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Invigoration of Local Kamba Rice Seeds Using Biopriming Rhizobacteria in the Rolled Paper Test Method Established in Plastic (UKDdp)

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Abstract

The quality of local rice seeds among farmers is low because they generally use harvested seeds from previous crops. One technique that can be done is seed invigorisation using rhizobacteria biopriming technique. The aim of this study was to determine the response of dormant Kamba local rice seeds to rhizobacterial biopriming treatment in increasing the viability and vigor seeds. The research method used a Completely Randomized Design (CRD) with treatments consisting of Control (B0), Biopriming isolate B1; B2; B3; B4; B5; B6; B7; B8; B9; B10; B11; B12; B13; B14. Each treatment was repeated three times to obtain 45 experimental units. Each experiment used 40 seeds for a total of 1800 seeds. Variable observations of seed viability and vigor were carried out with the parameters of germination (%), maximum growth potential (%), simultaneity of growth (%), vigor index (%) and T50% (days). The results showed that biopriming with rhizobacterial isolates using the Rolled Paper Established in Plastic (UKDdp) method had a significant effect on increasing viability and vigor and breaking dormancy of local Kamba rice seeds. The biopriming treatment of KLE25 isolate was effective in increasing germination rate (97.50%), maximum growth potential (99.17%), growth simultaneity (49.17%), vigor index (32.50%) and T50% (4 days) when compared to without biopriming (control).

Keywords: *Biopriming, invigorization, Kamba local rice, PGPR, rhizobacteria.*

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INTRODUCTION

Rice plants (*Oryza sativa* L.) are the main commodity as a source of carbohydrates for the Indonesian people, so that it has economic value for development. In the process of rice cultivation, the availability of quality seeds is a determinant of success, as is the case for local rice varieties. One of the main obstacles to local rice cultivation is seed availability. Farmers generally use seeds from previous plantings or from fellow farmers, resulting in poor seed quality. Another issue is improper and relatively long seed storage methods. Substandard seed storage can lead to decreased seed quality. Poor seed quality will impact crop yields, characterized by uneven seedling growth, germination rates, and a tendency to be less resilient to abiotic environmental stresses. The seeds ability to adapt to the environment is also reduced, ultimately impacting rice productivity (Mudi et al., 2021).

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Therefore, it is crucial to ensure that the seeds used in rice cultivation are of good quality. One technique that can be used to improve seed quality is seed priming. To obtain seeds with high vigor and viability, seed priming techniques can be applied. Seed priming is a seed preparation process using various methods to increase seed germination rates. Additionally, seed priming can improve germination rates, seedling emergence uniformity, seed vigor, yield, and plant characteristics. This technique involves manipulating the amount of water available to the seeds. Solichatun et al. (2022) reported seed priming can significantly improve seed quality. Seed priming has many benefits for plants, including increasing germination by 10-15%. This technique can also increase plant resistance to drought stress and improve nutrient uptake, resulting in optimal plant growth and yield (Abdallah et al., 2016).

Several seed priming technologies can be used, such as hydropriming, which involves soaking the seeds in plain water. Another method is osmopriming, which involves hydrating the seeds with osmotic solutions at different water potentials. Chemical priming is soaking seeds in chemicals such as chlorine, putrescine, pacloburtrazol, ZnSO4, CurSO4, dan KH2PO4. Halo-priming involves treating seeds with an inorganic solution. Biological priming, or biopriming, involves inoculating seeds with active bacteria. Hormonal priming involves treating seeds with growth hormones. Solid matrix priming involves applying a solid matrix to seeds. Nurtripriming by adding nutrients such as Magnesium, Zinc, and Boron (Marthandan et al., 2020; Rhaman et al., 2020). All these techniques have the same goal, namely to improve seed quality and crop yields.

Seed priming integrated with rhizobacteria as biological agents is called biopriming. Seed priming itself is a technique used to improve seed quality and performance before planting by soaking or treating the seeds with specific agents to trigger physiological processes that can increase germination and seed vigor. In the context of biopriming, the agents used are rhizobacteria, microorganisms found in the root zone of plants. Rhizobacteria act as plant growth promoters, increasing nutrient uptake and cycling by plants. Rhizobacteria also play a role in disease control and are able to increase seed viability and vigor (Mudi et al., 2019). Furthermore, Sudewi et al. (2021a) reported that rhizobacteria isolated from the roots of local rice plants have the ability to produce the growth hormone indole-3-acetic acid (IAA). IAA is a type of auxin that plays a vital role in various plant physiological processes, including cell division, cell elongation, and cell differentiation. With IAA, rhizobacteria can stimulate root and shoot growth and increase seed germination. In addition to producing IAA, rhizobacteria can also produce hydrogen cyanide (HCN), a compound known as a biological control agent due to its ability to inhibit pathogen growth and HCN-producing rhizobacteria are able to stimulate the germination of local rice seeds in vitro (Sudewi et al., 2021b)

