I. INTRODUCTION

1.1. Background

One of the main food commodities for most people in Indonesia is rice. Therefore, most farmers, especially on the island of Java, cultivate rice. Badan Pusat Statistik (2024) presents data showing that rice production in 2024 decreased by 5% compared to rice production in 2023, reaching ± 484 thousand tons. This fluctuation in rice production can be influenced by several factors, such as climate crisis, soil or irrigation conditions, and pest and disease attacks.

One of the causes of fluctuations in rice production is the high incidence of plant pests. Plant pests are animals and plants, both microscopic and macroscopic in size, that can disturb, inhibit, and kill cultivated plants (Zanky et al., 2024). There are various types of Plant Pest Organisms that attack rice plants, namely pests such as planthoppers, stink bugs, rats, golden apple snails, and others, as well as diseases caused by viruses, bacteria, fungi, and nematodes. Attacks on rice plants, especially diseases, can result in a decrease in production, quality, and quantity, either directly or indirectly. One of the most common diseases found in rice plants is bacterial leaf blight caused by the bacterium *Xanthomonas* sp.

Xanthomonas sp. is a pathogenic bacterium that attacks rice plants and causes bacterial leaf blight (BLB). This disease is a major problem that hinders rice productivity. Infection *by Xanthomonas* sp. can occur at all stages of rice growth, from the vegetative to the generative phase. As a result, BLB can reduce rice yields by 30 to 40% (Seri Yanti et al., 2018). According to research by Istiqomah et al. (2022), the symptoms caused by this bacterium can be considered characteristic, starting with the formation of wet lines on the tips of leaf blades, which gradually turn yellow like they are burnt and spread, damaging the edges of the leaves and causing them to become wavy.

Control of BLB disease has so far depended on land sanitation, resistant varieties, and chemical bactericides. The use of chemical bactericides cannot be used for long periods of time. This is because chemical bactericides have residues that can pollute the surrounding environment. They can contaminate waterways, damage soil conditions, and even endanger humans due to residues that stick to

plants and rice production. Therefore, to avoid excessive use of chemicals, alternative methods are needed to reduce these chemicals. One such method is control using biological agents such as antagonistic bacteria and fungi (Seri Yanti et al., 2018).

Control of diseases caused by plant pathogens can be done through the use of biological agents. These biological agents include organisms such as predators, parasitoids, entomopathogens, and antagonistic microorganisms that play a role in suppressing the population of pests and plant pathogens. One of the advantages of using biological agents is that the residues produced are organic, so they can be integrated into plant metabolism and decompose naturally over time (Oktafia et al., 2022; Soensanto, 2017). There are several biological agents that are believed to control BLB, including the antagonistic bacteria *Bacillus* sp. and the antagonistic fungus *Trichoderma* sp.

Bacillus sp. bacteria are one of the biological agents belonging to the group of antagonistic bacteria that can suppress plant diseases. *Bacillus* sp. can live and grow optimally at a pH range of 7.3-10.5 and at a temperature range of 25-35ºC. In addition, *Bacillus* sp. can also survive at extreme temperatures of up to 40-45º C (Handayani et al., 2023). Based on its morphological characteristics, this genus of bacteria is described as rod-shaped, Gram-positive, aerobic or facultative anaerobic, and catalase-positive (Miljakovi´c et al., 2020). This bacterium also produces siderophores, binds nitrogen, acts as an antibacterial agent, wards off plant pathogens, and dissolves phosphate.

Trichoderma sp. is a microscopic fungus known for its ability as a biological control agent due to its antagonistic effects on other fungi and bacteria. These effects involve mechanisms such as predation, competition, parasitism, and the production of toxic compounds such as antibiotics. This fungus is a soil-dwelling fungus with the potential to degrade various heterogeneous substrates in the soil, produce nutrients for plants, and interact positively with its host. *Trichoderma* sp. has been proven to increase root length and plant height and can also reduce the severity of bacterial leaf blight disease (Gunawan et al., 2020; Sandy et al., 2019).

As is well known, there are many ways to control BLB. The use of biological agents can be an appropriate step in finding alternative solutions to control this disease. The two biological agents, *Bacillus* sp. Bth-22 bacteria and *Trichoderma* sp. fungus, each have very useful functions in controlling bacterial leaf blight. The combination of *Bacillus* sp. and *Trichoderma* has been widely used for plant growth and disease control. According to Manan et al. (2018), various enzymes such as nuclease, lipase, phosphatase, protease, chitinase, and so on, produced by the compatibility *of Bacillus* sp. and *Trichoderma* sp. can synergize with each other and reduce the virulence of pathogens that attack plants.

Based on the above description, it is necessary to know whether the two biological agents can be applied simultaneously and produce more optimal results in controlling BLB disease in rice plants. Therefore, this study was conducted to test the compatibility of these biological agents and their effect on *Xanthomonas* sp. bacterial attacks.

1.2. Problem Formulation

1. Does the consortium *of Bacillus* sp. Bth-22 and *Trichoderma* sp. inhibit the growth of *Xanthomonas* sp. bacteria more effectively than single antagonistic microbes *in vitro*?
2. Are *Bacillus* sp. Bth-22 and *Trichoderma* sp. compatible when used together in controlling BLB disease in rice plants compared to controlling antagonistic microbes individually?

1.3. Research Objectives

1. To determine the extent of the inhibitory effect of the *Bacillus* sp. Bth-22 and *Trichoderma* sp. consortium on *Xanthomonas* sp. compared to a single antagonistic microbe *in vitro*.
2. To determine the compatibility *of Bacillus* sp. Bth-22 and *Trichoderma* sp. when used simultaneously in controlling BLB disease in rice plants compared to controlling antagonistic microbes individually.

1.4. Research Benefits

This study is expected to provide information on the potential application of *Bacillus* sp. Bth-22 and *Trichoderma* sp. antagonistic microbes in consortium in controlling *Xanthomonas* sp. pathogenic bacteria, which cause BLB disease.