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Effectiveness and Timing of Trichoderma polysporum Inoculation on Controlling Fusarium wilt (Fusarium oxysporum f. sp. lycopersici (Sacc.) in Tomato Plants

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ABSTRACT

This study aims to determine the effect of the dose and application time of T. polysporum on the effectiveness of controlling Fusarium wilt in tomato plants. Fusarium wilt disease (Fusariun oxysporum) is an important disease in various cultivated plants, especially tomato plants. Fusarium wilt occurs in all tomato growing areas around the world and causes huge losses of up to 60%. Control of F. oxysporum pathogens using fungicides on agricultural land can cause environmental pollution. One of the environmentally friendly control alternatives is to use the biological agent Trichoderma polysporum. The results showed that compost containing T. polysporum was effective for controlling Fusarium wilt in tomato plants. The percentage effectiveness of compost containing T. polysporum in controlling the intensity of disease attacks, namely 0% in the control treatment, 47.80% with the application of 0.25 kg of compost containing T. polysporum, and 70.87% with the application of 0.5 kg of compost containing T. polysporum. The effect of time of application of compost containing T. polysporum is equally effective for controlling the pathogen attack of F. oxysporum. The large doses of T. polysporum compost applied prior to inoculation of the pathogen can increase plant growth and yield. In the application of 0.5 kg of compost containing T. polysporum, the highest growth in plant height was 18.03-19.84 cm, while the lowest growth average was in the control treatment of 16.53-16.70. The highest average plant production, namely 237.65 grams, was found in the application treatment 0.

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1. INTRODUCTION

Tomato (Lycopersicum esculentum Mill.) is one of the potential horticultural commodities to be developed, because it has quite high economic value and large export potential. Tomatoes are widely consumed by the people of Indonesia and the world in both fresh and processed forms, whose needs continue to increase along with an increase in population. As a food ingredient, the nutritional content of tomatoes is quite complete including vitamins A, B1, B2 and C. Apart from being consumed fresh, tomatoes are also used for various industries such as chili sauce, sauces, drinks, herbs and cosmetics (Wiryanta, 2002).

The use of tomatoes for several industries requires that the production of tomato plants must be increased but there are many failures due to pests and several other causes. Disturbing organisms that can fail crops include wilt disease caused by the attack of the pathogen Fusarium oxysporum.

Fusarium wilt is an important disease and causes considerable losses to tomato plants. The fungus that causes wilt disease is capable of forming chlamydospores which can survive for tens of years in the soil and have many forms that specialize in certain plant species. Fusarium is a soil born pathogen.

Organisms considered as soil pathogens are disease organisms that have the ability to survive indefinitely in soil without a host (as saprof), capable of infecting and causing symptoms related to plant organs in the soil (Abadi, 2004).

Chemical control has been known to have negative impacts, including causing environmental pollution in terms of soil, water and air, OPT resistance, and the presence of residues in production. In this era, biological pest control is highly prioritized because it is more environmentally friendly and does not have a negative impact on human health. The control alternative that is considered the most suitable and environmentally friendly is the use of antagonistic bodies.

Fusarium is a mushroom that is widespread in various places, not only in temperate and tropical climates, however, mushrooms are also found in various places around the north pole and deserts. Fusarium fungus is a saprophyte that becomes a pathogen in plants and animals. In plants, fusarium causes leaf spot, root rot, fruit rot, canker, and vascular wilt (Nelson, 1981). Fusarium is not only a plant pathogen but also infects vertebrates such as fish, and is an important pathogen in shrimp farming.

One of them is by using Trichoderma sp. as a biological agent. The use of Trichodderma viride as a biological agent has been known to be effective for controlling plant pathogens, especially soil pathogens. Trichoderma sp. highly compatible when combined with other biological controls. Trichoderma sp. is a good antagonist for biological control. This is due to the antagonistic power possessed by Trichoderma sp. in producing various kinds of toxic metabolites such as antibiotics or enzymes that are lytic in nature as well as the ability to compete with pathogens in fighting for nutrients, oxygen and space to grow.

