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The potential of JAKABA (eternal fortune fungus) from rice washing water as a liquid biofertilizer for pre-planting soil of mung bean (*Vigna radiata* L.)

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ABSTRACT

Mung bean (*Vigna radiata* L.) is a legume crop with high economic value, containing 20-25% protein and rich in vitamins and minerals. Despite its agronomic advantages, its productivity in Indonesia remains low. The quality of planting media and proper nutrient management significantly affect productivity. The use of inorganic fertilizers can negatively impact soil, necessitating alternatives such as liquid biofertilizers. One potential type of liquid biofertilizer is JAKABA, a fungal culture derived from fermented rice washing water. This study aims to determine the effect of JAKABA as a pre-planting liquid biofertilizer on the growth of mung bean plants. The experiment employed a Completely Randomized Design (CRD) with four treatments: P0 (control), P1 (JAKABA 1:5 water), P2 (JAKABA 1:10), and P3 (JAKABA 1:15 water), each replicated four times. The experimental procedure included JAKABA production, mung bean seeding, and watering for seven days. Measured parameters included plant height, stem diameter, number of leaves, leaf length, and leaf width. Data analysis used One Way ANOVA test, followed by Duncan's test at α=5% significance level if significant differences were found. Results showed that the application of JAKABA as a pre-planting liquid biofertilizer had a significant effect on mung bean growth. Application of JAKABA liquid biofertilizer in pre-planting soil significantly enhanced mung bean vegetative growth. The 1:5 water dilution optimally increased plant height (26.35±0.64 cm), stem diameter (0.22±0.05 cm), and leaf count (0.22±0.05), while the 1:15 dilution maximized leaf dimensions (length: 4.12±0.29 cm; width: 3.02±0.38 cm). To conclude, the use of JAKABA as a pre-planting liquid biofertilizer effectively enhancing the vegetative growth of mung bean plants, with varying effectiveness depending on the concentration and observed growth parameters.

Keywords: **growth parameters; inorganic fertilizer,vegetative growtht**

INTRODUCTION

Mung bean (*Vigna radiata* L.) is a legume crop with high economic value that plays a crucial role in meeting the food and nutritional needs of communities (Nair & Schreinemachers, 2020). Mung bean grain is high protein content (20-25%) and is rich in vitamins A, B1, C, and minerals such as calcium,

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phosphorus, and iron (Oso & Ashafa, 2021). Mung bean also has agronomic advantages, including a relatively short life cycle (55-65 days), good drought tolerance, and the ability to fix atmospheric nitrogen through symbiosis with Rhizobium bacteria (Trustinah et al., 2014). However, mung bean production in Indonesia is still relatively low at 221,616 tons (Badan Pusat Statistik, 2021). One of the factors affecting mung bean productivity is the quality of the planting medium and proper nutrient management.

The quality of the planting medium, particularly soil, significantly influences plant productivity both qualitatively and quantitatively. Soil functions as a reservoir of water and nutrients that play a role in optimizing plant characteristics (Nugrahaini, 2024). Soil fertility is influenced by various factors, one of which is the use of nutrients (Nurrohman et al., 2018). The application of inorganic fertilizers containing high concentrations of inorganic compounds can negatively impact soil biota, causes groundwater contamination, and results in soil quality degradation (Sianipar et al., 2024). Indicators of soil quality degradation include low organic matter content, cation exchange capacity (CEC), and base saturation (BS), as well as high aluminum content and unstable soil structure (Kazmierczak et al., 2020). In order to improve soil quality, it is essential to increase the use of environmentally friendly fertilisers and reduce the use of inorganic fertilisers. One category of environmentally benign fertiliser is the biofertiliser.

Biofertilizers contain living microorganisms that enhance nutrient availability and plant growth (Nasution, 2019). The nitrogen-fixing microorganisms in biofertilizers help plants access atmospheric nitrogen through biological nitrogen fixation (Nosheen et al., 2021). Biofertilizers have several important functions, including (1) enhancing nutrient availability through biological processes such as nitrogen fixation and phosphate solubilization; (2) producing plant growth-promoting substances; and (3) improving soil structure and biological activity through microbial interactions (Simanungkalit et al., 2006). One potential type of liquid biofertilizer is JAKABA (eternal fortune fungus), which is a fungal culture formed through the fermentation process of rice washing water (Abror et al., 2023).

