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Acremonium variecolor strain 130360 VS *Trichoderma harzianum* strain MGQ2 in Biocontrol: An Overview of Fungal Antagonist Applied Against Fungal Pathogen *Fusarium oxysporum*, A Cause of Moler's Disease in Shallot

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Abstract

One of the common diseases of shallot is moler disease, caused by Fusarium oxysporum. This disease causes some damage to the plant. The attack mechanism of Fusarium oxysporum is by penetrating, colonizing, and multiplying in the root area, then parasitizing and inhibiting the process of carrying water to whole parts of the plant. Biological control of moler diseases using fungal antagonist has developed considerably in recent years. Fungal antagonists play a significant role in controlling plant pathogens and moler diseases caused by Fusarium oxysporum, such as Trichoderma harzianum and Acremonium variecolor. A series of experiments in field conducted to assess the comparison of ability between Trichoderma harzianum strain MGQ2 and Acremonium variecolor strain 130360 in effectively controling moler in shallot.

Keywords: efficiency, production factors, productivity, rawa lebak rice fields.

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1. Introduction

Shallots are important spices that can be used as food seasonings, raw materials for the food industry, herbal medicines, and have high economic value [1]. One of the diseases that often attack shallots is moler disease caused by *Fusarium oxysporum*. This disease causes some damage to crops [2];[3].

The mechanism of attack of *Fusarium oxysporum* is to penetrate, colonize, and multiply in the root area, then parasitize and inhibit the process of carrying water to all parts of the plant, this is confirmed by [4], that the mechanism of inhibition carried out by *Trichoderma harzianum* against *Fusarium oxysporum* is a mechanism of parasitism.

Biological control techniques are considered safe for the environment using antagonistic microorganisms. The biological control of moler disease using fungal antagonists has developed rapidly in recent years. Fungal antagonists play an important role in controlling plant pathogens and moler diseases caused by *Fusarium oxysporum*, such as *Trichoderma harzianum* and *Acremonium variecolor*. *Trichoderma harzianum* is a fungus that can inhibit the growth of other fungal pathogens by releasing a number of toxic fungal substances and producing several enzymes that can degrade cell walls [4]. *Tricoderma harzianum* has been widely used as a biocontrol agent to suppress soil-borne pathogens, according to [5], the *Trichoderma harzianum* F116 strain has the most effective antagonistic activity against *Fusarium oxysporum* and has the potential for biological control. [6] also reported that *Trichoderma harzianum* TRICHO-SIN can be used as an effective biological control against *Colletotrichum* and *Fusarium* species. Meanwhile, *Acremonium* species generally have properties that are resistant to antifungal agents, such as azole compounds [7], so they can be used as biological agents for controlling moles.

This series of experiments was carried out to assess the comparison of the developmental ability of *Trichoderma harzianum* strain MGQ2 and *Acremonium variecolor* strain 130360 as biocontrol agents in controlling moler disease effectively in shallots which will assist in the development of efficient bioagents and will ultimately assist in crop improvement and management disease.

2. Materials and Methods

The purpose of the study was to control moler disease caused by *Fusarium oxysporum* by utilizing a fungi biological agent with *Acremonium variecolor* and *Trichoderma harzianum*. The materials used are shallot seeds, NPK fertilizer, *Trichoderma harzianum* strain MGQ2 and *Acremonium variecolor* strain 130360. The application was carried out in the same number with *Trichoderma harzianum*, which was sprayed around the plant twice a week, starting from the age of 10 DAC. The observation was made by measuring the intensity of the development of the disease. Repetitions were done three times, and sample observation carried out by taking ten plants for each repetition.

