Effect of *Trichoderma* Isolate from various regions on the growth inhibition of *Fusarium* sp on red chili (*Capsicum annuum*)

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ABSTRACT

So far, many farmers still use chemical pesticides and fungicides for their crops. This makes the plants produced contain a number of chemicals that are not good for health. Pathogenic fungi can be avoided by using fungicides from natural ingredients instead of chemical fungicides. One disease that is often found in red chili plants (*Capsicum annum*) is fusarium wilt. Previous studies have stated that the use of Trichoderma can reduce the wilting rate due to Fusarium. However, no studies have compared the ability of Trichoderma to Fusarium from various locations. Because of this, in this study a comparison of the antagonistic abilities of *Trichoderma* originating from three cities, namely Bandung, Tasikmalaya, and Banjar, will be carried out against *Fusarium*. The implementation method used is by inoculating *Trichoderma* with *Fusarium* in one petri dish. Then the diameter of the growing *Trichoderma* and *Fusarium* colonies was measured. Then an analysis was carried out by measuring the percentage of inhibition value of *Trichoderma* against *Fusarium*. The PIRG results showed that *Trichoderma* from Banjar had better results than *Trichoderma* from Tasik and Lembang. This is due to changes in metabolite results or due to differences in subcultures. *Trichoderma* affects the inhibition of *Fusarium* growth. The higher the value of the length and width of *Trichoderma*, the lower the value of the length and width of *Fusarium* because its growth is inhibited by the growth of *Trichoderma*.

Keywords: Bio-fungicide, inhibition, *Fusarium, Trichoderma*
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INTRODUCTION

So far, many farmers still use chemical pesticides and fungicides for their crops. This makes the plants produced contain a number of chemicals that are not good for health. According to Abadi *et. Al.* (2024), the continuous use of pesticides can cause the death of non-pathogenic microorganisms and cause pathogen resistance. In addition, chemical pesticides can also threaten the ecosystem if used continuously. According to Coomber *et al.* (2021), the continuous use of fungicides can lead to new pathogens that are more virulent and cause environmental pollution. The way that can be done to overcome this is to replace chemical pesticides and fungicides with pesticides and fungicides from natural ingredients. However, the health of the chili produced also needs to be considered. Process planting and maintenance is the main focus in avoiding plants chilies from disease attacks. According to Cachon *et al.* (2019), chili is influenced by some pathogens such as bacteria that cause soft rot, spotting, and wilt, gray mold, black mold, and anthracnose causes high post-harvest losses. Results of interviews with Catrianti (2022).

Director of Vegetables and Medicinal Plants, Directorate General of Horticulture Ministry of Agriculture (Kementan) Tommy Nugraha, stated that this happened decrease in chili yields caused by increasing pests in rainy season. Under normal conditions, the number of chilies produced is reaches one quintal, while during the rainy season the number of chilies is low only 20 kilograms are produced. According to Vivaldy *et al.* (2017), several viruses that usually attacks chili plants, namely CVMV (Chilean Veinal Mottle Potyvirus), CMV (Cucumber Mosaic Cucumovirus), PMMoV (Peppers Mild Mottle Potyvirus), and PYLCV (Peppers Yellow Leaf Curl Virus).

One way that can be done to avoid chili plants from Pathogenic attacks are by using pesticides and fungicides. So far, Many chili farmers still use pesticides and fungicides chemicals for the plants. This makes the chilies produced contains a number of chemicals that are not good for health. According to Abadi *et al.* (2024), continuous use of pesticides can cause the death of non-pathogenic microorganisms and causing pathogen resistance. Besides Moreover, chemical pesticides can also threaten ecosystems if used excessively prolonged. According to Coomber *et al*. (2024). , continuous use of fungicides continuously can give rise to new pathogens that are more virulent and cause environmental pollution. Ways that can be done to overcome this namely by replacing chemical pesticides and fungicides with pesticides and fungicide from natural ingredients.

