



RESEARCH ARTICLE

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Effectiveness of Fobio Biopesticide in Controlling *Fusarium* sp. Stem Rot in Maize (*Zea mays* L.)

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Abstract

Stem rot disease caused by *Fusarium* sp. is one of the major disease affecting corn plants and can reduce crop productivity by damaging stem tissues and disrupting the transport of water and nutrients. This study aimed to determine the effectiveness of the biopesticide Fobio in controlling *Fusarium* stem rot disease in corn plants and its effects on plant growth and defense-related compounds. The study was conducted from December 2025 to February 2026 in Johowino Village, Mojoagung District, Jombang Regency, using a Completely Randomized Design (CRD) with five treatments and four replications: P0 (control), P1 (chemical fungicide), P2 (Fobio 5 mL/L), P3 (Fobio 7.5 mL/L), and P4 (Fobio 10 mL/L). The observed parameters included disease intensity, plant height, number of leaves, and salicylic acid and jasmonic acid contents. The results showed that Fobio application reduced disease intensity to 3.8%, compared with 9.16% in the control treatment, and increased plant growth and salicylic acid content by 4.08 mg/100 g. These findings indicate that Fobio biopesticide has potential as an alternative for controlling *Fusarium* sp. stem rot disease in corn plants. The primary advantage of Fobio is its potential to suppress disease development while promoting plant growth and enhancing defense-related compounds, making it a potentially more environmentally friendly alternative to chemical fungicides. Therefore, Fobio may be recommended as a sustainable disease management strategy for corn farmers to suppress *Fusarium* stem rot and improve crop performance.

Keywords: Biological Control, Disease Intensity, Jasmonic Acid, Plant Growth, Salicylic Acid

1. Introduction

Corn (*Zea mays* L.) is an important food commodity in Indonesia, serving as a source of food, animal feed, and industrial raw materials. The increasing demand for corn needs to be accompanied by improvements in crop productivity. However, corn production continues to face various challenges, including plant diseases that can significantly reduce crop yields (BPS, 2025; Sulaiman et al., 2018).

One of the major diseases affecting corn is stem rot caused by *Fusarium* sp. This pathogen infects stem tissues, disrupting the transport of water and nutrients and potentially causing plants to lodge before harvest. *Fusarium* sp. can survive in soil and crop residues for several years, allowing it to serve as a source of inoculum in subsequent growing seasons. Stem rot caused by *Fusarium* has been reported to reduce corn yields by 10–30%, while yield losses can exceed 50% under severe disease conditions.

The pathogen's ability to persist in soil and crop residues for extended periods makes the disease difficult to manage and can substantially affect crop productivity (Asiedu & Miedaner, 2025).

Disease management in corn still relies heavily on chemical pesticides. However, excessive or prolonged use of chemical pesticides can harm the environment and non-target organisms. Therefore, the development and application of more environmentally friendly disease management strategies are needed, including the use of biopesticides containing antagonistic microorganisms (Arif, 2015).

Biopesticides suppress pathogen growth while stimulating plant defence systems by increasing defence compounds such as salicylic acid and jasmonic acid. These compounds play a role in plant resistance mechanisms against pathogen attack (Astiko et al., 2022).

Fusarium stem rot disease in corn plants and its effect

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on plant growth and the content of plant defense compounds.

2. Material and Methods

The research was conducted from December 2025 to February 2026 in agricultural land in Johowinong Village, Mojoagung District, Jombang Regency, East Java Province, Indonesia. The research location is at coordinates around 7°31'26" South Latitude and 112°21'30" East Longitude with an altitude of ± 31 –35 meters above sea level (masl). The research area has flat topography dominated by agricultural land, with an average air temperature of 28–32°C and relative humidity of 70–85%.

2.1. Tools and Materials

Materials used in this study included corn seeds, Fobio biopesticide, chemical fungicides, water, and base fertilizer. Tools included a sprayer, a ruler or tape measure to measure plant height, writing instruments, a camera, and laboratory equipment to analyze salicylic acid and jasmonic acid content.

2.2. Research Methods

The study used a single-factor Completely Randomized Design (CRD) with five treatments and five replications. The treatments used were P0 (control), P1 (chemical fungicide), P2 (Fobio 5 ml/L), P3 (Fobio 7.5 ml/L), and P4 (Fobio 10 ml/L). Observed parameters included stem rot disease intensity, plant height, leaf number, and salicylic acid and jasmonic acid content.

