Compatibility of MO PLUS biofertilizer and *Paenybacillus polymyxa* to stimulate rice germination

Baharuddin\textsuperscript{1,2}, R. Jahuddin\textsuperscript{2}, A. Yani\textsuperscript{3} and M. Tuwo\textsuperscript{3,4}

\textsuperscript{1}Department of Plant Pests and Diseases, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, 90245
\textsuperscript{2}Agrotechnology Study Program, Makassar Islamic University, Makassar, South Sulawesi, 90245
\textsuperscript{3}Agricultural Biotechnology Laboratory, Faculty of Agriculture, Hasanuddin University, Makassar, South Sulawesi, 90245
\textsuperscript{4}Department of Biology, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Makassar, South Sulawesi, 90245

E-mail: baharuddin@agri.unhas.ac.id

**Abstract.** The level of productivity of rice plantations can be increased through technical improvements in culture, namely spur plant growth. Increasing the germination rate is done by using growth regulators. Plants have limited synthesizing growth hormones in support of optimal growth. Therefore, it is necessary to add additional growth hormone from outside which can be given through fertilizers and symbiosis of microorganisms, including through the help of growth-regulating bacteria. MO Plus which is a combination of biological fertilizers and microorganisms *Bradyrhizobium japonicum* which is forming soybean root nodules to take nitrogen directly from the air and *Streptomyces* as biological control of plant diseases. Efforts to merge MO Plus with *P. polymyxa* isolates in a consortium of biological product formulations need to be initiated to stimulate rice germination. The research stage consisted of synergistic tests by growing *P. polymyxa* bacteria and microbial consortium and calculating the number of bacterial colonies 48 hours in liquid media Nutrient Broth. The ability test produced IAA using L-Triptofan as a precursor, and the ability to produce GA3. The results showed that the levels of IAA and GA3 in Mo plus were 0.095 and 2.225 µg.l\textsuperscript{-1} respectively, while *P. polymyxa*: 0.087 and 2.251 µg.l\textsuperscript{-1}. Synergism test results show that *P. polymyxa* and MO Plus bacteria can be grown on the same media simultaneously with the number of colonies of 2.3.10\textsuperscript{8} CFU/ml. The treatment of MO Plus + *Paenybacillus* has the best influence on germination, wet weight, and dry weight of rice seeds.

**1. Introduction**

Rice self-sufficiency is achieved, among others, by the use of superior varieties, extensification programs with the use of production facilities and intensification programs by opening new land, especially outside Java. The Indonesian government had succeeded in self-sufficiency in rice in 1984 and in 2005-2009 had only succeeded in self-sufficiency in rice while rice production in the period 2010-2014 increased by an average of 1.63\% per year with the highest productivity level achieved in
2014 of 51, 35 quintals per hectare. While productivity at the provincial level in South Sulawesi is even higher at 52.17 quintals per hectare [1].

The trigger for increasing rice production is because of the increase in harvested area of 540 thousand ha and productivity of 1.20 quintals per ha. The growth of rice harvest area in Java is only around 0.20% per year while outside Java is around 1.76% per year. Likewise, the increase in rice productivity in Java is only around 0.08% per year while outside Java is around 1.45% per year [2]. The level of productivity of rice plantations can still be improved in various ways including the technical improvement of its cultivation and one of the most important cultivation techniques to consider is the germination phase because it will affect the next phase of plant growth. The germination of germination is usually done by using growth regulators.

Substances regulating growth in plants are organic compounds that are not included in nutrients, which in small amounts can promote (inhibit) and inhibit plant physiology [3], [4]. Plants have limited synthesizing growth hormones in support of optimal growth. Therefore, it is necessary to add additional growth hormone from outside which can be given through fertilizers and symbiosis of microorganisms, including through the help of growth-regulating bacteria. The synthesis of plant growth regulators (auxin and gibberellin) by microbes is an important factor in soil fertility [5], [6]. Giving gibberellins in the germination phase is very beneficial. Gibberellins help the enzymatic process to convert starch into sugar which is then trans-located to the embryo. Sugar will be used as an energy source for growth, so that the embryo grows quickly. Meanwhile, according to Kazan [7], auxin will spur the process of forming roots so that root growth will be better and soaking the seeds with auxin will increase the quantity of the crop.

