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Response Of Migo Biological Fertilizer On The Growth And Yield Of Trisakti Rice Plants (Oryza Sativa L.) At Ug Tecnopark Cianjur

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Abstract

Rice (Oryza sativa L.) is the primary food commodity in Indonesia and plays a crucial role in national food security. One key factor influencing rice productivity is the use of appropriate fertilizers. Biofertilizers offer a sustainable alternative that can enhance plant growth and yield by improving soil fertility and increasing nutrient availability, while remaining environmentally friendly. This study aimed to analyze the effect of MIGO biofertilizer on the growth and yield of the Trisakti rice variety in the UG Technopark paddy fields. The research employed a quantitative approach using a completely randomized design (CRD) and an independent-samples t-test in IBM SPSS 27. The experiment involved one factor: the application of MIGO biofertilizer treatment versus a control (without MIGO). Observed parameters included plant height, number of tillers, number of productive tillers, number of productive panicles, harvest age, fresh weight per clump, 1000-grain weight, and grain yield. The results demonstrated that MIGO biofertilizer significantly enhanced the growth of the Trisakti rice variety, increasing various growth parameters, including plant height, number of tillers, number of productive tillers, number of productive panicles, stover weight, 1000-grain weight, and grain yield per plot.

Keywords: Biological Fertilizer, MIGO, Plant Growth, Rice, Yield

1. Introduction

Rice (Oryza sativa L.) is the primary staple crop for most of the Indonesian population and a strategic commodity across Asia. As the main source of carbohydrates, rice plays a crucial role in ensuring both national and global food security. Its nutritional content, rich in carbohydrates and essential vitamins, makes rice an indispensable source of daily energy (FAO, 2021). However, national rice production has fluctuated and declined, from 54.7 million tons in 2022 to 53.1 million tons in 2024 (BPS, 2025). This situation underscores the urgent need to enhance rice productivity to meet the continuously growing demand.

One effective strategy to enhance rice productivity is through agricultural technological innovation, particularly the use of biofertilizers. Biofertilizers contain beneficial microorganisms that improve soil fertility, increase nutrient availability, and reduce dependence on chemical fertilizers, thereby promoting environmentally sustainable agricultural systems (Hayat et al., 2010).

Increased productivity is needed to keep up with consumption growth, and one way is through agricultural technology innovations such as biofertilizers. Biofertilizers contain microbes that can improve soil fertility, increase nutrient availability, and reduce dependence on chemical fertilizers (Hayat et al., 2010). MIGO (Mikroba Google) biofertilizer contains superior microbes that can accelerate the decomposition of organic matter and increase the availability of N, P, and K, potentially increasing the yield of superior rice varieties, including Trisakti. The Trisakti rice variety, developed by Prof. Dr. Ir. Ali Zum Mashar, is known among farmers for its ability to be harvested in a short time (±75 HST) and its high yield potential. However, it should be noted that, to date, the Trisakti variety has not been listed among the superior varieties with a Variety Release Decree from the Minister of Agriculture or officially registered with the Center for Rice Instrument Standard Testing (BBPSIP Padi, 2023). Therefore, its pest resistance and productivity performance are still independent breeding claims that are highly dependent on specific nutrient management practices, such as the use of phosphate-solubilizing microbes (M-Bio), to achieve optimal results in the field.

Despite the potential benefits of MIGO biofertilizer, scientific data on its effects on the growth and yield of the Trisakti rice variety remain limited, especially under the field conditions of the UG Technopark paddy fields. Moreover, the extent to which MIGO biofertilizer can contribute to sustainable and environmentally friendly rice production systems has not been thoroughly evaluated. This study aims to analyze the effect of MIGO biofertilizer application on the growth and yield of Trisakti rice in UG Technopark paddy fields. The findings are expected to provide scientific evidence supporting the development of efficient and sustainable fertilization strategies that enhance rice productivity and maintain the long-term balance of agricultural ecosystems (Vacheron et al., 2013**).**

2. Materials and Methods

This research was conducted in Mande District, Jamali-Mulyasari Village, Cianjur Regency, at an altitude of 400 to 700meters above sea level, with coordinates of -6.90° latitude and 107.15° longitude. The study spanned four months, from December 2024 to March 2025. The equipment used included two-wheeled tractors, rulers, digital scales, 15-liter sprayers, and bamboo stakes to mark plot boundaries. The primary research materials were MIGO biofertilizer and Trisakti superior rice seeds.