Endo-rhizobacterial consortia have significantly improved the viability and vigor of local upland rice seeds. The use of endo-rhizobacterial consortia can significantly improve seed quality (Mudi et al., 2021) As also found by Megasari et al. (2022) that biopriming with Rhizobacteria at a concentration of 25.86 g L^{-1} provided a real response to increasing the viability and vigor of Inpari 32 rice seeds germinated using the UKDdp method. In addition, biopriming can also be applied to plants to increase their resistance to unfavorable environments (Sulaiman et al., 2016). Invigoration using rhizobacterial biopriming techniques can break physiological dormancy in seeds and reduce the incidence of phytophthora rot disease from 93.8% to 65.6%. (Sutariati et al., 2014; Hikmawati et al., 2019).

Seed germination testing in the laboratory can be done using several methods, one of which is the Rolled Paper Test method erected in plastic (UKDdp) (Faisal et al., 2022). The UKDdp method is a seed vigor testing method that can describe the potential for seed growth in the field (Sadjad et al., 1999). This method uses a paper substrate that is rolled up and set in plastic, so that it can maintain optimal humidity and temperature for seed germination.

According to the findings, the use of the UKDdp method can improve the germination performance of cucumber seeds better than pleated paper method (UKD). It was reported that the UKDdp germination method has the capacity to improve the germination rate of corn seeds. The results of this study indicate that the UKDdp method can provide more accurate and consistent test results compared to other methods. Jawak & Juharni (2022), the UKDdp method can improve cucumber seed germination performance better than pleated paper method. Nurhafidah et al. (2021) reported that the UKDdP germination method has the capacity to increase corn seed germination. The results of this study indicate that the UKDdp method can provide more accurate and consistent test results compared to other methods. Wibowo (2020) research showed that the UKDdp method was effective in testing the germination of Pandanwangi rice seeds. Rice seeds tested using the UKDdp method had higher germination rates compared to other methods, such as the between paper method (UAK) and the top of paper (UDK). The use of the UKDdp method in testing the vigor of local Kamba rice seeds invigorated with

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rhizobacterial biopriming can provide more comprehensive information regarding the potential for seed growth in the field. This is important to ensure the success of local Kamba rice cultivation in the field.

Based on this description, one effort to improve the quality of local rice seeds is through rhizobacterial biopriming invigoration using the UKDdp germination method. Integrating rhizobacterial biopriming and the UKDdp method can be an effective solution to address the problem of low viability and vigor of local Kamba rice seeds. Biopriming with rhizobacteria can increase seed vigor and viability, while the UKDdp method can be used to measure and evaluate the effectiveness of this treatment. Through testing using the UKDdp method, data on seed vigor indicators including germination rate, root length, and dry weight of seedlings were obtained. This information can be used to evaluate the success of rhizobacterial biopriming treatment and become the basis for the development of more effective seed invigoration technology for local Kamba rice. Biopriming is a simple, cost-effective, effective, and efficient seed invigoration technology that can be used more widely and is environmentally friendly. The purpose of this study was to determine the level of seed vigor of local Kamba rice that has undergone dominance with rhizobacterial biopriming treatment.

MATERIALS AND METHODS

Place and Time

The research was conducted at the Microbiology Laboratory of Alkhairaat University, Palu, September-November 2023.

Materials and Equipment

The materials used consisted of 20 rhizobacteria isolates, (obtained from the rhizosphere of local Kamba rice in the Bada Valley area, Poso Regency, Central Sulawesi), local Kamba rice seeds, sterile water (One Med), paper sheets measuring 25 x 35 cm, plastic sheets measuring 25 x 35 cm, label paper, rubber bands, and clip plastic bags. The equipment used included a cutter knife, scissors, pincers, burner, 500 mL hand sprayer, ruler, analytical balance, germinator, 250 mL glass jar bottle, measuring glass, writing and drawing tools, and a camera.