Currently there are many useful bacterial formulation products available plants including MO Plus which is a combination of biological fertilizers and microorganisms formulated in liquid form and produced through biotechnology processes to support the needs of organic farming. MO Plus contains a variety of useful microorganisms that can increase crop production and enriched with the bacteria *Bradyrhizobium japonicum*, which forms soybean root nodules to extract nitrogen directly from the air and *Streptomycetes* as biological control of plant diseases. Efforts to merge MO Plus with *P. polymyxa* isolates in a consortium of biological product formulations need to be pioneered to stimulate germination and control of diseases in rice seedlings and currently have no effect on various rice varieties because each variety is thought to have a different response to isolates. MO Plus and *P. polymyxa* isolates so it was deemed necessary to conduct research related to this.

2. Materials and Methods

2.1. Hormone Production Test

2.1.1. Measurement of Indole Acetic Acid (IAA)

Measurement of IAA production was carried out using the standard method, namely by culturing in advance 3 cork temporary isolates of MO Plus by adding L-tryptophan (0.1 g) and incubating (shaker) for 48 hours in a dark room at room temperature. IAA produced by isolates in MO Plus products was filtered using filter paper and then centrifuged 3000 rpm for 30 minutes, add 2 drops of orthophosphoric acid, then add again with 4 ml salkowski reagent (50 ml, 35% sulfuric acid, 1 ml 0.5 moles of FeCl$_{3}$ solution), keep the dark room for 24 hours, change the color of the solution to pink means that the MO Plus and *P. polymyxa* formulations have produced IAA. Furthermore, measuring the absorbance of IAA absorption using a spectrometer (spectronic 20) at a wavelength of 530 nm. IAA concentration was determined by comparing it to the IAA standard curve. The regression equation is substituted with the absorbance value of the sample. Auxin concentration was measured using IAA standard curve with regression equation $Y = 0.064x + 0.09$ where $R = 0.995$ was made from serial dilution of IAA stock solution.
2.1.2. Gibberalic Acid (GA3) Production Test
Testing of the production of Gibberellic Acid (GA₃) is measured using the standard method. MO Plus and _P. polymyxa_ isolates from NA media were taken and then grown on Nutrient brout (NB) media and incubated at room temperature 27°C for 7 days. After that, the culture was centrifuged at 8000 rpm for 10 minutes, and transferred 15 ml into the test tube and added 2 ml of acetate zinc solution. After 2 minutes 2 ml of potassium ferrocyanide solution was added and centrifuged at 8000 rpm for 10 minutes. 5 ml of supernatant was added 5 ml of 30% hydrochloric acid and incubated at 27°C for 75 minutes. Absorbance is measured at 254 nm in the UV-VIS spectrophotometer. The GA₃ concentration was measured using the standard GA₃ curve with the regression equation Y = 0.888 X + 0.441 where R² = 0.921, made from the serial dilution of the stock solution GA₃.

2.2. In-Vitro Test for Germination of Three Rice Varieties
The seeds are first soaked in a solution of MO Plus formulations, _P. polymyxa_, and a combination of MO Plus and _P. polymyxa_ and control for 24 hours. The seeds with 3 varieties of Brang seeds, Phioner, and Ciherang are soaked with 100 seeds each. The concentration of treatment of each formulation is 1%, 3%, 5%, 7%, and 10% and is done with three replications, then sown.

2.2.1. Germination
The percentage of sprouts was observed by calculating the percentage of seeds that germinated with an interval of 2 x 24 hours for 7 days from the total number of seeds germinated. The seeds are said to germinate if they have grown radially. The percentage observation is done in units of percent.

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\text{Percentage of sprouts} = \frac{\text{Number of seeds that Grow}}{\text{Number of seeds germination}} \times 100\%
\]

2.2.2. The length of canopy/plant height
Measured from the base of the stem of the plant until the tip of the leaf is measured on the 7th day in units of cm.

2.2.3. Root length
Measured from the base of the stem to the root tip measured on 7th day in units of cm.

2.2.4. Root wet weight
Root wet weight is the root weight measured on the 7th day in units of grams.

2.2.5. Root dry weight
Root dry weight is the root dry weight obtained by drying the roots with an oven 100°C for 2x24 hours at the end of the observation in units of grams.

2.2.6. Canopy wet weight
The canopy wet weight is the canopy weight measured on the 7th day in units of grams.

2.2.7. Dry weight of canopy
The dry weight of the canopy is the canopy dry weight obtained by drying the roots with an oven 100°C for 2x24 hours at the end of the observation in units of grams.