JAKABA is reported to contain various microorganisms developed during the fermentation process, though specific microbial species identification and their roles need further scientific investigation. The fermentation process of rice washing water may produce various metabolites and compounds, but detailed chemical analysis is required to validate its contents and mechanisms of action. While some studies suggest potential benefits of JAKABA application, comprehensive research is still needed to understand: (1) the specific microbial communities present; (2) the biochemical changes during fermentation; (3) the optimal application methods; and (4) the mechanisms of its interaction with soil and plants (Sinh et al., 2021). In this study, JAKABA is applied to pre-planting soil with the aim of minimizing plant damage due to pest attacks and other environmental factors. The main objective of this research was to determine the effect of JAKABA derived from rice washing water as a pre-planting liquid biofertilizer on the growth of mung bean plants (*Vigna radiata* L.).

METHODOLOGY

This research employs an experimental method using a Completely Randomized Design (CRD). There were 4 treatments tested: P0 (control), P1 (JAKABA 1:5 water), P2 (JAKABA 1:10 water), and P3 (JAKABA 1:15 water). Each treatment was repeated four times, resulting in 16 experimental units.

1. JAKABA Production

JAKABA can be obtained through two methods: direct production from rice washing water or acquisition from commercially available products. The traditional production process utilizes the first rice washing water, which contains carbohydrates, proteins, minerals, and vitamins that can serve as nutrients for microbial growth (Mohidem et al., 2022). The process begins by collecting the first rice washing water in a clean glass or plastic container to maintain sterility and prevent contamination. The container is then covered with a clean cloth and secured with string to allow gas exchange while preventing contamination from insects or debris. The covered container is placed in a dark location at room temperature (25-30 °C) to facilitate the fermentation process. During the 14-day fermentation period, various microorganisms naturally present in the rice washing water and environment, including beneficial fungi and bacteria, undergo succession and produce metabolites (Kim et al., 2022).

2. Seeding

The experiment was conducted in polybags (40 × 40 cm) filled with 5 kg of growing medium consisting of a mixture of soil, sand, and compost (2:1:1 v/v). Three mung bean seeds were sown per polybag at a depth of 2 cm. Prior to planting, seeds were surface sterilized with 1% sodium hypochlorite for 3 minutes, rinsed with sterile water, and then soaked in water for 5 minutes to break dormancy. JAKABA liquid biofertilizer was applied as a soil drench at a rate of 100 mL per polybag one day before sowing. Each treatment was replicated five times in a completely randomized design, with one plant retained per polybag after thinning at 7 days after sowing (DAS) to maintain uniform plant population. Growth measurements were taken from these single representative plants per experimental unit.

3. **Watering**

Plants were maintained under a transparent plastic shelter that allowed 70% light transmission to protect them from heavy rain while ensuring adequate light for photosynthesis. Watering was conducted daily at 9 AM with 30 mL of water per plant and applied twice daily (morning and afternoon) based on visual assessment of soil moisture and weather conditions. Of the three seeds planted per polybag, plants were thinned to one healthy seedling per experimental unit at 7 days after sowing (DAS).

4. **Data Analysis**

The data being compared in this study are plant height, stem diameter, number of leaves, leaf length, and leaf width. Data analysis uses the One Way ANOVA test, and if there are significant differences, a Duncan's Post Hoc Test is conducted with a significance level of α=5%.

RESULTS AND DISCUSSION

1. **Plant Height and Stem Diameter**

The data pertaining to plant height (PH) and stem diameter (SD) are presented in Table 1. Based on the data, the application of liquid biofertilizer to pre-planting soil resulted in significant PH & SD differences between the treated plants (P1, P2, and P3) and the control (P0). Treatment P1 the highest PH and SD, with an average plant height reaching 26.35 cm and stem diameter of 0.22 cm on the 7th day after seeding. These results indicate that the addition of JAKABA as a pre-planting liquid biofertilizer positively influences the height and stem diameter of mung bean.

Rice washing water contains various water-soluble compounds including carbohydrates, proteins, amino acids, and minerals that are leached from the rice bran layer during washing (Liu et al., 2021; Mohidem et al., 2022). However, the specific nutrient composition and microbial communities in JAKABA fermented from rice washing water require detailed chemical and microbiological analyses for accurate characterization. While previous studies have documented the presence of beneficial microorganisms in fermented agricultural products (Dharaneedharan & Heo, 2016), the specific microbial populations in JAKABA and their roles in plant growth promotion need to be scientifically validated through isolation, identification, and functional studies. The potential growth-promoting effects observed in plants treated with JAKABA might be attributed to multiple factors including microbial metabolites, plant growth regulators, and enhanced nutrient availability, but these mechanisms require further investigation using modern analytical techniques (Oh et al., 2024).

Table 1.
Plant height and stem diameter parameters of mung bean (*Vigna radiata* L.)