Experimental Design

The experiment was arranged using a Completely Randomized Design (CRD). The treatments consisted of one control and fourteen biopriming treatments using different rhizobacteria isolates:
B0: Control (without biopriming)
B1: Biopriming with rhizobacteria isolate KBA1
B2: Biopriming with rhizobacteria isolate KBA8
B3: Biopriming with rhizobacteria isolate KBA14
B4: Biopriming with rhizobacteria isolate KBA22
B5: Biopriming with rhizobacteria isolate KBK3
B6: Biopriming with rhizobacteria isolate KBK14
B7: Biopriming with rhizobacteria isolate KLE2
B8: Biopriming with rhizobacteria isolate KLE18
B9: Biopriming with rhizobacteria isolate KLE19
B10: Biopriming with rhizobacteria isolate KLE25
B11: Biopriming with rhizobacteria isolate KBU14
B12: Biopriming with rhizobacteria isolate KBU22
B13: Biopriming with rhizobacteria isolate KBU26
B14: Biopriming with rhizobacteria isolate KGU14

Each treatment in this study was replicated three times to ensure the reliability and consistency of the experimental results. With a total of 15 treatments applied, this arrangement resulted in 45 experimental units (15 treatments × 3 replications). Each experimental unit consisted of 40 seeds, so the overall number of seeds used in the experiment was 1.800. The experimental procedure involved subjecting the seeds to biopriming according to their respective rhizobacteria treatments. Seeds assigned to the control treatment were not subjected to any biopriming process. Throughout the experiment, all experimental units were maintained under uniform environmental and management conditions to minimize variability unrelated to the treatments applied.

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Research Implementation

Rhizobacteria Propagation

The rhizobacteria used in this study were isolated from the rhizosphere of local Kamba rice plants in Kamba, Poso Regency, Central Sulawesi (Sudewi et al., 2020; Sudewi et al., 2021c). The rhizobacteria were purified and stored in Ependorf tubes. The isolates used in this study have not yet been molecularly identified; however, they were selected based on morphological characteristics and their potential as plant growth-promoting rhizobacteria (PGPR) from preliminary screening. Therefore, purification was carried out to obtain pure cultures and ensure the consistency of each isolate used in the experiment. The rhizobacteria were purified and stored in Eppendorf tubes.

The rhizobacteria were used for the study, each rhizobacteria isolate was first cultured (sub culture) on solid Nutrient Broth (NB) media and incubated for ± 48 hours at 28^0C. Next, each colony of bacteria that has grown is taken using a needle and suspended in liquid NB media (sterile water + NB media). The suspension is shaken using a rotary shaker for 48 hours, until a population density of 10^{-9} mL^{-1} is obtained so that it becomes a suspension of rhizobacterial isolates (Sutariati et al., 2014b). Each suspension that has been made is put into a glass jar bottle, labeled, turpentine using plastic and foil, then stored in a laminar air flow flask.

Seed Preparation and Treatment with Rhizobacteria

The rice seeds used were local “Kamba” seeds that had undergone a storage period of approximately 6 months (dormancy period). All seeds were disinfected for 3 minutes using 70% ethanol, followed by rinsing three times for 1 minute each with sterile distilled water. The seeds were then air-dried on filter paper and placed in a laminar airflow cabinet for approximately 1 hour. The biopriming treatment was carried out by soaking the seeds in 150 mL of the suspension of each rhizobacterial isolate for 24 hours according to each treatment (Madyasari et al., 2018). The control treatment used liquid NB medium without any bacterial suspension.

Figure 1. Biopriming of local Kamba rice seeds for 24 hours using a suspension of PGPR isolates.

Preparation of Growth Media, Seed Viability, and Vigor Testing

The growth media used were 5 sheets of Whatman filter paper measuring 25 x 35 cm, which had been moistened with water for each experimental unit, and 1 sheet of plastic used to cover the filter paper. The method involved placing seeds on the rolled filter paper arranged upright inside the plastic covering (Rolled Paper Test in Plastic, RPTP). A total of 40 local Kamba rice seeds were placed uniformly on each rolled paper unit, which were then labeled according to each treatment. The rolled filter papers were then placed upright in the germinator for approximately 7 days. Observations of seed viability and vigor were conducted using the following parameters:

1. Germination percentage (%) is calculated by counting the percentage of normal germinated seeds (NG) at the end of the 7-day observation (7 DAS = Days After Sowing) according to Sadjad et al. (1999) using the formula:

   $$\text{Germination Percentage} = \frac{\text{Number of normal germinated seeds at 7 DAS}}{\text{Total number of seeds tested}} \times 100$$

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2. Maximum germination potential (MGP) is calculated by counting the number of normal germinated seeds on the last observation day (7 DAS):
   $$\text{MGP} = \frac{\text{Number of normal germinated seeds at 7 DAS}}{\text{Total number of seeds tested}} \times 100$$