3. Results and Discussion
The ability to produce Indole Acetic Acid (IAA) is characterized by the formation of pink in the supernatant isolates MO Plus and _P. polymyxa_. The more concentrated the pink color, the higher the IAA level (Figure 1), while the ability to produce GA₃ is indicated by the change in the color of the supernatant of the isolate compared to the clear colored control (Figure 2).
IAA levels produced by MO Plus and *P. polymyxa* isolates were lower than GA$_3$ levels. However, both in IAA and GA$_3$, hormone levels of isolates MO Plus and *P. polymyxa* did not show large differences. MO Plus hormone levels are slightly higher than *P. polymyxa*. Quantitative measurements using a spectrophotometer $\lambda$ 530 nm for levels of IAA and GA$_3$ $\lambda$ 254 nm showed that the levels of IAA and GA$_3$ in MO Plus were 0.095 and 2.225 µg.l$^{-1}$ respectively, while *P. polymyxa* were 0.087 and 2.251 µg.l$^{-1}$ respectively (Figure 3).
IAA includes natural auxin phytohormones and acts as a plant growth booster because it can increase the synthesis of DNA and RNA, and increase proton exchange [8]. IAA is one of the most important plant hormones, regulating many aspects of plant growth and development of the entire plant cell cycle, from cell division, cell elongation and differentiation to root initiation, apical dominance, tropistic response, flowering, fruit ripening and senescence. The regulation of all these processes by auxin is believed to involve changes in auxin induction in gene expression [9].

Antagonist bacterial isolates incubated for 7 days on Nutrient Broth (NB) media with L-Tryptophan precursor 0.1 mg\textsuperscript{-1} showed the ability to produce the Indole Acetic Acid hormone. This is evidenced by the supernatant color change being pink compared to the control (without administration of fungal suspension) which is clear green in color. The high and low content of IAA possessed by bacterial isolates is shown in pink. The thicker the color of the suspension, the higher the IAA content. Mohite [10] states that IAA hormone production can be known in the supernatant culture and the presence of carbon in the media affects hormone production. Although microbes can produce auxin, but require triptopan to produce this compound as a precursor. Bacteria are able to synthesize tryptophan to be used in the process of forming the IAA hormone [11]. Supernatant of MO Plus isolates showed higher levels than \textit{P. polymyxa} isolates, respectively 0.095 mg l\textsuperscript{-1} and 0.087 mg l\textsuperscript{-1} (Figure 4). This shows that MO Plus is a source of natural IAA hormone that is needed by plants.

Gibberellic acid is one of the important growth hormones for plants. The ability of microbial isolates to produce GA\textsubscript{3} was tested by growing it on NB media which was incubated for 7 days at 37\textdegree C. The culture was then added with zinc acetate and potassium ferrocyanide solution and centrifuged for 10 minutes. A 15 ml supernatant was added 5% hydrochloric acid. The supernatant was then compared with the control (without bacterial suspension).

All isolates tested had the ability to produce gibberellic acid. This is indicated by the difference in color of the control supernatant with the bacterial supernatant. Although the color difference is not too far away. The measurement results showed that \textit{P. polymyxa} had a higher GA\textsubscript{3} hormone concentration than MO Plus isolates, although the difference was not too far away. The hormone GA\textsubscript{3} \textit{P. polymyxa} concentration is 2,251 mg l\textsuperscript{-1} and MO Plus is 2,225 mg l\textsuperscript{-1}. MO Plus contains a variety of useful microorganisms that can increase crop production and enriched with \textit{Bradyrhizobium javanicum} bacteria, which forms soybean root nodules to take direct nitrogen from the air and \textit{Streptomycetes} as plant disease biological control [12].

Antagonist bacterial isolates were grown in NB liquid media and incubated for 7 days. At that time, there was an adaptation of bacteria to the medium and then began to utilize nutrients in the media.
After that the culture was centrifuged at 8000 rpm for 10 minutes, zinc acetate was added, and Potassium ferrocyanide solution after 2 minutes. Then again centrifuged at 8000 rpm for 10 minutes. The treatment causes isolates to produce secondary metabolites. According to de Oliveira et al [13], the production of gibberellic acid is still the initial stage when growth stops and continues until the end of the fermentation period. In fact, almost all sugar has disappeared in the medium after 90 minutes of inoculation.

Overall, the treatment of antagonistic bacteria has the ability to produce IAA and GA3. The levels of GA3 growth hormone possessed by isolates were higher than IAA levels. Like the IAA, the GA3 hormone is very useful for plant growth and physiological processes. This process includes seed germination, seedling appearance, stem and leaf growth, flower induction and flower and fruit growth. Gibberellins are also involved in promoting root growth, root hair abundance, inhibition of flower bud differentiation in angiosperms, dormant vegetative and generative bud regulation, and senescence delay in many organs in various plant species [14, 15].