The use of Trichoderma sp. has been widely used as a biological agent to control several pathogens in cultivated plants, besides that the mechanism of the fungus Trichoderma sp. in controlling pathogens has also been extensively studied. Usefulness of Trichoderma sp. as a biological agent against plant pathogens, it is necessary to study the most effective dose and inoculation time to control plant pathogens.

2. METHOD

2.1 Types of research

The research method used in this study is the experimental method. The experimental method is a form of observation under artificial conditions, where these conditions are created and regulated by the researcher. That is, basically conducting an experiment to see the results, and the results of the experiment will confirm how the causal position is between the variables being investigated.

2.2 Research Variables

The data obtained from each observation variable was analyzed by means of the F test at the 5% level, if there is a significant difference then it is continued with the Least Significant Difference test (LSD at 5% level).

2.3 Research design

This study used a randomized block design (RBD) factorial pattern (3x3) with 6 replications. The first factor was the dose of compost containing T. polysporum which consisted of 3 levels, namely 0 kg of compost containing T. polysporum in 5 kg of soil (control), 0.25 kg of compost containing T. polysporum in 5 kg of soil, and 0.25 kg of compost containing T. polysporum in 5 kg of soil. 5 kg of compost containing T. polysporum in 5 kg of soil. The second factor was the application time of compost containing T. polysporum consisting of 3 levels, namely 7 days before inoculation of the pathogen, during inoculation of the pathogen, and 7 days after inoculation of the pathogen. The research was conducted at the Mycology Laboratory and Wire House, Department

of Plant Pests and Diseases, Faculty of Agriculture, Brawijaya University, Malang from February to August 2009.

2.4 Sampling location

This study used tomato plants with the influence of FUSARIUM wilting (Fusarium oxysporum f. sp. lycopersici (Sacc.)

2.5 Time and Place of Research.

This research was conducted in a greenhouse, UPT Compost and Soil Chemistry Laboratory, Department of Soil, Faculty of Agriculture, University of Brawijaya. Implementation time started in February to March 2006.

2.6 Tools and materials

The tools used in this study were: autoclave, 9 cm diameter petri dish, test tube, tube rack, bunsen pipette, ose needle, beaker glass, handcounter, microscope, electric stove, raffia rope, staples, plastic bag, haemocytometer, laminar flow, scissors, knife, ruler, 5 kg capacity polybag, cotton to support plants, and labels.

The materials used in this study were as follows: tomato seeds of the monica variety, isolates of the antagonistic fungus T. polysporum and isolates of the pathogenic fungus F. oxysporum obtained from the collection of the Mycology Laboratory of the Department of Plant Pests and Diseases, University of Brawijaya, Potato Dextrose Agar (PDA) media, alcohol 70%, sterile distilled water, spiritus, sterile soil, and sterile compost.

2.7 Research procedure

The research was started with inoculation, which was started by making a suspension of the fungus F. oxysporum. The number of conidia needed in this study was 106 conidia/ml then the application of compost containing T. polysporum to the soil was carried out 7 days before inoculation of the pathogen, during the inoculation of the pathogen, and 7 days after the inoculation of the pathogen after all the materials needed were prepared and applied and carried out with observation

2.8 Data analysis.

Data analysis was used to determine the effect between treatments of different application doses of compost that had been inoculated with T. polysporum and different application times on the effectiveness of controlling fusarium wilt by using the F test at an error level of 5% and followed by the Least Significant Difference (LSD) test. at the level of 5%.

3. RESULTS AND DISCUSSION

3.1 Research result

3.1.1 Incubation Period

Based on the observations of the incubation period of fusarium wilt due to attack by the pathogen F. oxysporum presented in Table 1. In the treatment without application of compost containing T. polysporum (control), symptoms of wilting appeared earlier than treatment with application of compost containing T. polysporum. In the treatment of application of 0.5 kg of compost containing T. polysporum to 5 kg of soil, wilting symptoms did not appear in all treatments from the first inoculation of the pathogen until the end of the 12-week observation, whereas in the control treatment, wilting symptoms began to appear on the 7th week of observation.