3. Germination uniformity (%) is calculated based on the percentage of normal germinated seeds on the fourth day (4 DAS) (Tefa, 2017):
   $$\text{Germination uniformity} = \frac{\text{Number of normal germinated seeds at 7 DAS}}{\text{Total number of seeds tested}} \times 100$$

4. Vigor index (%) is observed by counting the number of normal germinated seeds on the first count (third day):
   $$\text{Vigor Index (\%)} = \frac{\text{Number of normal seedlings at the first count}}{\text{Total number of seeds tested}} \times 100$$

5. T50 (days) is a parameter describing seed vigor, indicating how long it takes to reach 50% of total germination. It is calculated by counting the number of seeds germinated each day using the formula:
   $$\text{T50} = ti + \frac{(n50\% - ni)}{nj - ni}(tj - ti)$$

   where:

ti	=	time (days) before reaching 50% germination
tj	=	time (days) after reaching 50% germination
n50	=	50% of the total number of seeds germinated
ni	=	number of seeds germinated at time ti
nj	=	number of seeds germinated at time tj

Data Analysis

The data obtained were then tabulated and analyzed using analysis of variance. If the analysis results were significant, it was continued with the Tukey test α = 5%.

RESULTS AND DISCUSSION

Seed Germination (%)

The treatment of rhizobacterial biopriming on the average germination power of local Kamba rice was 85.00% to 97.50%, while the control (without biopriming) produced a germination power of 70.00% (Figure 2). This increase can be attributed to the beneficial effects of plant growth-promoting rhizobacteria (PGPR), which enhance germination and seedling survival through various mechanisms. *Bacillus* spp. and *Pseudomonas* spp. have been shown to solubilize essential nutrients such as phosphorus and potassium, produce the plant growth hormone indole acetic acid (IAA), and exhibit biocontrol activity against pathogens, thus promoting healthier and more productive plant growth (Fiodor et al., 2023; Ekowati, Yuni & Widijastuti, 2023); Musa, Saheed & Ikhajiagbe, 2023). Based on the graph and analysis of variance, the biopriming treatment with rhizobacterial isolates was significantly different from the control. Isolates KLE25 and KBU22 gave the best germination results of 97.50% which was not significantly different from the biopriming treatment of isolate KBU14 (96.67%) which was similar to the treatment soaked for 24 hours.

The germination rate resulting from the treatment without biopriming (control) resulted in a low yield of 70.00%. This indicates that the local Kamba rice variety has experienced a dormant period, resulting in low quality, even below the standard for germination of 75%-80% (Zakia et al., 2017). Therefore, it is necessary to apply the following treatments to break dormancy. The cumulative evidence from this study underscores the effectiveness of rhizobacterial biopriming in enhancing rice germination and plant growth, making it a promising and environmentally friendly alternative for sustainable agriculture. The significant increase in germination rates observed with isolates KLE25, KBU22, and KBU14 in local Kamba rice varieties, along with these results, indicates the practical benefits of biopriming in agricultural practices.

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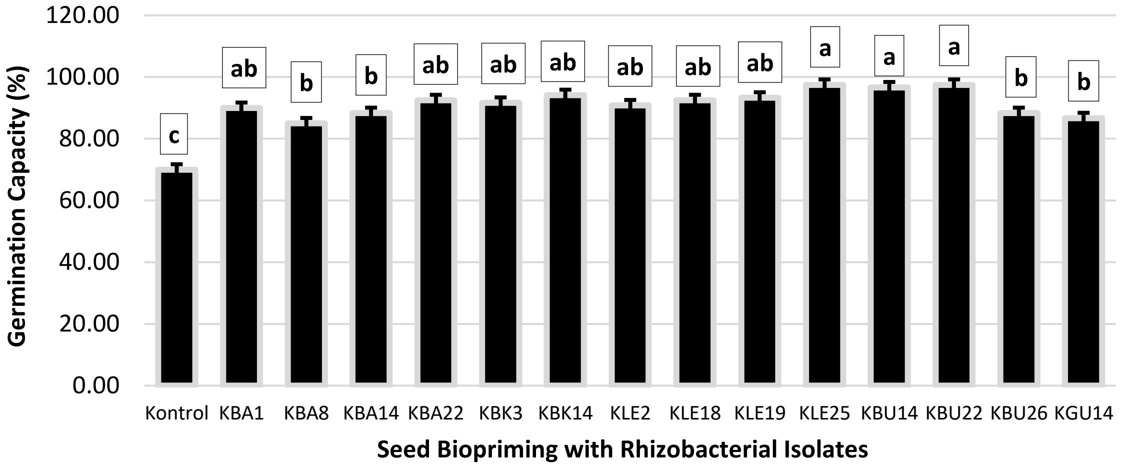

