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# APPLICATION OF FOBIO BIOPESTICIDE IN SUPPRESSING THE INTENSITY OF BACTERIAL LEAF BLIGHT DISEASE IN PADDY PLANTS USING INTEGRATED PEST MANAGEMENT (IPM) IN RICE FIELDS OF PUTON VILLAGE, DIWEK DISTRICT, JOMBANG REGENCY, EAST JAVA

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## ABSTRACT

Control of bacterial leaf blight in rice plants is often done by applying chemical pesticides whose future effects will be very bad for the soil and plants that will be planted next. An alternative that can be applied is using the biopesticide Fobio. The aim of this research was to measure the effectiveness of the application of fobio in reducing the intensity of bacterial leaf blight attacks. This research was carried out in June-September 2023 in Diwek District, Jombang Regency. The study used a Randomized Block Design with two factors, namely the Fobio dose consisting of 3 levels, namely P0 (without giving Fobio / 0ml/liter), P5 (dose 5 ml/liter), and P10 (dose 10 ml/liter), the second factor was long The soaking time for seeds using Fobio consists of 3 levels, namely W10 (10 minutes soaking time), W20 (20 minutes soaking time), and W30 (30 minutes soaking time) so there are 9 treatment combinations. Observation parameters include plant height, number of leaves, number of tillers, and intensity of disease attacks. The results of the combination treatment were not significantly different for the number of leaves and number of tillers, for single and combination treatments the plant height and intensity of disease attacks were significantly different. Application of Fobio can increase plant height, number of leaves, and number of tillers on rice plants, and Fobio can suppress bacterial leaf blight attacks that attack rice plants.

**KEYWORDS** *Fobio Biopesticide, Bacterial Leaf Blight, Integrated Pest Management (IPM)*



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## INTRODUCTION

Rice (Oryza sativa L.) is one of the most important crops since the Indonesian population primarily relies on it as their main food source. It is the most crucial crop for small-scale farmers across various regions of Indonesia. Rice is commonly cultivated in paddy fields, in addition to swamps and dry land. Paddy fields are artificially created lands designated for rice cultivation and are flooded with water. This agroecosystem optimally supports rice growth but, on the other hand, can lead to massive weed growth. According to Chika and Abdul (2023), rice cultivation often encounters issues that result in crop failure, with one of the major problems being plant diseases, which led to a production loss of 54.6 million tons in 2020. The application of the Integrated Pest Management (IPM) concept is expected to improve inefficient and ineffective rice cultivation practices, ultimately increasing production quantity and farmers' income.

Bacterial leaf blight (BLB) is one of the major diseases affecting rice plants, caused by Xanthomonas oryzae pv. oryzae. This disease can infect rice from the vegetative to the generative stage, potentially reducing yields by 30 to 40%. The development of bacterial leaf blight is influenced by environmental factors such as humidity, temperature, cultivation methods, rice varieties, and excessive nitrogen fertilization. Several control methods have been attempted, including synthetic fungicides, land sanitation, and crop rotation with non-host plants. However, these methods have not provided satisfactory results. According to Rini et al. (2021), the unsatisfactory results are due to the high genetic diversity of Xoo, influenced by environmental factors, the varieties used, and genetic mutations. The most effective control method so far has been planting resistant varieties.

Biopesticides are an essential component in controlling plant pests and diseases. They are composed of organic compounds and antagonistic microbes that can inhibit or eliminate plant pests and diseases. According to Wiyatiningsih et al. (2021), Fobio biopesticide is formulated as either a liquid or dry formulation, with most formulations containing carrier substances. The microorganism suspension used in this biopesticide is created using a liquid medium derived from meat extract, 100 ml of potato extract, black glutinous rice extract, siwalan palm sap, fresh cow milk, honey, and sugar water. The microorganisms used are those naturally found in the rhizosphere of coconut plant roots, mangrove roots, and tunjang plant roots, as well as those inhabiting siwalan palm sap, coconut palm sap, and fresh cow milk. These microorganisms can effectively enhance plant resistance to pathogens for up to two years and have been granted a standard patent registration under No. P00201200183.