3. Results and Discussion

The comparison result between *Trichoderma* and *Acremonium* in controlling moler disease is observed in Figure 1. From the result, all two types of treatment suffered moler attack, but with different levels of severity. The most severe attack is in *Trichoderma* treatment, where the development of moler disease at the end of the planting season reaches 80%. This is because *Trichoderma* has difficulty adapting and dominating the growth of fungi that cause moler disease. The usage of *Trichoderma* in disease control is used as commercial biopesticides done worldwide. *Trichoderma* species was potential bio-control agents and producers of powerful cellulases [8]. [9] found a perfect correlation between increased cellulase production and rhizosphere competence by *T. harzianum*. The ineffectiveness of *Trichoderma* application in this experiment might be caused by the massively use of this fungi in the environment.

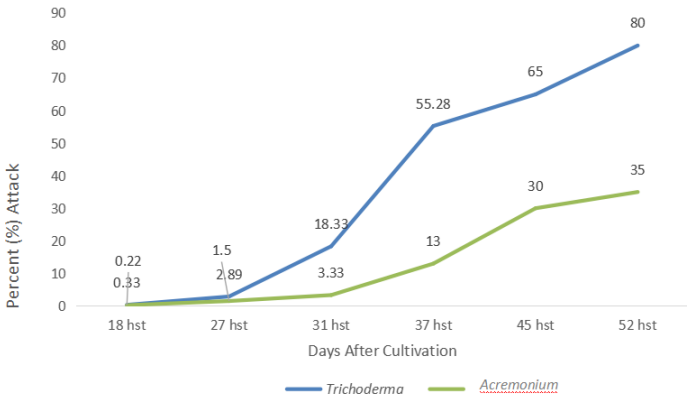

Figure 1. Comparison of the Shallot Moler Trend of Attack

The ineffectiveness of giving *Trichoderma* sp in this case to shallot plants can be caused by several factors, namely, the best time of application before planting [10], competition between soil pathogens, survival from the influence of fungicide residues in the soil, besides that also influenced by physical, chemical, and biological soil factors [8]; [11]. It was also stated by [12], that the rate of infection, plant susceptibility to pathogens, the ability of pathogenicity to pathogens, and plant physiological conditions, are strongly influenced by environmental conditions. This ineffectiveness can also be caused by the low adaptability and development of the rhizosphere population after being introduced into the soil, the adaptability and development of *Trichoderma* sp in the crop ecosystem is very decisive in the success of sustainable plants [13].

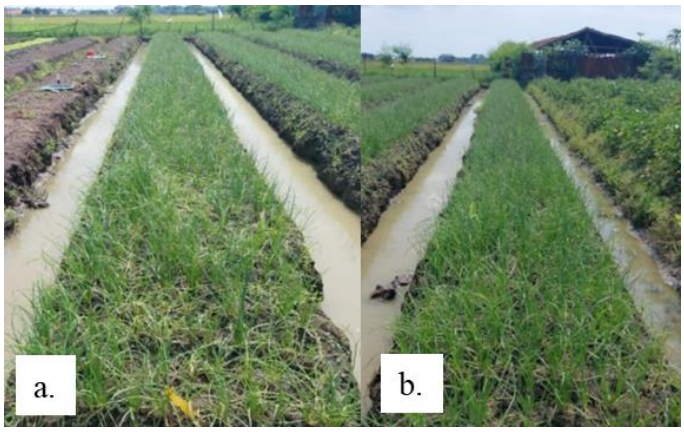

Figure 2. Visualization of Moler Attack on Shallot at the age of 27 DAC; a. *Trichoderma*, b. *Acremonium*

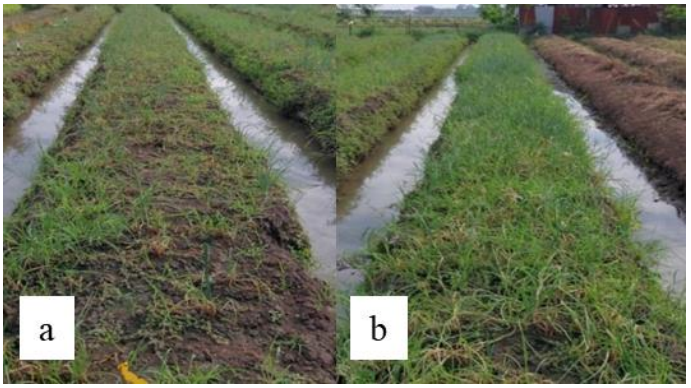

Figure 3. Visualization of moler attack on shallot at the age of 34 DAC; a. *Trichoderma*, b. *Acremonium*