Figure 2. Average Germination Capacity (%) of Local Kamba Rice Seeds in the Rhizobacteria Biopriming Treatment Using the UKDdp method (Different Letters Above the Bars Indicate Significant Differences at $p < 0.05$ Based on Tukey's HSD Test)

The germination rate resulting from the treatment without biopriming (control) resulted in a low yield of 70.00%. This indicates that the local Kamba rice variety has experienced a dormant period, resulting in low quality, even below the standard for germination of 75%-80% (Zakia et al., 2017). Therefore, it is necessary to apply the following treatments to break dormancy. The cumulative evidence from this study underscores the effectiveness of rhizobacterial biopriming in enhancing rice germination and plant growth, making it a promising and environmentally friendly alternative for sustainable agriculture. The significant increase in germination rates observed with isolates KLE25, KBU22, and KBU14 in local Kamba rice varieties, along with these results, indicates the practical benefits of biopriming in agricultural practices.

Maximum Growth Potential (%)

Biopriming treatment with isolates KLE25 and KBU22 showed a significantly higher average maximum growth potential than the control treatment. The best average maximum growth potential was obtained in the biopriming treatment of isolates KLE25 and KBU22 (99.17%) and was not significantly different from the treatment of isolates KBA1, KBA8, KA14, KBA22, KBK14, KLE18, KLE19, KBU 14 and KBU26 but significantly different from the control treatment (75.00%). These results are in line with Sunkad et al. (2022) who highlighted the efficacy of biopriming and biological agents in increasing rice growth and yield by using *Trichoderma harzianum* which has been proven to significantly increase seed germination, root length, shoot length, and seedling fragility indices in rice, thus indicating the potential of biopriming in accelerating plant growth. Graphs and analysis of variance on the maximum growth potential of local Kamba rice treated with biopriming rhizobacterial isolates showed significantly different results from the control treatment (Figure 3).

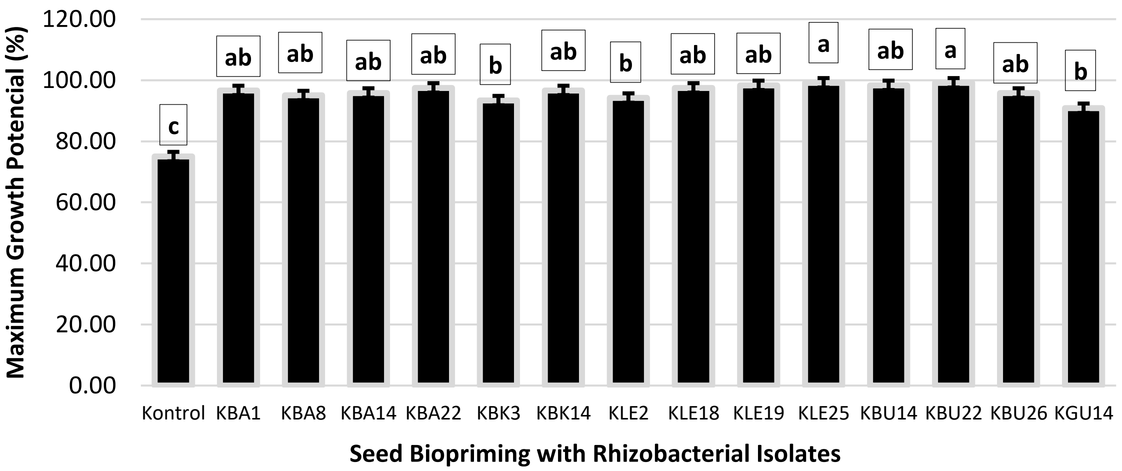

Figure 3. Average Maximum Growth Potential (%) of Local Kamba Rice Seeds in the Rhizobacteria Biopriming Treatment Using the UKDdp method (Different Letters Above the Bars Indicate Significant Differences at $p < 0.05$ Based on Tukey's HSD Test)

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Simultaneity of Growth (%)

Rice with good vigor will have faster seedling germination. The higher seedling germination rate is in line with the high germination rate. The graph and analysis of variance on seedling germination of local Kamba rice treated with biopriming rhizobacterial isolates are presented in Figure 4. Biopriming treatment of rhizobacterial isolates produced varying results of turmeric density on local Kamba rice plants, namely 34.17% to 49.17%, while the control produced an average turmeric density of 33.33%. The highest average turmeric density was obtained in the biopriming treatment of KLE18 and KLE25 isolates of 49.17%, followed by KLE2 and KLE19 isolates of 48.33%, which were not significantly different from the biopriming treatment of other rhizobacterial isolates.