2.3. Data Analysis

We analysed the results using normality and homogeneity tests as prerequisites. We then analysed the data using Analysis of Variance (ANOVA) at a 95% confidence level ($\alpha = 0.05$). If significant differences were found between treatments, we performed a further Honestly Significant Difference (HSD) test at the 5% level. All statistical analyses were performed using IBM SPSS Statistics version 26.

2.4. Research Flowchart

Start → Land Preparation → NK Perkasa Corn Seed Preparation → Planting → Treatment Application (P0, P1, P2, P3, P4) → Plant Maintenance → *Fusarium* sp. Inoculation → Observation (Disease Intensity, Plant Height, and Number of Leaves) → Leaf Sampling → Salicylic Acid and Jasmonic Acid Analysis → Data Analysis Using SPSS Version 26 → Conclusion → End.

3. Results and Discussion

3.1. Exploration of *Fusarium* sp.

Observations show that corn plants infected with stem rot exhibit symptoms ranging from brownish to blackish discolouration of the stems and decaying stem tissue

(Figure 1). In some plants, the pathogen attack makes the stems brittle, causing the plants to fall over easily. This indicates that the *Fusarium* sp. pathogen is capable of invading the plant's vascular tissue and inhibiting water and nutrient transport. The presence of the pathogen in the field is a major factor influencing the disease intensity and growth of corn plants. Stem rot caused by *Fusarium* sp. can significantly reduce yields because tissue damage occurs from within the stem and is often undetected in the early stages (Zhang *et al.*., 2022).



Figure 1. Symptoms of *Fusarium* sp. stalk rot in maize plants. Source: Personal collection.

3.2. Disease Intensity

The results of the study showed that the application of Fobio biopesticide affected the intensity of stem rot disease caused by *Fusarium* sp. The highest disease intensity was in the control treatment (P0) at 9.16%, while the lowest was in the P4 treatment at 3.8% (Figure 2). The decrease in disease intensity with increasing Fobio dose indicates that the microorganisms in the biopesticide can inhibit pathogen development of pathogens.

in plant tissues. Antagonistic microorganisms can suppress pathogen growth through nutrient competition, the production of antibiotic metabolites, and colonization of plant root and stem surfaces. This reduction in pathogen attack is the initial factor influencing plant physiological conditions, allowing optimal plant growth. Overall, this research strengthens the theory that appropriate and measured disease management can effectively reduce the severity of attacks in agricultural land.

The reduction in disease intensity in the Fobio treatment is thought to be due to the activity of antagonistic microorganisms contained in the biopesticide. These microorganisms inhibit pathogen development through competition for space and nutrients and the production of antibiotic compounds. By reducing pathogen development, the level of plant tissue damage can be suppressed,

resulting in lower disease intensity compared to untreated plants.

Table 1. Average disease intensity on 42–70 DAP on maize plants

Treatment	Disease Intensity (%) $\pm$ SE
P0 (Control)	9.16 $\pm$ 0.93a
P1 (Fungicide)	6.62 $\pm$ 0.93b
P2 (Fobio 5 ml/L)	5.96 $\pm$ 0.93b
P3 (Fobio 7.5 ml/L)	4.20 $\pm$ 0.93b
P4 (Fobio 10 ml/L)	3.80 $\pm$ 0.93c

3.3. Plant Height

Application of the biopesticide Fobio also affected corn growth, as shown by increased plant height (Figure 2). Plants treated with Fobio tended to have higher plant heights than those treated with the control. This is thought to be related to reduced disease intensity, allowing plants to grow optimally.

In addition to suppressing pathogen growth, the microorganisms contained in biopesticides can also play a role in increasing nutrient availability around plant roots. This can improve the plant's ability to absorb nutrients needed for vegetative growth.