Several studies have previously investigated approaches to managing bacterial leaf blight (BLB) in rice. For example, Rini et al. (2021) found that genetic diversity of the pathogen Xanthomonas oryzae pv. oryzae (Xoo) complicates control efforts, as environmental conditions and mutation rates affect pathogen virulence, making resistant variety development a continuous challenge. Meanwhile, Wiyatiningsih et al. (2021) demonstrated the effectiveness of Fobio biopesticide formulations in suppressing various plant pathogens due to the synergistic action of indigenous antagonistic microbes. However, current research remains limited in directly comparing the effectiveness of these biopesticides with traditional pest management approaches under field conditions affected by diverse agroecological variables.

This study aims to evaluate the effectiveness of biopesticides composed of indigenous antagonistic microorganisms in suppressing bacterial leaf blight (BLB) in rice, and to assess their role within the broader Integrated Pest Management (IPM) strategy. The benefits of this study include providing sustainable and environmentally friendly disease control strategies that reduce reliance on chemical pesticides, enhancing rice yields, and supporting farmer livelihoods. Additionally, this research contributes to agricultural resilience and food security in Indonesia by introducing scalable biocontrol solutions that align with ecological farming principles.

## RESEARCH METHOD

**Location and Research Period**

This study was conducted on farmers' rice fields in Pojok Village, Puton Subdistrict, Diwek District, Jombang Regency, from June to September 2023. Puton Village is a lowland area at an altitude of approximately 50 meters above sea level, located at -7°38'00.7"S and 112°14'31.3"E. Observations were made directly in the field.

**Materials and Tools**

The materials used in this research included Fobio biopesticide, urea, bokashi fertilizer, Phonska fertilizer, biopesticides derived from jengkol and chili extracts, and water. The tools used included a hoe, fork hoe, bucket, hand tractor, plastic containers, diesel pump, hose, measuring glass, manual sprayer, electric sprayer, bamboo stakes, yellow traps, writing tools, ruler, and measuring tape.

**IR 64 Rice Seeds**

Farmers in Pojok Village, Puton Subdistrict, Diwek District, Jombang Regency, predominantly use the IR 64 rice variety. This variety has a plant height of approximately 85 cm, produces a high number of productive tillers, and has a 1,000-grain weight of around 27 g. According to the Indonesian Center for Rice Research (Pangan, 2013), IR 64 is highly favored by both farmers and consumers due to its delicious rice taste, short maturity period (110-125 days), and high yield potential of up to 5 tons per hectare.

**Seed Soaking Process**

Rice seeds were soaked in plastic containers for 24 hours before broadcasting. After soaking in water, Fobio biopesticide was added to each container at concentrations of 5 ml/L and 10 ml/L for 10, 20, and 30 minutes. After soaking, the seeds were drained and prepared for sowing in the rice field.

**Land Preparation**

Land preparation was carried out twice before transplanting. In the first stage, Fobio biopesticide was applied to the soil before plowing. The field was then flooded, and plowing was performed using a hand tractor to turn the soil, ensuring even distribution of Fobio throughout the field. After three days, a second plowing was conducted using the same method, but in this stage, the soil was leveled using a harrow to prevent excessive soil compaction and achieve an even planting bed.

**Bacterial Leaf Blight Identification**

The disease was identified directly by observing visible symptoms on rice leaves. Observations were conducted from the 3rd to the 9th week. During these seven weeks, Fobio biopesticide was applied weekly at a concentration of 10 ml/L.

**Research Observation Parameters**

The observed parameters included plant height, number of leaves, number of tillers, and bacterial leaf blight disease intensity. The disease incubation period was measured as the number of days required for initial symptoms to appear after inoculation with X. oryzae pv. oryzae. Disease severity was calculated using the following formula:

Where:

$$IP = \sum_{i=0}^{n} \frac{(n_i \, x \, v_i)}{Z \, x \, N} \, x \, 100\%$$

IP = Disease severity intensity (%)
$n_i$ = Number of affected plants or plant parts at a given damage scale
$v_i$ = Damage scale value for the i-th sample
N = Total number of sampled plants
Z = Highest damage scale value

**Data Analysis**

This study used a Randomized Block Design (RBD) with two factors and four replications. The two factors analyzed in this study were Fobio biopesticide dosage (P) and soaking duration (W):

Fobio Biopesticide Dosage (P):

$P_0$ = No Fobio application
$P_5$ = Fobio biopesticide at 5 ml/L concentration
$P_{10}$ = Fobio biopesticide at 10 ml/L concentration

Soaking Duration (W):
$W_{10}$ = Biopesticide soaking for 10 minutes
$W_{20}$ = Biopesticide soaking for 20 minutes
$W_{30}$ = Biopesticide soaking for 30 minutes

The collected data were analyzed using ANOVA (Analysis of Variance) and followed by the 5% Honest Significant Difference (HSD) test to determine the significance of treatment effects in this study.