Based on research conducted by Pertiwi (2021), microorganisms in the intestines of Black Soldier Fly (BSF) can be used as a manufacturing material biopesticide and bio-fungicide because it has a number of bacteria and fungi Good for plant growth and disease resistance. According to Aghis *et al.* (2020), biopesticides and bio-fungicides are biological materials that can destroy and can control pests and pathogenic fungi with using raw materials, namely plants or microorganisms, for example bacteria and fungi that function to attack certain pests or diseases. Pests exposed to biopesticides will usually experience damage to the body, stunted growth and development, then dies.

Pathogenic fungi can be avoided by using fungicides from natural ingredients instead of chemical fungicides. One of the natural ingredients that functions as a chemical fungicide is a fungus from the genus Trichoderma. According to Yao *et al.* (2023), *Trichoderma* sp. is a genus of fungi capable of acting as a biological pathogen control agent and is beneficial for plant growth.

One disease that is often found in red chili plants (*Capsicum annum*) is fusarium wilt. The symptoms of this disease begin with the blanching of the veins, especially the upper leaves. In addition, the leaf stalks will also droop and eventually the plant will wither (de Silva *et al.,* 2019).

Previous research conducted by Yao *et al.* (2019) proved that *Trichoderma* sp. can prevent wilt disease in chili plants. Another study conducted by Filizola (2019) showed that the use of Trichoderma could reduce the wilting rate due to *Fusarium* in tomato plants by 23.7%. Because of this, in this study a comparison of the antagonistic abilities of Trichoderma originating from three cities, namely Bandung, Tasikmalaya, and Banjar, will be carried out against *Fusarium*.

MATERIALS AND METHODS

Time and Location of Research

The research was conducted during November 2022. The location of this research was at the Microbiology Laboratory of the Vegetable Research Institute (Balitsa) which is located in Lembang District, West Bandung Regency.

Tools and materials used

The tools used in this study were plastic sampling, labels, shovels, vials, soil tester meters, refrigerators, aluminum foil, mortar pestles, vortex shakers, osse needles, petri dishes, incubators, microscopes, rulers, Bunsen burners, biosafety cabinets. The materials needed in this study were 70% alcohol, distilled water, 0.85% NaCl, PDA media, PSA media.

Isolation of Trichoderma from soil

Soil was taken from 10 points in the Lembang area, 1 point in the Tasikmalaya area, 1 point in the Banjar area. Soil is taken by digging the soil at a depth of 5-10 cm then the soil is put into a plastic bag that has been labeled with a location code and sampling point. In addition to taking samples, measurements of abiotic factors were also carried out at each point which included soil moisture, pH and soil temperature. Next, the vials are put into the refrigerator and left to die. After that, it is sterilized by soaking in 70% alcohol for 2-5 minutes and rinsed with distilled water. Soil is placed in a vial containing insects to get fungal spores and tightly closed with aluminum foil.

Fusarium and Trichoderma Inoculations

Rejuvenated Fusarium was inoculated onto PDA media. Then in the same cup, the *Trichoderma* that has been made is also inoculated. Then incubated at 27'C. After that, the diameter of Trichoderma and *Fusarium* colonies was measured to determine the antagonism effect of Trichoderma on *Fusarium*m.

Results Analysis

Analysis of the results was carried out by testing the ability of *Trichoderma* against Fusarium by measuring the length of the stem and root. The results obtained in each city were compared and a comparison was also made of plants with treatment and without treatment (control) to see the effectiveness of *Trichoderma* in suppressing Fusarium. In addition, Percentage Inhibition of Radial Growth (PIRG) was also calculated to determine the inhibition percentage of Fusarium by *Trichoderma*. The PIRG formula according to Yazid et. al. (2023) is as follows

PIGR (%) = (R1-R2)/R1 x 100%

Where

R1 = Diameter of pathogen without antagonist (control)

R2 = Diameter of pathogen with antagonist (dual culture)

RESULT AND DISCUSSION

Trichoderma isolates were obtained from 3 cities, namely Lembang, Tasikmalaya and Banjar. Even though they were taken from different cities, these three isolates had the same characteristics when cultured on PDA media, namely hyphae that were insulated, greenish in color, and had round-shaped conidia arranged in a chain (Figure 1). This is in accordance with the results of previous observations made by Del Carmen (2021who stated that the early development of Trichoderma sp. starting with white, slightly greenish white, light green, green, and dark green with round conidia. Observations were made to determine the antagonism of Trichoderma from various areas in Lembang, Tasikmalaya and Banjar against *Fusarium* on red chili (*Capsicum annuum*).