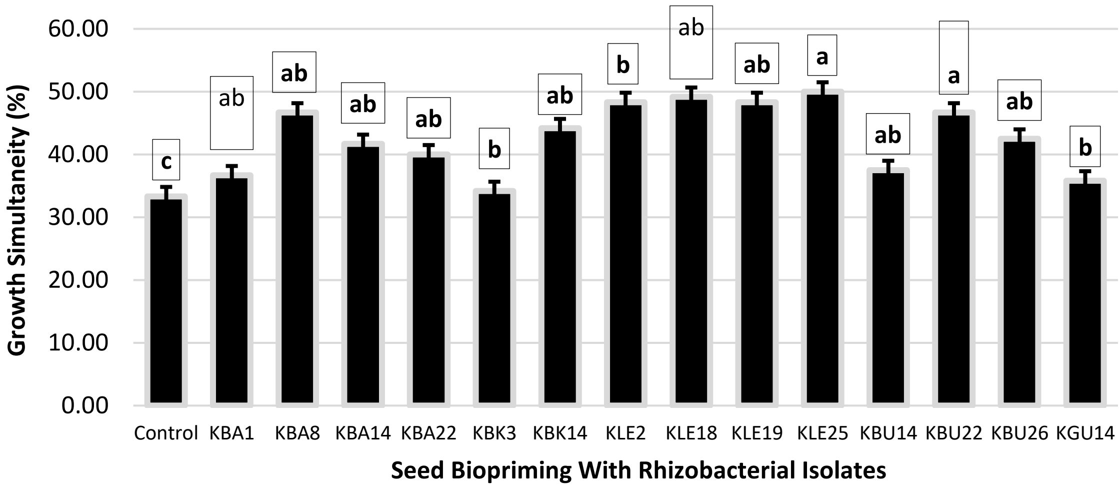

Figure 4. Average Growth Simultaneity (%) of Local Kamba Rice Seeds in the Rhizobacteria Biopriming Treatment Using the UKDdp method (Different Letters Above the Bars Indicate Significant Differences at $p < 0.05$ Based on Tukey's HSD Test)

Vigor Index (%)

The graph and analysis of variance on the vigor index of local Kamba rice treated with biopriming rhizobacterial isolates are presented in Figure 5. The lowest average vigor index was obtained in the control treatment of 17.50%, which is significantly different from the biopriming rhizobacterial isolate treatment. Local Kamba rice treated with biopriming rhizobacterial isolates produced an average vigor index of 21.67% to 32.50%. The KLE25 isolate produced the best average vigor index, namely 32.50%, which was not significantly different from the treatment of isolates KBA8 (31.67%), KBK14 (30.00%), KLE2 (29.17%), KLE19 (31.67%), KBU26 (30.00%) and significantly different from the treatment of isolates KBA1, KBA14, KBA22, KBK3, KBU14 and KGU14.