## RESULT AND DISCUSSION

The average intensity of bacterial leaf blight infection calculations shows an increase in infection each week, indicating that Fobio can suppress bacterial leaf blight despite not being fully effective, as the numbers are still significant enough to cause crop failure.

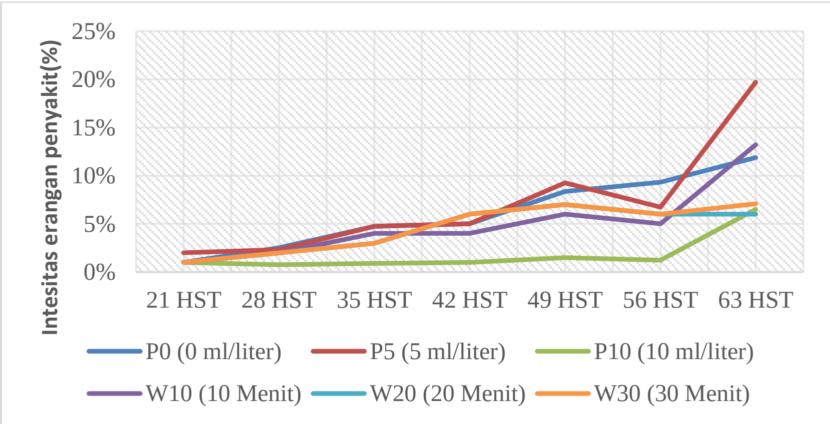


**Figure 1. Average intensity of bacterial leaf blight severity caused by Xanthomonas oryzae pv. Oryzae**

Based on the research results, the application of Fobio biopesticide in suppressing bacterial leaf blight intensity in rice plants shows that the single treatment (W) of soaking duration has little effect in reducing bacterial leaf blight intensity, except at 42 DAS (Days After Sowing), where it slightly reduced the intensity. Meanwhile, the single treatment of dosage (P) was able to suppress bacterial leaf blight intensity, and the higher the dosage of Fobio biopesticide, the more effective it was in reducing the intensity. This aligns with Sumartini (2016), who stated that biopesticides are effective for preventing pest or disease attacks before they occur. Biopesticides function as organic compounds and antagonistic microbes that inhibit or eliminate pests and plant diseases.

The results of this study indicate that applying Fobio biopesticide can suppress bacterial leaf blight infection, as shown by the declining disease severity scores from week 7 to 9. This finding is consistent with Gusdiono et al. (2021), who stated that Fobio biopesticide functions as a microorganism that enhances plant resistance to disease attacks. The microorganisms in Fobio biopesticide act as biological agents, decomposers, and PGPR (Plant Growth-Promoting Rhizobacteria). The nutrient content in the formula can increase yield while maintaining ecological balance, environmental sustainability, economic feasibility, and human health. The use of Fobio can also reduce chemical residue in soil and plants.