The research employed a quantitative approach using a completely randomized design (CRD). Tests for normality and homogeneity were conducted prior to conducting an independent-samples t-test using IBM SPSS 27. There was only one treatment factor: the application of MIGO biofertilizer at two levels—control without MIGO (M0) and MIGO at 250 ml per 15 liters of water (M1). Each treatment was replicated 10 times, resulting in a total of 20 experimental units. Each replicate contained 9 plants, totaling 180 plants grown on an area of 800 m².

Data collection was conducted through direct field observation and measurement of various plant growth variables, including plant height, number of tillers, number of productive tillers, number of productive panicles, 1000-seed weight, fresh weight per plant, harvest age, and yield.

3. Materials and Methods

Normality and homogeneity tests

The results of the normality and homogeneity tests indicate that several observed variables met the assumptions of normality and homogeneity of variance ($p > 0.05$). In contrast, others failed to meet either assumption ($p < 0.05$). This variation suggests differences in the distribution characteristics of growth and yield parameters, both with and without MIGO biofertilizer application.

Variables that met the assumptions of normality and homogeneity of variance were deemed suitable for further analysis using parametric statistical tests. Conversely, variables that violated these assumptions required alternative analytical approaches to ensure the validity and reliability of the statistical inferences. Therefore, appropriate statistical methods were selected based on the distribution and variance characteristics of each variable.

Table 1: Normality and homogeneity test

Variable	Normality (p-value)	Homogeneity (p-value)
Plant height with MIGO fertilizer	.593	.006
Number of tillers with MIGO fertilizer	.008	.843
Plant height without MIGO fertilizer	.154	.796
Number of tillers without MIGO fertilizer	.035	.006
Productive tillers with MIGO	.017	.386
Productive panicles with MIGO	.006	.365
Productive tillers without MIGO	.033	.365
Productive panicles without MIGO	.682	.400
Weight per hill with MIGO	.020	.010
1,000-grain weight with MIGO	.006	.005
Weight per hill without MIGO	.058	.007
1,000-grain weight without MIGO	.006	.010

Note: Data are considered normally distributed and homogeneous when $p > 0.05$.

Plant Height

Table 2 shows a very significant effect of MIGO on plant height in M1, whereas in M7, there is a noticeable difference. The MIGO treatment resulted in taller rice plants than those without MIGO.

Table 2. Plant Height (cm)

Treatment	M1	M3	M5	M7
	Mean	*Mean*	*Mean*	*Mean*
MIGO	21.226**	41.818	67.750	103.468*
Without MIGO	20.178	41.482	67.454	99.685

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested using the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M1: observation of plant height in week 1; M3: observation of plant height in week 3; M5: observation of plant height in week 5; M7: observation of plant height in week 7.*

The functional microbes contained in the MIGO treatment, such as *Azotobacter* sp., *Azospirillum,* and *Bacillus* sp., play an important role in increasing plant height. This significant difference indicates that these microbes are effective in stimulating growth. These microorganisms function by increasing nitrogen availability in the soil through biological nitrogen fixation, as well as by producing phytohormones (auxin, cytokinin, and gibberellin) that accelerate shoot and stem growth. This is supported by research by Bashan & de-Bashan (2010), which states that *Azospirillum* and *Azotobacter* can improve nutrient uptake and root growth, while *Rhizobium* sp. and *Bacillus* sp. are nitrogen-fixing bacteria that support plant growth.

Number of Tillers

Table 3 shows that there is a significant difference in the effect of MIGO on the number of tillers in M5, while in M7, there is a very significant difference. The treatment with MIGO produced more rice tillers than without MIGO.

Table 3. Number of Tillers (Tiller)

Treatment	M3	M5	M7
	Mean	*Mean*	*Mean*
MIGO	4.611	11.655*	27.900**
Without MIGO	4.177	10.911	23.833

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level, ** significantly different at the 1% significance level, and no asterisk indicates no significant difference. M3: observation of the number of offspring in the 3rd week; M5: observation of the number of offspring in the 5th week; M7: observation of the number of offspring in the 7th week.*

The use of MIGO biofertilizer gradually increases the number of rice seedlings over time, demonstrating its progressive adaptation and influence on plant growth. Although its effect is not yet optimal at the beginning of growth (M3), over time, the functional microbes within it begin to work effectively to increase nutrient availability, improve soil structure, and produce growth hormones. A significant increase in the number of tillers is clearly visible from the middle vegetative phase (M5) to the advanced stage (M7). This increase is supported by various microorganisms in MIGO, such as *Azotobacter* sp., *Azospirillum*, *Rhizobium* sp., *Bacillus* sp., and *Pseudomonas*, which play a role in nitrogen fixation, phosphate solubilization, and plant hormone synthesis.