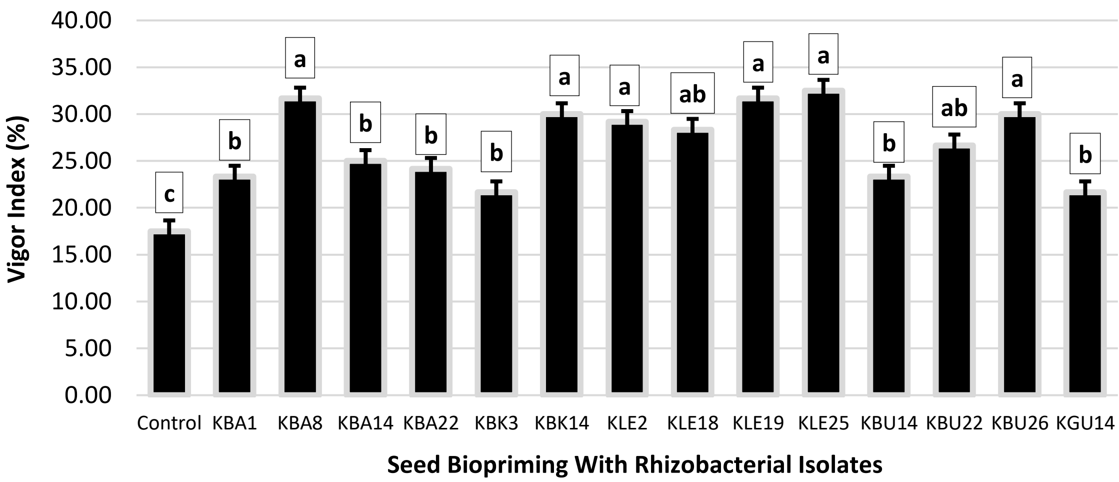

Figure 5. Average Vigor Index (%) of Local Kamba Rice Seeds in the Rhizobacteria Biopriming Treatment Using the UKDdp method (Different Letters Above the Bars Indicate Significant Differences at $p < 0.05$ Based on Tukey's HSD Test)

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The correlation between vigor index and germination rate is influenced by various factors, including genetic, environmental, and biochemical variables. Vigor, which encompasses rapid and uniform germination and rapid seedling emergence, is a critical factor in crop success under varying conditions (Hakim et al., 2025; Reed & Bradford, 2022). Research has shown that vigor index and germination rate are closely related. High vigor index often results in faster and more uniform germination.

T50% (day)

The T50% parameter represents the time required for 50% germination of seeds, which is an important metric in evaluating the germination efficiency of seeds. In the context of local Kamba rice with biopriming treatment using rhizobacterial isolates, the average T50% was significantly reduced compared to the control. The graph and analysis of variance on T50% of local Kamba rice treated with biopriming of rhizobacterial isolates are presented in Figure 6. The average number of seeds that germinated 50% (T50%) with the longest time was obtained in the control treatment, namely 7.73 days, while the biopriming treatment of rhizobacterial isolates KBA8, KBA22, KLE2, KLE18, KLE19, KLE25, and KBU22 gave the fastest T50% time, namely 4.00 days. The treatment of other rhizobacterial isolates (KBA1, KBA14, KBK3, KBK14, KBU14, KBU26, and KGU14) based on the results of analysis of variance indicated that the time required to germinate up to 50% was 7.33 days to 7.56 days. This indicated that biopriming could significantly increase the germination rate of rice seeds, which was consistent with the results from other studies on pure priming and biopriming.

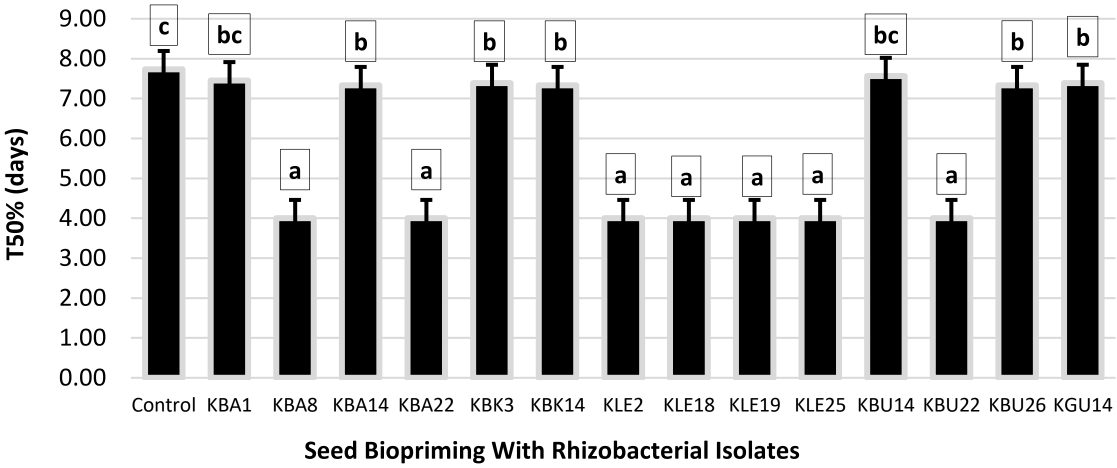

Figure 6. Average T50% (days) of Local Kamba Rice Seeds in the Rhizobacteria Biopriming Treatment Using the UKDdp method (Different Letters Above the Bars Indicate Significant Differences at $p < 0.05$ Based on Tukey's HSD Test)