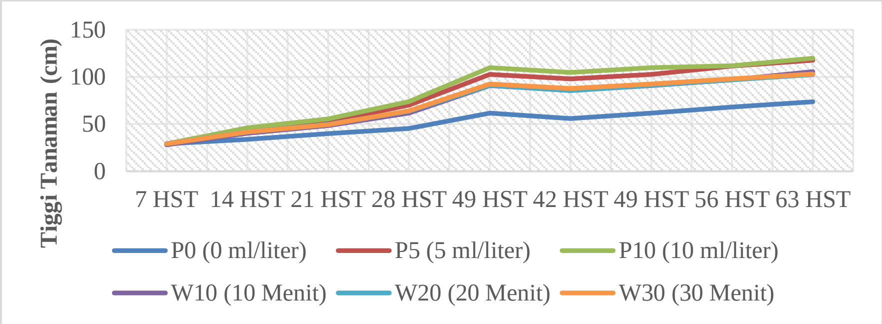


**Figure 2. Average effect of Fobio biopesticide application on rice plant height (PHT)**

The single treatment had a significant impact on increasing the average plant height. The highest average plant height (119.83 cm) was recorded in the treatment with a 10 ml/L Fobio dosage, whereas the lowest average height (73.71 cm) was found in the control group (without Fobio). An increase in plant height is one indicator of successful plant growth and development, and the use of PGPR in Fobio formulation can assist in rice plant growth. This aligns with Zerrouk et al. (2019), who found that PGPR can produce IAA, which controls plant growth by stimulating cell division and enlargement, ultimately increasing plant height.

The Fobio formulation contains Rhizobium sp., which plays an essential role in fixing atmospheric $N_2$ into a form absorbable by plants. This is consistent with Prasetyani et al. (2021), who stated that inoculating Rhizobium sp. significantly affects plant height and dry root weight. Rhizobium sp. belongs to the gram-negative bacterial group and functions as a nitrogen-fixing bacterium for plant growth (Dewantari et al. 2015; Nasution et al., 2016; R. Sari et al., 2018; R. K. Sari et al., 2021; Usnawiyah & Delvian, 2019; Yusuf & Risnawati, 2019).

Graph 2 also shows that the combination treatment of Fobio dosage and seed soaking duration significantly influenced plant height at 21 DAS and 28 DAS. At 21 DAS, the average plant height was 58.00 cm, and at 28 DAS, the highest average was 77.61 cm. This aligns with Putra et al. (2020), who found that soaking rice seeds with POC (liquid organic fertilizer) can maximize plant height components, leaf count, and tiller number by providing essential nutrients.

Seed soaking is often conducted to break seed dormancy, allowing water absorption during imbibition. Soaking in warm water is proven to remove germination inhibitors and stimulate growth hormone production, promoting seed germination. According to Surya et al. (2020), seed soaking is an invigoration method that accelerates germination and improves seedling quality.

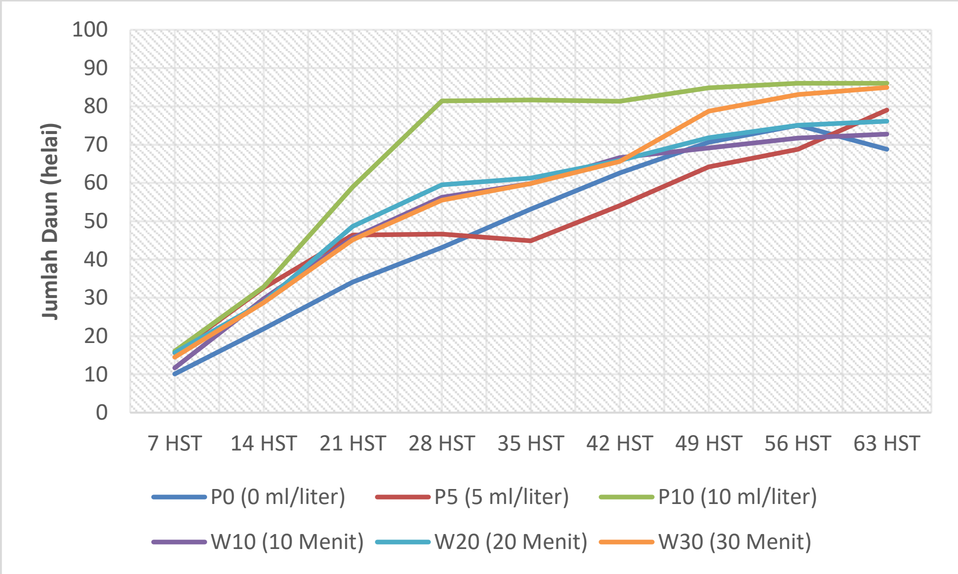


**Figure 3. Average effect of Fobio biopesticide application on the number of rice leaves (PHT)**

The increase in average leaf number due to Fobio application significantly impacted the single treatment. The graph shows that the 10 ml/L Fobio dosage yielded the highest number of leaves (86.03 leaves) at 63 DAS, whereas the control group (without Fobio) had the lowest average (68.78 leaves). Fobio contains PGPR, which aligns with Maulina & Darmayasa (2018), who found that PGPR increases chlorophyll content, enabling plants to expand leaf area and maximize light absorption for photosynthesis.