The average rice plant height of 3 varieties applied by antagonistic bacteria is presented in Table 1. Table 1 shows the control is significantly different from the other treatments. The highest plant height was found in the control ie 7.51 cm and the lowest was in P. polymyxa treatment which was 6.13 cm.

### Table 1. The height of Brang Biji varieties of rice applied by various concentrations of antagonistic bacteria

| Concentration (%) | Control | MO Plus | Paenybacillus | MO Plus + Paenybacillus | Average |
|-------------------|---------|---------|---------------|-------------------------|---------|
| 1                 | 7.51<sup>b</sup> | 6.89<sup>ab</sup> | 6.52<sup>ab</sup> | 7.10<sup>b</sup> | 7.01<sup>b</sup> |
| 3                 | 6.87<sup>ab</sup> | 6.55<sup>ab</sup> | 6.87<sup>ab</sup> | 6.76<sup>b</sup> | 6.76<sup>b</sup> |
| 5                 | 6.47<sup>ab</sup> | 5.82<sup>ab</sup> | 5.62<sup>ab</sup> | 5.97<sup>ab</sup> | 5.97<sup>ab</sup> |
| 7                 | 5.73<sup>ab</sup> | 6.39<sup>ab</sup> | 7.45<sup>b</sup> | 6.52<sup>b</sup> | 6.52<sup>b</sup> |
| 10                | 6.31<sup>ab</sup> | 6.29<sup>ab</sup> | 6.83<sup>a</sup> | 6.75<sup>ab</sup> | 6.75<sup>ab</sup> |
| Average           | 7.51<sup>b</sup> | 6.36<sup>a</sup> | 6.13<sup>b</sup> | 6.39<sup>a</sup> | 6.39<sup>a</sup> |

Note: The numbers followed by the same letter mean that there is no significant difference in the BNJ α 1% test.

### Table 2. The height of the Pioner varieties of rice applied by various concentrations of antagonistic bacteria

| Concentration (%) | Control | MO Plus | Paenybacillus | MO Plus + Paenybacillus | Average |
|-------------------|---------|---------|---------------|-------------------------|---------|
| 1                 | 4.59<sup>bc</sup> | 4.57<sup>bc</sup> | 4.77<sup>bc</sup> | 2.33<sup>a</sup> | 4.07    |
| 3                 | 4.15<sup>ab</sup> | 5.45<sup>bcd</sup> | 5.33<sup>ab</sup> | 4.98        |
| 5                 | 3.77<sup>ab</sup> | 5.37<sup>bcd</sup> | 6.56<sup>cd</sup> | 5.24        |
| 7                 | 4.98<sup>bc</sup> | 5.45<sup>bcd</sup> | 6.92<sup>d</sup> | 5.78        |
| 10                | 4.62<sup>bc</sup> | 4.07<sup>ab</sup> | 7.07<sup>d</sup> | 5.25        |
| Average           | 4.59<sup>a</sup> | 4.42<sup>d</sup> | 5.02<sup>ab</sup> | 5.64        |

Note: The numbers followed by the same letter mean that there is no significant difference in the BNJ α 1% test.

Table 2 shows the treatment of MO Plus + P. polymyxa is significantly different from the treatment of other antagonistic bacteria. The highest plant height in MO Plus + P. polymyxa treatment, while at the highest concentration treatment at 7%.
Table 3. The height of the Ciherang variety rice applied by various concentrations of antagonistic bacteria

| Concentration (%) | Control | MO Plus | Paenybacillus | MO Plus + Paenybacillus | Average |
|-------------------|---------|---------|---------------|------------------------|---------|
| 1                 | 4.84    | 3.30<sup>ab</sup> | 5.14<sup>cd</sup> | 2.63<sup>a</sup> | 3.98 |
| 3                 | 3.28<sup>ab</sup> | 5.65<sup>cd</sup> | 4.62<sup>cd</sup> | 4.52 |
| 5                 | 4.17<sup>abc</sup> | 5.57<sup>cd</sup> | 5.98<sup>d</sup> | 5.24 |
| 7                 | 4.23<sup>bcd</sup> | 3.97<sup>ab</sup> | 5.77<sup>d</sup> | 4.66 |
| 10                | 4.80<sup>bcd</sup> | 5.53<sup>cd</sup> | 5.50<sup>cd</sup> | 5.28 |
| Average           | 4.84<sup>b</sup> | 3.96<sup>a</sup> | 5.17<sup>a</sup> | 4.90<sup>a</sup> |

Note: The numbers followed by the same letter mean that there is no significant difference in the BNJ α 1% test.