This is presumably due to the absence of application of compost containing T. polysporum in the control treatment resulting in low soil fertility which includes the physical, chemical and biological properties of the soil, so that the plants are in a weak condition and are easily infected with pathogens. According to Stone (2003), states that the addition of organic matter in the soil can improve soil functions such as infiltration, water holding capacity, storing and releasing nutrients, and resistance to wind and erosion. In addition, the addition of organic matter from plant residues to organic compost can reduce the spread of root rot due to various kinds of plant pathogenic fungi. Kwok et al. (1987 in Hoitink et al., 2001) also explained that the fungus Trichoderma spp. including T. hamantum and T.

During the observation period (14, 28 and 42 DAP) soil pH increased in all treatments. In the control (without treatment) has the lowest pH value. But this pH value does not differ much from the treatment on the leaves. It is suspected that in the treatment of the leaves, the compost tea given did not interact directly with the soil so that the pH value did not change much. Whereas in the treatment of soil, soil pH values tended to be higher presumably due to organic acids dissolved in

the compost tea. These organic acids are able to reduce the Ca-P Alfisol bonds, so that the pH increases due to the addition of alkaline cations in the soil (Hakim et al., 1986). Added by Stevenson (1977) an increase in pH is suspected of protonation and deprotonation of the results of the decomposition of organic matter which in turn affects the H+ concentration of the soil solution.

3.1.2 Attack Intensity

Based on the results of variance, it was shown that there was an effect due to different doses of compost application that had been inoculated by T. polysporum on the intensity of attack by the fungus F. oxysporum. Meanwhile, different compost application times and interactions had no significant effect on the intensity of attack by the fungus F. oxysporum on tomato plants.

Table 1. Average Attack Intensity of F. oxysporum and Effectiveness of Compost Containing T. polysporum Application to Control Fusarium Wilt Disease in Tomato Plants.

Dosage of Compost T. polysporum	Attack Intensity (%)	% Control
0 kg compost/5 kg soil (control)	9.58	0.00%
0.25 kg of compost/5 kg	2.79	47.80%
0.5 kg of compost/5 kg	1.07a	70.87%

Note: Numbers followed by the same letter in the same column are not significantly different based on the LSD test at the 5% level.

In the application of compost containing T. polysporum to the soil, the effectiveness of controlling fusarium wilt increased with increasing doses of T. polysporum compost applied. Application of 0.25 kg of compost containing T. polysporum to 5 kg of soil control effectiveness was 47.80% and application of 0.5 kg of compost containing T. polysporum to 5 kg of soil was effective in controlling fusarium wilt disease of 70.87% compared to with control treatment.

3.1.3 Tomato Plant Growth.

Based on the observations, it showed that there was a significant effect on the average height increase of tomato plants with different doses of application of compost containing T. polysporum and different application times to control fusarium wilt disease. It showed that application of compost containing T. polysporum at different application times in soil, can increase the height of tomato plants infected with pathogen F. oxysporum. The highest mean increase in plant height was in the treatment of application of 0.5 kg of compost containing T. polysporum to 5 kg of soil, respectively 19.84 cm, 18.89 cm and 18.03 cm and the lowest average was in the control treatment of 16.53 cm. Plant growth will be better if the dose of compost application contains T.

At the same dosage of T. polysporum compost application to soil and different application times, the best average height increase was application of compost containing T. polysporum 7 days before inoculation of the plant pathogen. The results of variance showed that there was an interaction effect between the doses of application of compost containing T. polysporum and the time of application of compost containing T. polysporum on the average number of leaves of tomato plants and showed that the fresh weight of plants was only affected by differences in the doses of compost containing T. polysporum. , while different application times and interactions did not significantly affect plant wet weight and based on the results of variance showed that the different application doses of compost containing T.

Table 2. Average Plant Wet Weight with Compost Application Dosage Contains T. polysporum

Dosage of Compost T. polysporum	Wet Weight Average (gram)
0 kg compost/5 kg soil (control)	172.70
0.25 kg of compost/5 kg	200.87
0.5 kg of compost/5 kg	243.74

Note: A number followed by the same letter in the same column indicates no significantly different based on the BNT test at the 5% level.