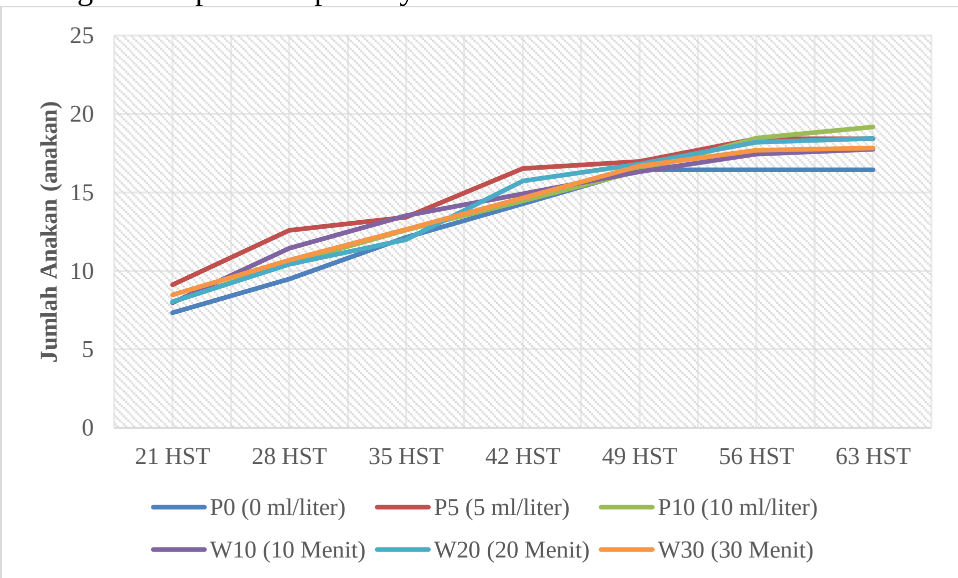


**Figure 4. Average effect of Fobio biopesticide application on the number of rice tillers (PHT)**

Tiller count observations were conducted from 21 DAS to 63 DAS. The results in Graph 4 indicate that the single treatment of 10 ml/L Fobio dosage produced the highest average number of tillers (19.17), while the control group had the lowest (16.44). The Rhizobacteria in Fobio formulation positively influenced tiller formation. This is in line with Ni Komang Budiyani et al. (2021), who found that using Rhizobacteria alters plant hormone concentrations and has antagonistic effects on plant pathogens through antibiotic production and systemic resistance induction. This approach is expected to improve seed quality and increase productive tiller numbers.

The number of productive tillers depends on the total number of tillers produced. Observations show that more tillers lead to a higher number of productive tillers. Rice tillers are classified into primary, secondary, and tertiary categories based on their formation timing. The first-formed tillers are more productive than later ones since older leaves cannot supply sufficient photosynthates for panicle formation in later-emerging tillers (Budiyani et al., 2021; Fauziah, 2019; Hadi, 2019; Lana et al., 2021).

## CONCLUSION

This research concludes that the application of Fobio biopesticide, particularly at a dosage of 10 ml/L, effectively suppresses the intensity of bacterial leaf blight caused by *Xanthomonas oryzae* pv. *oryzae* and enhances rice plant growth indicators, including plant height, leaf number, and tiller count. The biopesticide, containing beneficial microorganisms such as *Rhizobium* sp. and PGPR, significantly supports plant resistance, growth regulation, and nutrient absorption, leading to better vegetative performance. While single treatments of seed soaking showed limited influence on disease suppression, their combination with appropriate dosages showed promising synergetic effects in promoting early plant development. These findings highlight the potential of integrating biopesticides into sustainable rice cultivation practices to reduce chemical pesticide dependency, enhance crop resilience, and support environmentally friendly agriculture. For future research, field-scale evaluations across diverse agroecological zones and long-term assessments of yield components and soil health impact are recommended to validate the broader applicability and economic feasibility of Fobio-based biocontrol systems. Further exploration into microbial interactions within the rhizosphere and their genomic responses under stress conditions could also provide deeper insights into optimizing formulation efficacy.

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