Treatments	Mean	
	PH (cm)	SD (cm)
P0	23.07±1.34[a]	0.12±0.03[a]
P1	26.35±0.64[b]	0.22±0.05[b]
P2	26.17±1.11[b]	0.20±0.04[b]
P3	25.60±1.78[b]	0.20±0.04[b]

Note: Numbers followed by the same letter indicate no significant difference according to Duncan's test

2. Number of Leaves, Leaf Length, and Leaf Width

The data pertaining to the number of leaves (NL), leaf length (LL), and leaf width (LW) are presented in Table 2. Data in Table 2 shows significant differences between treatments P1, P2, and P3 compared to the control (P0) for leaf length and width parameters. Treatment P3 shows the highest results with an average leaf length of 4.12 cm and leaf width of 3.02 cm. Meanwhile, for the number of leaves parameter, treatments P1 and P2 do not show significant differences compared to P0, but P3 shows a significant difference. Nevertheless, treatment P1 produces the highest average number of leaves with a value of 4 leaves per plant.

Table 2.
Number, length, and width parameters of leaves in mung bean (*Vigna radiata* L.)

Treatments	Mean		
	NL	LL (cm)	LW (cm)
P0	2.00± 0.82a	2.97± 0.13a	0.80± 0.32a
P1	4.00± 0.82ab	3.82± 0.09b	2.20± 0.63b
P2	3.00± 0.82ab	3.95± 0.24b	2.67± 0.17bc
P3	3.00± 0.82c	4.12± 0.29b	3.02± 0.38c

Note: Numbers followed by the same letter indicate no significant difference according to Duncan's test.

The number of leaves on plants positively correlates with nutrient provision; the more leaves, the higher the plant's capacity to accumulate nutrients. Nitrogen acts as a stimulant for plant vegetative growth (Nuraini & Zahro, 2020), phosphorus functions to promote root growth (Sipayung et al., 2023), while potassium plays a role in strengthening plant structure (Yulhasmir & Wijaya, 2022). Larger leaves have a higher capacity for absorbing sunlight in the photosynthesis process (Himayana & Aini, 2018).

3. Characteristics of Planting Media After Watering

The application of liquid biofertilizer from rice washing water as pre-planting soil treatment in mung bean cultivation demonstrates enhanced soil fertility compared to conventional inorganic fertilizers. This is supported by research showing that RWW contains essential nutrients such as nitrogen, phosphorus, potassium, magnesium, calcium, sulfur, iron, and vitamins B1 (thiamine) that contribute to plant growth (Lim et al., 2020). The nutrient content in rice washing water, particularly carbohydrates and vitamins, also supports beneficial soil microorganisms that improve soil structure and nutrient availability. Studies have shown that rice washing water application can enhance crop yields by improving soil physical properties and microbial activity while providing a more environmentally sustainable alternative to inorganic fertilizers (Sinh et al., 2021).

Hasbiah & Wahidah (2013) states that the content of inorganic nutrients does not show significant differences with the nutrient content in organic materials in terms of comparing photosynthesis rates in mustard plants (*Brassica juncea*). However, inorganic fertilizers tend to have higher concentrations of chemical elements that can impact plant growth (Pahalvi et al., 2021). Furthermore, the use of organic fertilizers positively impacts higher oxygen pressure compared to plants given inorganic fertilizers (Bhunia et al., 2021).

Base saturation has a positive correlation with soil fertility and soil pH (Culman *et al.*, 2021). The relationship between base saturation and soil pH is influenced by the presence of exchangeable bases (Ca^{2+}, Mg^{2+}, K^{+}, and Na^{+}) in the soil complex. Higher base saturation typically indicates greater availability of these essential nutrients for plant uptake (Singh & Ryan, 2015). When organic matter decomposes, microorganisms produce organic acids that participate in mineral weathering processes. During this process, hydrogen ions (H^{+}) from the organic acids exchange with base cations on soil particles, potentially leading to decreased soil pH if base cations are leached from the system (Nair et al., 2021). This ion exchange process is particularly relevant when considering soil amendments and their effects on soil chemical properties.

CONCLUSION

The application of JAKABA as a liquid biofertilizer to pre-planting soil for mung beans demonstrated a significant positive effect on various plant growth parameters. Treatment P1 (JAKABA 1:5 water) yielded the best results for plant height growth and stem diameter, as well as producing the highest number of leaves. Meanwhile, treatment P3 (JAKABA 1:15 water) showed the most significant effect on leaf length and width. Overall, the use of JAKABA as a pre-planting liquid biofertilizer proved effective in enhancing the vegetative growth of mung bean plants compared to the control, with varying effectiveness depending on the concentration and observed growth parameters.

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