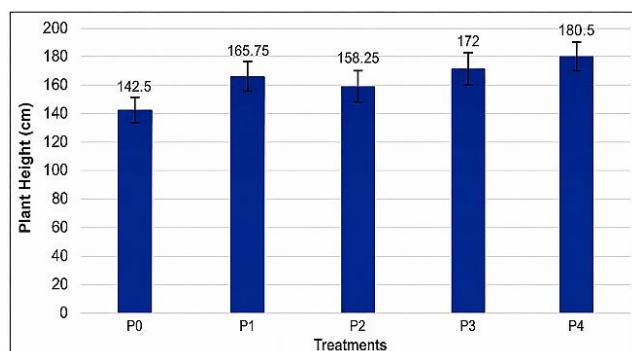


Figure 2. Graph of average height 14–70 DAP (Days After Planting) for maize plants

Thus, the reduction in disease intensity due to biopesticide application indirectly contributes to increased corn plant growth. Furthermore, environmental factors and soil fertility also significantly influence plant productivity and growth. Low plant productivity can be influenced by low soil fertility, increased pest infestation, microclimate changes, and the use of low-quality seeds (Triharyanto *et al.*, 2013).

3.4. Number of Leaves

The number of leaves in corn plants tended to increase in the treatment with the biopesticide Fobio compared to the control treatment (Table 2). Plants with lower disease intensity had a better ability to carry out the process of photosynthesis. They were therefore able to produce more leaves than plants attacked by the pathogen with high intensity.

The number of leaves is directly related to the plant's photosynthetic surface area. More leaves mean greater photosynthate production, supporting overall plant growth. This shows that biopesticide use not only suppresses pathogens but also increases corn vegetative growth.

Table 2. The average number of leaves on maize plants from 14 to 70 days after planting (DAP)

Treatment	Number of Leaves $\pm$ SE
P0 (Control)	10.25 $\pm$ 0.25a
P1 (Fungicide)	11.50 $\pm$ 0.25b
P2 (Fobio 5 ml/L)	12.00 $\pm$ 0.25b
P3 (Fobio 7.5 ml/L)	13.25 $\pm$ 0.25c
P4 (Fobio 10 ml/L)	14.00 $\pm$ 0.25c

3.5. Salicylic Acid Content

Salicylic acid content in corn plants increased in the treatment with the biopesticide Fobio compared to the control. The highest salicylic acid content was found in the P4 treatment at 4.08 mg/100 g (Table 3). This increase in compound content indicates activation of the plant's defense system against pathogen attack.

Salicylic acid is a plant hormone that plays a crucial role in pathogen resistance by activating systemic defence responses. Increasing salicylic acid levels can induce the plant's immune system, making it more tolerant to pathogen attacks (Rahmawati & Subekti, 2021; Putri & Wibowo, 2021).

Table 3. Salicylic acid content in maize plants subjected to treatments.

Treatment	Salicylic Acid mg/100 g
P0 (Control)	1.22a
P1 (Fungicide)	2.18b
P2 (Fobio 5 ml/L)	2.22b
P3 (Fobio 7.5 ml/L)	3.12b
P4 (Fobio 10 ml/L)	4.08c

Description: Data are the results of observations from one sample in each treatment, so statistical analysis was not carried out because there were no research replicates.

3.6. Jasmonic Acid Content

Jasmonic acid content in corn plants also showed an increasing trend in the treatment with the biopesticide Fobio (Table 4). The increase in jasmonate levels indicates that the plants activated physiological defense mechanisms against pathogen attack. Jasmonic acid is known to play a role, along with salicylic acid, in regulating the plant's defense response to pathogens through the activation of defense genes and the production of antimicrobial compounds (Maksimov *et al.*, 2020; Rai *et al.*, 2021).

The increase in jasmonic acid levels observed in the Fobio treatment indicates that the biopesticide not only directly suppresses pathogen development but also induces systemic plant resistance. Thus, the results indicate that

Fobio biopesticide application can suppress disease intensity, increase plant growth, and stimulate plant resistance by increasing salicylic acid and jasmonic acid levels.

Table 4. Contents of jasmonic acid on the treatment of corn plants

Treatment	Jasmonic Acid mg/100 g
P0 (Control)	1.04a
P1 (Fungicide)	2.15b
P2 (Fobio 5 ml/L)	2.19b
P3 (Fobio 7.5 ml/L)	3.05b
P4 (Fobio 10 ml/L)	4.16c

Description: Data are the results of observations from one sample in each treatment, so statistical analysis was not carried out because there were no research replicates.

4. Conclusion

Applying the biopesticide Fobio effectively reduces

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