Table 3. Average Dry Weight of Plants with Compost Application Dosage Contains T. polysporum.

T. Polysporum Compost Dosage	Wet Weight Average (gram)
0 kg compost/5 kg soil (control)	46,44
0.25 kg of compost/5 kg	53,53
0.5 kg of compost/5 kg	65,77

Note: A number followed by the same letter in the same column indicates no significantly different based on the BNT test at the 5% level.

3.2 Discussion

The results showed that compost containing T. Polysporum was effective in controlling Fusarium wilt in tomato plants. The percentage of effectiveness of compost containing T. polysporum in controlling the intensity of disease attacks was 0% in the control treatment, 47.80% with the application of 0.25 kg of compost containing T. polysporum, and 70.87% with the application of 0.5 kg of compost containing T. .polysporum. The effect of time of application of compost containing T. polysporum is equally effective for controlling the pathogen attack of F. oxysporum. The large doses of T. polysporum compost applied prior to inoculation of the pathogen can increase plant growth and yield.

In the application of 0.5 kg of compost containing T. polysporum, the highest growth in plant height was 18.03-19.84 cm, while the lowest growth average was in the control treatment of 16.53-16.70. The highest average plant production of 237.65 grams was found in the application treatment of 0.5 kg of compost containing T. polysporum on 5 kg of soil applied 7 days before inoculation of the pathogen and the lowest average production of 112.06 grams occurred in the control treatment. Mushrooms have a single conidiophore, simple or assembled, have complex branching from the sporodosium, the branches ending in the pialides. Has two types of conidia, macroconidia with one or more septa, hyaline, cylindrical or hooked. Microconidia have no septa or only one septa oval to cylindrical in shape but short. Chlamydospores are usually single or in the middle of a series, with thick walls (Cook and Baker, 1996). According to Nugroho et al. (2003), the compost media contains a lot of organic matter and is highly favored by the fungus Trichoderma sp. as a place to grow because it contains a lot of chitin. The fungus Trichoderma sp. as a very effective biocontrol microbe to inhibit the growth of plant pathogens related to its ability to produce chitinase enzymes that can degrade pathogenic chitin randomly. The chitinase enzyme produced by Trichoderma sp. plays an important role in the control of plant pathogens by mycoparasitism. the compost media contains a lot of organic matter and the fungus Trichoderma sp. as a place to grow because it contains a lot of chitin. The fungus Trichoderma sp. as a very effective biocontrol microbe to inhibit the growth of plant pathogens related to its ability to produce chitinase enzymes that can degrade pathogenic chitin randomly. The chitinase enzyme produced by Trichoderma sp. plays an important role in the control of plant pathogens by mycoparasitism. the compost media contains a lot of organic matter and the fungus Trichoderma sp. as a place to grow because it contains a lot of chitin. The fungus Trichoderma sp. as a very effective biocontrol microbe to inhibit the growth of plant pathogens related to its ability to produce chitinase enzymes that can degrade pathogenic chitin randomly. The chitinase enzyme produced by Trichoderma sp. plays an important role in the control of plant pathogens by mycoparasitism. The chitinase enzyme produced by Trichoderma sp. plays an important role in the control of plant pathogens by mycoparasitism. The chitinase enzyme produced by Trichoderma sp. plays an important role in the control of plant pathogens by mycoparasitism.

4. CONCLUSION

Application of compost containing T. polysporum is effective for controlling fusarium wilt caused by F. Oxysporum f.sp. lycopersici on tomato plants and the application dose of compost containing T. polysporum affected the intensity of fusarium wilt attack on tomato plants. The application dose of compost containing T. polysporum has an effect on the effectiveness of controlling fusarium wilt, with the application of 0.25 kg and 0.5 kg of compost containing T. polysporum on 5 kg of soil able to control fusarium wilt by 47.80% and 70, respectively. 87% compared to the control treatment and application of compost containing T. polysporum to the soil at different times is equally effective for controlling the development of the pathogen.

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There is a need for further research on the effect of combining cultivation techniques that are usually carried out by farmers, as well as the most effective and efficient media for application on a field scale in order to obtain maximum production results.

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