penetration of pathogens more difficult. There is a defensive structure. This morphology is thought to make Bali Karet experience an area under the development curve with lower disease than Keta Monca. However, it is necessary to xperiment to see the morphological characteristics of Bali Karet that contribute to resistance of this variety.

IV. CONCLUSION

Based on the results and discussion, it can be concluded that the dosage application legundi Trichoderma biofungicide 2.5 ml/plant-10 ml/plant was able to reduce the incidence of Fusarium wilt in both shallot varieties, respectively 12.17-42.73% (Keta Monca) and 19.56-66.57% (Bali Karet) compared to other crops without the application of biofungicides, reduced the infection rate of Fusarium wilt, and dampened area under the disease progression curve (decreasing AUDPC value) compared with control. A dose of 10 ml/plant provides the best disease suppression. Onion varieties red Bali Karet is more resistant to Fusarium wilt with a disease incidence lower (35.40%) and lower AUDPC (222.7) than Keta Monca with a higher disease incidence (68.74%) and a higher AUDPC (1192.912).

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