Based on the observations in Table 1, it can be seen that all Trichoderma from Lembang, Tasikmalaya, and Banjar have the potential for antagonism. The average length value of *Trichoderma* from Lembang was 8.28 with an average width of 6.19 while the average length of Fusarium applied to *Trichoderma* from Lembang was 4.12 with an average width of 3.1. *Trichoderma* antagonism in the Banjar and Tasikmalaya areas was able to inhibit *Fusarium* fungus with inhibition areas of 2 cm and 1.9 cm in diameter.

In the graph comparing the antagonism of *Trichoderma* from various cities to the growth of *Fusarium,* it can be seen that the higher the length and width of the Trichoderma colony, the lower the length and width of the *Fusarium* colony. The highest mechanism of antagonism occurs in *Trichoderma* from Tasikmalaya and Banjar. *Fusarium* without *Trichoderma* treatment showed the highest growth compared to Fusarium treated with Trichoderma.

The inhibition value (PIRG) of *Trichoderma* against Fusarium, namely Based on the results of the inhibition values, it can be seen that *Trichoderma* from Banjar has better results than *Trichoderma* from other places. There was a difference in growth rates between *Trichoderma* taken from Lembang and *Trichoderma* taken from Tasikmalaya or Banjar, possibly caused by changes in metabolite yields or due to differences in subcultures.

According to Saadaoui (2023), differences in *Trichoderma* growth rates could be due to differences in re-isolation or subculture between Trichoderma species. In addition, according to Lestiyani *et al.* (2022), *Trichoderma* should be inoculated before *Fusarium*. This is because *Trichoderma* will have a high opportunity to compete for food and a place to live first and be faster in penetrating the cell wall and entering the

Table 1. Antagonism among *Trichoderma* sp. to *Fussarium* sp.

Region	*Trichoderma*		*Fusarium*	
	Length	Width	Length	Width
Lembang	9.0 ±0.15	9.0±0.46	2.3±0.33	2.0 ±0.20
Tasikmalaya	8.28 ±0.15	6.0±0.46	4.7±0.33	3.5 ±0.20
Banjar	8.75±0.15	5.5±0.46	4.5±0.33	3.3 ±0.20

Table 2. PIRG value

Isolate *Trichoderma*	PIRG (%)
Lembang	8.4
Tasikmalaya	55.6
Banjar	57.8

cell to take nutrients and produce antibiotics that can kill Fusarium. According to Mustifa *et al.* (2024), the antagonistic mechanism arises because of competition between two types of fungi that are grown on one medium, this competition occurs because of the same need of each fungus for a place to grow and get media nutrients. According to Zin and Badaludin (2024), the mechanism of *Trichoderma antagonism* against pathogens can occur in several ways, namely competition for space and nutrition, producing metabolites that inhibit pathogen spores, direct contact, and toxic synthesis and killing cells with antibiosis. According to Panchalingam *et al.* (2022), the mechanism of antagonism of *Trichoderma* sp. against *Fusarium* sp. namely by entanglement and hyphae intervention so that the antagonist can penetrate the pathogenic fungal hyphae. According to Xiao *et al.* (2023), hyphae intervention by Trichoderma results in changes in chemical elements and particles in the cell wall so that it can affect the permeability of the pathogenic cell wall. According to Tyśkiewic *et al.* (2022), antagonistic hyphae that successfully intervene and penetrate will absorb food nutrients so that the pathogenic fungal hyphae can shrink and die.

Trichoderma acts as an antagonist to Fusarium. *Trichoderma* from Banjar had better results in inhibiting Fusarium. This result may be due to changes in metabolite yields or due to differences in subcultures. The higher the value of the length and width of *Trichoderma*, the lower the value of the length and width of Fusarium because its growth is inhibited by the growth of *Trichoderma*.

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