The results of the study indicate that the biopriming treatment of rhizobacteria with UKDdp modifier is able to increase the viability and vigor of local Kamba rice seeds compared to the control, which is indicated by the parameters of germination capacity, maximum growth potential, growth simultaneity, vigor index, and T50%. The increase in viability and vigor of local Kamba rice seeds compared to the control in this study was due to the rhizobacteria used having the characteristics of potential as PGPR. Based on the research results of Sudewi et al. (2021b) rhizobacteria isolated from the local rice rooting area of Kamba have the ability to produce IAA and Gibberellin hormones, dissolve phosphate, fix nitrogen, produce siderophores and Hydrogen cyanide so that they can be classified as PGPR (Plant Growth Promotion Rhizobacteria). The IAA and gibberellin hormones produced by rhizobacteria can produce hydrolaser enzymes that function in breaking down food reserves in the soil so that they are able to encourage root and plumule growth in the soil (Sari et al., 2021). Furthermore, Arief et al. (2017) reported that invigoration with matriconditioning treatment using red brick serum combined with Bacillus sp. bacteria increased the viability and vigor of papaya with an incubation time of 72 hours.

In addition, the UKDdp germination substrate and paper substrate used in the seed germination process (Figure 7) also have an effect on increasing seed viability and vigor (Yuniarti et al., 2017). The UKDdp substrate is used as a light-sensitive substrate in the germination process and is able to provide optimal conditions for seed germination. The use of paper in the UKDdp substrate has a high absorption

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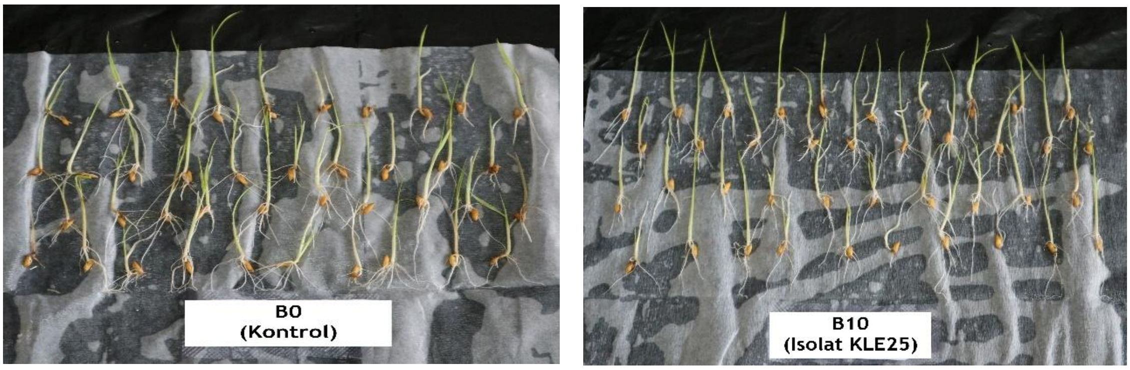
capacity of 24.40g/unit media so that it is able to retain water when used in the imbibition process (Wibowo, 2020; Nura et al., 2025).



(a) (b)

Figure 7. (a) Germination of Local Kamba Rice Seeds Without Biopriming (b) Germination with Biopriming of Rhizobacterial Isolates at an Observation Age of 3 HST

(a) (b)

Figure 8. (a) Local Kamba Rice Sprouts Without Biopriming, (b) Local Kamba Rice Sprouts with Biopriming of Rhizobacterial Isolates, observation 7 HST

Rhizobacteria can influence plant growth through merchanisms, namely direct merchanisms (phytohormone synthesis, nitrogen fixation, phosphate solubilization, siderophore production that enhances Fer) and indirect (increasing plant growth through phytopathogen metabolism by producing Hydrogen cyanide and other merchanisms) (Indahwardani et al., 2017; Wulandari et al., 2020). In general, from each observation variable, biopriming with isolate KLE25 (Figure 7) significantly increased the viability and vigor of local Kamba rice seeds, and the biopriming treatment was able to break dormancy in seeds that had undergone storage for approximately 6 months. Meanwhile, biopriming treatment with other rhizobacteria isolates showed different results, but significantly affected viability and vigor compared to the control. This is suspected because each rhizobacteria has different activities in adapting to its various environments, thus influencing the results of each observation variable.

CONCLUSION

Biopriming with rhizobacteria using the Rolled Paper Test Method Established in Plastic (UKDdp) method significantly increased the viability and vigor and broke the dormancy of local Kamba rice. The biopriming treatment of KLE25 isolate was effective in increasing germination capacity, maximum growth potential, growth simultaneity rate, vigor index and T50% compared to the control without biopriming. Further research is needed to determine the effectiveness of rhizobacterial isolates in the field and to identify the selected superior isolates at the molecular level.

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