Table 3 shows the control treatments differ significantly from other treatments. The highest Ciherang variety was in P. polymyxa, which was 5.17 cm. The wet weight of the roots of rice plants is shown in the following table:

Table 4. Average wet weight (g) of the roots of Pioner varieties of rice at various concentrations of antagonistic microbes

| Concentration (%) | Control | MO Plus | Paenybacillus | MO Plus + Paenybacillus | Average |
|-------------------|---------|---------|---------------|------------------------|---------|
| 1                 | 0.051   | 0.032<sup>abc</sup> | 0.043<sup>abcde</sup> | 0.026<sup>ab</sup> | 0.038 |
| 3                 | 0.021<sup>a</sup> | 0.032<sup>abc</sup> | 0.042<sup>bcd</sup> | 0.032 |
| 5                 | 0.031<sup>ab</sup> | 0.049<sup>de</sup> | 0.050<sup>ade</sup> | 0.043 |
| 7                 | 0.042<sup>bcd</sup> | 0.036<sup>abcd</sup> | 0.052<sup>de</sup> | 0.043 |
| 10                | 0.030<sup>ab</sup> | 0.050<sup>cd</sup> | 0.056<sup>c</sup> | 0.045 |
| Average           | 0.051<sup>a</sup> | 0.031<sup>c</sup> | 0.042<sup>c</sup> | 0.045<sup>ab</sup> |

Note: The numbers followed by the same letter mean that there is no significant difference in the BNJ α 1% test.

Table 4 shows the concentration treatment has no significant effect on root wet weight. However, the type of antagonistic bacteria and its combination with concentration significantly affected the wet weight of the roots of the Pioner varieties. In the Ciherang and Brang Biji varieties, the concentration and type of antagonistic bacteria did not significantly influence the wet weight of the plants. The highest root wet weight obtained in the MO Plus + <i>P. polymyxa</i> treatment with 10% concentrate, while the lowest is in the control treatment. The highest root wet weight in the treatment of MO Plus + <i>P. polymyxa</i> concentration of 1% is 0.29 g, while the lowest is in control. The treatment of antagonistic bacteria did not significantly affect the dry weight of Pioner varieties. But it has a significant effect on the Ciherang and Brang Biji varieties of rice.
Table 5. Average dry weight of roots of Ciherang varieties at various concentrations and types of antagonistic bacteria

| Concentration (%) | Control   | MO Plus   | Paenybacillus | MO Plus + Paenybacillus | Average |
|-------------------|-----------|-----------|---------------|-------------------------|---------|
| 1                 | 0.013     | 0.008<sup>a</sup> | 0.009<sup>c</sup> | 0.006<sup>b</sup> | 0.009   |
| 3                 | 0.009<sup>a</sup> | 0.015<sup>c</sup> | 0.010<sup>ab</sup> | 0.011         |         |
| 5                 | 0.009<sup>c</sup> | 0.018<sup>c</sup> | 0.012<sup>b</sup> | 0.013         |         |
| 7                 | 0.011<sup>ab</sup> | 0.015<sup>c</sup> | 0.012<sup>b</sup> | 0.013         |         |
| 10                | 0.011<sup>ab</sup> | 0.016<sup>c</sup> | 0.011<sup>ab</sup> | 0.012         |         |
| Average           | 0.013<sup>a</sup> | 0.009<sup>c</sup> | 0.015<sup>b</sup> | 0.010<sup>b</sup> |         |

Table 5 shows the type of antagonist bacteria singly and the combination has a significant effect on the average dry weight of Ciherang varieties. The treatment of antagonistic bacteria has a very significant effect on the length of the roots of rice plants, as well as the combination with the concentration. But rice varieties are not significant. The average root length of each rice plant variety is presented in Table 6.

Table 6. Root length of 3 rice varieties at various concentrations and types of antagonistic bacteria