Productive Tiller

Based on Table 4, the treatment with MIGO significantly improved results compared to the treatment without MIGO. This indicates that the use of MIGO had a highly significant effect on increasing the number of productive rice seedlings during that period.

Table 4. Productive Tiller (Tiller)

Treatment	M10
	Mean
MIGO	24.366**
Without MIGO	20.444

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

The application of MIGO biofertilizer resulted in a significant increase in the number of productive tillers in rice. The average number of productive tillers in the MIGO treatment was 24.366, much higher than the 20.444 in the treatment without MIGO. This increase is driven by the active role of microorganisms in MIGO, such as *Azotobacter* sp., *Azospirillum*, *Rhizobium* sp., *Bacillus* sp., and *Pseudomonas*, which enhance the availability of nitrogen and phosphorus. These microorganisms facilitate biological nitrogen fixation and phosphate solubilization, and produce natural growth hormones, which collectively support the formation of productive tillers and grain filling during the generative phase. The nitrogen and phosphorus nutrients supplied by microorganisms are crucial in this process, as both support vegetative growth and the development of reproductive plant organs.

Productive Panicles

Based on the data presented, treatment with MIGO significantly improved yields compared to treatment without MIGO. The use of MIGO had a highly significant effect on increasing the number of productive rice panicles at that time.

Table 5. Productive panicles (Panicle)

Treatment	M10
	Mean
MIGO	24.155**
Without MIGO	19.344

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

The application of MIGO biofertilizer significantly increases the number of productive panicles in rice plants. The average number of productive panicles in the MIGO treatment reached 24.155, higher than 19.344 in the treatment without MIGO. This increase is due to the active role of microorganisms in MIGO, including *Azotobacter* sp., *Azospirillum, Bacillus* sp., and *Pseudomonas.* These microorganisms provide essential nutrients, such as nitrogen (through fixation) and phosphorus (through solubilization), which are crucial for panicle formation and development. Additionally, microorganisms, such as *Pseudomonas*, produce phytohormones that support the growth of reproductive organs and facilitate potassium absorption, which is important for optimal grain filling in rice. The number of tillers and productive tillers also increased with the MIGO treatment. This is very important, as productive tillers contribute directly to grain yield potential (Uphoff *et al*., 2013).

Harvest Age

Table 6 shows the percentage of rice harvest age in treatments using MIGO and without MIGO at the time of observation M10. It can be seen that the treatment with MIGO reached 100% harvest age, while the treatment without MIGO reached 95%. This indicates that the use of MIGO can accelerate or ensure optimal harvest age in rice plants.

Table 6. Harvest Age (%)

Treatment	M10
	Age at harvest %
MIGO	100%
Without MIGO	95%

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

Treatment with MIGO biofertilizer resulted in a significant increase in rice grain maturity by up to 100%, higher than the treatment without MIGO, which was only 95%. This indicates that MIGO acts as a bioregulator that optimizes the physiological process of grain maturation, consistent with the research by Priyadi *et al.* (2022). This perfect grain maturation results in better harvest weight, moisture content, and rice quality, providing important agronomic benefits for productivity and crop quality and proving a significant increase in the number of panicles capable of producing grain. Harvesting age in the MIGO treatment reached 100%, more optimal than the control (95%), indicating an acceleration of grain maturity towards the ideal harvest time (Pusat Penelitian Tanaman Pangan, 2012).

Weight per fresh clump (biomass)

Table 7 shows the average weight per clump (biomass) of rice in treatments using MIGO and without MIGO at observation time M10. Based on the data presented, the treatment with MIGO resulted in a significant increase in the yield compared to the treatment without MIGO. This indicates that the use of MIGO significantly increased the fresh weight per rice plant (biomass) at that time.