Meanwhile, *Acremonium* shows the lower attack result, with a moler severity level of 35%. It showed that *Acremonium variecolor* strain CBS 130360 are better powerful biological agents to dominate and suppress the growth of *F.oxysporum* than *Trichoderma harzainum* strain MGQ2. The *Acremonium* endophyte has been observed to stimulate the tall fescue plant's production of chitinase, an enzyme associated with disease resistance [14].

Additionally, the effectiveness of this fungus against *Fusarium* has also been observed in tomato plants. *Acremonium* induced tylosis, indicating a possible pre-infectional resistance mechanism towards a later *Fusarium* infection [15]. In addition, according to [7], *Acremonium* species are generally resistant to antifungal agents, such as azole compounds.

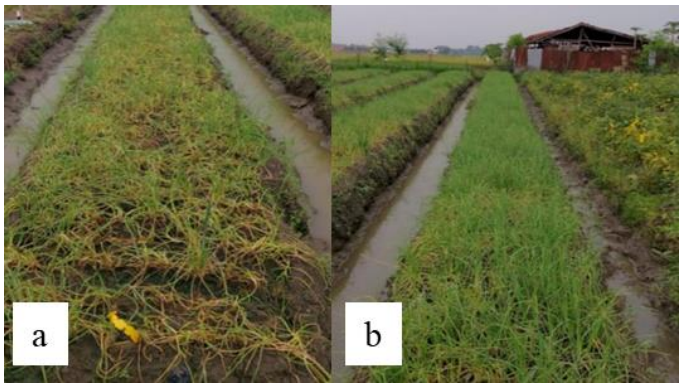

Figure 4. Visualization of moler attack on shallot at the age of 52 DAC; a. *Trichoderma*, b. *Acremonium*

The visual condition of shallot affected by moler disease observed after applying *Trichoderma harzianum* strain MGQ2 and *Acremonium variecolor* strain 130360. At the age of 27 DAC (Figure 2) observed visually that moler attack on shallot appears first in the treatment of *Trichoderma*, wherein some spots of the plant leaves have shown wilting attack. Furthermore, at the age of 34 DAC (Figure 3) observed that moler attacks detected in the treatment of *Acreminum* as well wheres the leaves are twisted and wilt (Figure 4). Shallots that are attacked by moler disease show symptoms of yellowing and twisting of the leaves, further attacks cause plants to die, tubers rot, and plants are easily removed. Most observed attacks spreadly found in the treatment of *Trichoderma*, while in the treatment of *Acremonium* these attacks found only in a few spots. Among the three types of treatment above, the condition of the plant result of the *Acremonium* is much better than *Trichoderma*. This indicates that *Acremonium variecolor* strain CBS 130360 is the best way to suppress the moler disease due to *F. oxysporum* fungi.

Efforts to obtain shallot varieties that have resistance to moler disease are not only done through breeding or with antagonistic biological agents but can also be modified by inducing shallot resistance triggered by certain chemical compounds, such as salicylic acid in vitro [16], and exploitation of compostability [18].

4. Conclusion

This research as the insight necessary to improve the another potential of fungal antagonist against *Fusarium* as fungal pathogen causes moler disease. *Acremonium variecolor* strain CBS 130360 fungi have tested and proven in controlling moler disease caused by *Fusarium oxysporum* with much better results compared to *Trichoderma harzianum* strain MGQ2.

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