| Treatment                  | Concentration (%) | Varieties     |              |              |         |
|----------------------------|-------------------|---------------|--------------|--------------|---------|
| Control (a1)               |                   | Pioneer       | Brang Biji   | Ciherang     |         |
| 1                          | 5.65<sup>abc</sup> | 7.49<sup>bc</sup> | 4.35<sup>a</sup> |         |         |
| 3                          | 3.52<sup>abc</sup> | 5.63<sup>p</sup>  | 3.85<sup>a</sup> |         |         |
| 5                          | 2.13<sup>c</sup>  | 6.69<sup>p</sup>  | 4.07<sup>c</sup> |         |         |
| 7                          | 2.71<sup>a</sup>  | 5.79<sup>p</sup>  | 4.79<sup>c</sup> |         |         |
| 10                         | 3.37<sup>abc</sup> | 5.08<sup>p</sup>  | 6.32<sup>a</sup> |         |         |
|                           | 1.95<sup>c</sup>  | 4.69<sup>p</sup>  | 6.19<sup>c</sup> |         |         |
| MO Plus (a2)               |                   | Pioneer       | Brang Biji   | Ciherang     |         |
| 1                          | 6.13<sup>abc</sup> | 6.35<sup>p</sup>  | 6.17<sup>c</sup> |         |         |
| 3                          | 5.61<sup>abc</sup> | 6.23<sup>p</sup>  | 5.69<sup>c</sup> |         |         |
| 5                          | 6.40<sup>abc</sup> | 5.16<sup>p</sup>  | 6.19<sup>c</sup> |         |         |
| 7                          | 5.80<sup>abc</sup> | 6.58<sup>p</sup>  | 5.38<sup>c</sup> |         |         |
| 10                         | 4.00<sup>abc</sup> | 6.24<sup>p</sup>  | 6.32<sup>a</sup> |         |         |
|                           | 1.95<sup>d</sup>  | 4.69<sup>p</sup>  | 6.19<sup>c</sup> |         |         |
| Paenybacillus (a3)         |                   | Pioneer       | Brang Biji   | Ciherang     |         |
| 1                          | 3.67<sup>abc</sup> | 5.44<sup>p</sup>  | 3.24<sup>c</sup> |         |         |
| 3                          | 3.77<sup>abc</sup> | 4.58<sup>p</sup>  | 4.98<sup>c</sup> |         |         |
| 5                          | 4.67<sup>abc</sup> | 6.09<sup>p</sup>  | 6.13<sup>c</sup> |         |         |
| 7                          | 5.70<sup>abc</sup> | 5.32<sup>p</sup>  | 5.14<sup>c</sup> |         |         |
| 10                         | 7.39<sup>c</sup>  | 3.84<sup>p</sup>  | 6.41<sup>c</sup> |         |         |

Table 6 shows the highest root length in Brang Biji varieties with water (control), which is 7.49 cm. The next highest root length in Pioner varieties with MO Plus + *P. polymyxa* treatment concentration of 10%, which is 7.39 cm. The results of the variance analysis showed the treatment of various concentrations and types of antagonistic bacteria, and the interaction of the two treatments had a very significant effect on the germination of three rice varieties.
Table 7. The percentage of germination (%) of the seeds of three rice varieties at various concentrations and types of antagonistic bacteria

| Treatment                  | Concentration (%) | Varieties  |
|----------------------------|-------------------|------------|
|                            | Pioneer | Brang Biji | Ciherang |
| Control (a1)               | 100.0\textsuperscript{c} | 100.0\textsuperscript{c} | 99.3\textsuperscript{y} |
|                            | 3 \textsuperscript{82.0} | 96.3\textsuperscript{y} | 100.0\textsuperscript{c} |
|                            | 5 \textsuperscript{65.7} | 93.0\textsuperscript{t} | 84.67\textsuperscript{x} |
|                            | 7 \textsuperscript{68.7} | 92.7\textsuperscript{t} | 100.0\textsuperscript{c} |
|                            | 10 \textsuperscript{51.0} | 57.3\textsuperscript{t} | 100.0\textsuperscript{c} |
| MO Plus (a2)               | 1 \textsuperscript{100.0} | 100.0\textsuperscript{t} | 100.0\textsuperscript{c} |
|                            | 3 \textsuperscript{82.0} | 96.3\textsuperscript{t} | 100.0\textsuperscript{c} |
|                            | 5 \textsuperscript{65.7} | 93.0\textsuperscript{t} | 84.67\textsuperscript{x} |
|                            | 7 \textsuperscript{68.7} | 92.7\textsuperscript{t} | 100.0\textsuperscript{c} |
|                            | 10 \textsuperscript{51.0} | 57.3\textsuperscript{t} | 100.0\textsuperscript{c} |
| Paenbacillus (a3)          | 1 \textsuperscript{100.0} | 100.0\textsuperscript{t} | 100.0\textsuperscript{c} |
|                            | 3 \textsuperscript{90.0} | 93.3\textsuperscript{r} | 98.3\textsuperscript{y} |
|                            | 5 \textsuperscript{82.3} | 85.3\textsuperscript{rs} | 99.3\textsuperscript{x} |
|                            | 7 \textsuperscript{83.0} | 82.7\textsuperscript{r} | 100.0\textsuperscript{c} |
|                            | 10 \textsuperscript{86.0} | 79.3\textsuperscript{r} | 100.0\textsuperscript{c} |

Note: The numbers in the same column and followed by the same letter mean that they are not significantly different from the BNJ Test $\alpha = 0.01$

Table 7 shows the highest number of germinating seeds in all types of rice varieties in the control treatment, namely 100%. The Ciherang variety has the highest germination in $P$. polymyxa, compared to other varieties. The results of the variance analysis showed the treatment of various concentrations and types of antagonistic bacteria, and the interaction of the two treatments had a very significant effect on the wet weight of three rice varieties.