Table 7. Weight Per Fresh Clump (g)

Treatment	M10
	Mean
MIGO	254.155**
Without MIGO	221.266

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

The use of MIGO biofertilizer resulted in a significant increase in the weight of rice panicles per plant. The average weight in the MIGO treatment reached 254.155 g, much higher than 221.266 g in the treatment without MIGO, indicating a significant increase in biomass. This increase is attributed to the synergistic activity of functional microorganisms in MIGO, such as phosphate-solubilizing bacteria (*Bacillus* sp., *Pseudomonas*) and nitrogen-fixing bacteria (*Azotobacter* sp., *Azospirillum*). These microorganisms optimize the availability of macronutrients (N, P, K) that are crucial for vegetative growth, root development, and plant metabolism. These results are consistent with other studies showing that biofertilizers based on *Azospirillum* and *Bacillus* sp. can increase biomass weight and improve the efficiency of inorganic fertilizer utilization. The fresh weight per clump (biomass) parameter also increased significantly to 254,155 g in the MIGO treatment compared to 221,266 g in the control, indicating an increase in grain biomass per clump (Fukami et al., 2018).

Weight of 1000 Grains

Table 8. Weight of 1000 Grains (g)

Treatment	M10
	Mean
MIGO	25.500**
Without MIGO	23.722

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

The use of MIGO biofertilizer resulted in a significant increase in the weight of 1000 grains of rice. The average weight in the MIGO treatment reached 25.500 g, heavier than the 23.722 g in the treatment without MIGO. This increase is due to the role of functional microorganisms in MIGO, such as *Azotobacter* sp., *Azospirillum, Bacillus* sp., and *Pseudomonas,* which synergistically enhance the availability of essential nutrients. Nitrogen-fixing bacteria and phosphate solubilizers ensure optimal N and P supply for protein formation, ATP synthesis, and grain filling. Additionally, these microorganisms

Treatment	M10
	Mean
MIGO	1616**
Without MIGO	1000

facilitate potassium absorption, which is crucial for the translocation of photosynthetic products into the grains. The 1000-grain weight, an indicator of grain quality, increased from 23.722 g to 25.500 g, indicating an increase in grain size and quality (Gouda *et al*., 2018).

Wet Weight of Grain and Dry Weight of Grain

The wet grain weight of 1616 g and the dry grain weight of 1252 g show a significant difference because the water content in the wet grain is still high, whereas the drying process removes water, reducing the grain weight and accurately representing the net weight of the harvest.

Table 9. Wet Weight of Grain (g)

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

Table 10. Dry weight of grain (g)

Treatment	M10
	Mean
MIGO	1252 g*
Without MIGO	926 g

*Description: The number followed by an asterisk indicates the significance level of differences between treatments tested with the t-test, as follows: * significantly different at the 5% significance level; ** significantly different at the 1% significance level; no asterisk indicates no significant difference. M10: observation of productive panicles in the 10th week.*

The application of MIGO biofertilizer resulted in a significant increase in the wet and dry weight of rice compared to the treatment without MIGO. The wet weight increased from 1000 g to 1616 g, and the dry weight from 926 g to 1252 g. This increase is attributed to the role of functional microorganisms in MIGO that optimize nutrient availability. However, its effect may be influenced by environmental factors such as rainfall and soil conditions. Wet and dry grain yields also increased significantly, with wet grain weight reaching 1616 g and dry grain weight 1252 g compared to the control, indicating an increase in quantitative yield and post-harvest quality stability (Sutaryo, 2013).

4. Conclusion

In conclusion, this data lends credence to the idea that altitude has a significant role in determining the damage levels and population dynamics of fruit flies in West Sumatra. These findings also underline the ecological complexity of pest dynamics across altitude gradients and suggest that considering altitude when designing integrated pest management (IPM) strategies, localized monitoring, and tailored management interventions in pre-montane and montane agricultural zones.

This study demonstrates that the application of MIGO biofertilizer significantly improves the growth and yield performance of the Trisakti rice variety. The results indicate that MIGO biofertilizer effectively enhances key vegetative and reproductive growth characteristics, confirming its potential to improve rice productivity. MIGO biofertilizer increases various growth parameters such as plant height, number of tillers, leaf color, productive tillers, productive panicles, fresh weight of stover 254.1 g, weight of 1000 grains 25.500 g, and grain yield per plot 1616 g.

The significant response of Trisakti rice to MIGO application suggests that biofertilizers can be a viable component of sustainable rice cultivation systems, particularly to enhance soil biological activity and nutrient availability. These findings support the broader adoption of biofertilizer-based inputs as an environmentally friendly alternative to conventional fertilization practices.

Further research should prioritize optimizing appli cation strategies and validating them across diverse agroecological conditions. Incorporating economic feasibility studies and conducting long-term assessments of soil health will be essential to ensure both agronomic effectiveness and sustainability for farmers.

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