Table 8. The wet weight of three rice varieties at various concentrations and types of antagonistic bacteria

| Treatment                  | Concentration (%) | Varieties  |
|----------------------------|-------------------|------------|
|                            | Pioneer | Brang Biji | Ciherang |
| Control (a1)               | 0.070\textsuperscript{a} | 0.112\textsuperscript{p} | 0.061\textsuperscript{x} |
|                            | 3 \textsuperscript{0.114} | 0.034\textsuperscript{a} |
|                            | 5 \textsuperscript{0.098} | 0.051\textsuperscript{x} |
|                            | 7 \textsuperscript{0.086} | 0.047\textsuperscript{x} |
|                            | 10 \textsuperscript{0.075} | 0.059\textsuperscript{x} |
| MO Plus (a2)               | 1 \textsuperscript{0.067} | 0.032\textsuperscript{x} |
|                            | 3 \textsuperscript{0.101} | 0.092\textsuperscript{y} |
|                            | 5 \textsuperscript{0.087} | 0.038\textsuperscript{x} |
|                            | 7 \textsuperscript{0.108} | 0.038\textsuperscript{x} |
|                            | 10 \textsuperscript{0.082} | 0.033\textsuperscript{x} |
| Paenbacillus (a3)          | 3 \textsuperscript{0.067} | 0.092\textsuperscript{y} |
|                            | 5 \textsuperscript{0.087} | 0.038\textsuperscript{x} |
|                            | 7 \textsuperscript{0.108} | 0.038\textsuperscript{x} |
|                            | 10 \textsuperscript{0.082} | 0.033\textsuperscript{x} |
| MO Plus + Paenbacillus     | 1 \textsuperscript{0.032} | 0.025\textsuperscript{x} |
|                            | 3 \textsuperscript{0.097} | 0.058\textsuperscript{x} |
|                            | 5 \textsuperscript{0.065} | 0.064\textsuperscript{x} |
|                            | 7 \textsuperscript{0.131} | 0.067\textsuperscript{x} |
Table 8 shows on Pioneer varieties, the treatment of MO Plus + \textit{P. polymyxa} at a concentration of 5\% was significantly different compared to other treatments. This happened also in the Brang Biji variety with a concentration of 7\%. In the Ciherang variety, the treatment of 3\% \textit{Paenybacillus} was significantly different compared to other treatments.

The results of the variance analysis showed the treatment of various concentrations and types of antagonistic bacteria, and the interaction of the two treatments had a very significant effect on the dry weight of three rice varieties.

Table 9. Dry weight of three rice varieties at various concentrations and types of antagonistic bacteria

| Treatment | Concentration (%) | Pioneer | Brang Biji | Ciherang |
|-----------|-------------------|---------|------------|----------|
| Control (a1) | 10 | 0.013\textsuperscript{a} | 0.018\textsuperscript{p} | 0.012\textsuperscript{x} |
| MO Plus (a2) | 1 | 0.012\textsuperscript{a} | 0.019\textsuperscript{p} | 0.007\textsuperscript{q} |
| | 3 | 0.011\textsuperscript{a} | 0.018\textsuperscript{p} | 0.006\textsuperscript{q} |
| | 5 | 0.011\textsuperscript{a} | 0.016\textsuperscript{p} | 0.007\textsuperscript{x} |
| | 7 | 0.014\textsuperscript{a} | 0.015\textsuperscript{p} | 0.007\textsuperscript{q} |
| | 10 | 0.011\textsuperscript{a} | 0.014\textsuperscript{p} | 0.008\textsuperscript{p} |
| Paenbacillus (a3) | 1 | 0.010\textsuperscript{a} | 0.018\textsuperscript{p} | 0.011\textsuperscript{q} |
| | 3 | 0.011\textsuperscript{a} | 0.018\textsuperscript{p} | 0.017\textsuperscript{q} |
| | 5 | 0.011\textsuperscript{a} | 0.017\textsuperscript{p} | 0.015\textsuperscript{x} |
| | 7 | 0.013\textsuperscript{a} | 0.018\textsuperscript{p} | 0.016\textsuperscript{x} |
| | 10 | 0.009\textsuperscript{a} | 0.014\textsuperscript{p} | 0.016\textsuperscript{x} |
| MO Plus + Paenbacillus | 1 | 0.012\textsuperscript{a} | 0.018\textsuperscript{p} | 0.006\textsuperscript{p} |
| | 3 | 0.012\textsuperscript{a} | 0.019\textsuperscript{p} | 0.011\textsuperscript{q} |
| | 5 | 0.014\textsuperscript{a} | 0.016\textsuperscript{p} | 0.011\textsuperscript{q} |
| | 7 | 0.016\textsuperscript{b} | 0.028\textsuperscript{b} | 0.011\textsuperscript{x} |
| | 10 | 0.014\textsuperscript{a} | 0.013\textsuperscript{p} | 0.011\textsuperscript{x} |

Note: The numbers in the same column and followed by the same letter mean that they are not significantly different from the BNJ Test \( \alpha = 0.01 \)

Table 9 shows the Pioneer and Brang Biji varieties, the treatment of MO Plus + \textit{Paenybacillus} at a concentration of 7\% was significantly different than the other treatments. Whereas in the Ciherang variety, the treatment of \textit{Paenybacillus} with a concentration of 3\% was significantly different compared to other treatments.

In this research, three rice varieties were tested. Two of them are hybrid varieties namely Pioneer and Brang Biji. Ciherang variety was used as a control in this study. Pioneer is rice with an average production of 7.5 tons.ha\(^{-1}\) with yield potential reaching 10.4 tons.ha\(^{-1}\). This type of rice is rather resistant to leaf blight disease strain IV. It is well planted in the lowlands to an altitude of 450 m above sea level. While Ciherang has an average production of 5 tons.ha\(^{-1}\) with a potential yield of 7 tons.ha\(^{-1}\). This variety is resistant to bacterial leaf blight III and susceptible to strain IV. It is well planted in lowland irrigated land up to 500 m asl, and is well planted in infertile irrigated land [16]. Brang Biji is...
one of the hybrid varieties released in 2009. The average yield is 6.5 tons.ha$^{-1}$, with a potential yield of 9 tons.ha$^{-1}$. Susceptible to BLB strains IV and VIII.

The average Brang Biji variety of rice plant showed better control treatment than other treatments. Whereas Pioneer and Ciherang showed the best treatment on MO Plus + Paenymbacillus. Similarly, the root wet weight, root dry weight, and root length. The best plant height in control can be caused by water used in soaking more effectively to affect plant growth. Water can dissolve more types of chemicals than other liquids. Water as a solvent plays an important role in plant life. The molecular structure of proteins and nucleic acids is very much determined by the presence of surrounding water molecules. This allows various biochemical reactions to occur in plant cells [17]. This affects the vegetative growth of plants such as stems and roots.

The treatment of giving antagonistic microbes has a significant effect on the germination of rice seeds. Although the highest germination rate is found in the control. MO Plus and P. polymyxa have the ability to produce IAA and GA3 growth hormones. IAA is an auxin compound that primarily promotes cell extension, enlargement, division, and differentiation, and stimulates the growth of the coleopolite GA3 or the giberelin acts to stimulate primary growth. Gibberelin affects germination and breaks dormancy in seeds, and encourages the transport of food and minerals in seeds. This encourages high germination in rice seeds.

The highest average germination was obtained in the Ciherang variety. Ciherang was used as a control in this study. All treatment concentrations and types of antagonistic bacteria showed the highest germination in the Ciherang variety. This is possible Ciherang has had a high adaptability to the surrounding environment.

Observation of wet weight and dry weight of pioneer and Brang Biji varieties showed the best indication of MO Plus + P. polymyxa treatment. The treatment of synergizing these two types of antagonistic bacteria showed a high level of resistance and led to good vegetative growth of plants. MO Plus contains Bradyrhizobium which is one of the genus of rhizobia. B. japonicum has the form of round colonies, its diameter does not exceed 1 mm, the production of extracellular polysaccharides is abundant to little (this little production is generally in strains that grow more than 10 days), opaque, rarely translucent, white, convex, granular texture, alkaline (raising pH), classified as slow or very slow growing, growth rate of 6 days or more [18]. This bacterium can modulate soybean root nodules and fix Nitrogen (N).

The ability of N fixation by B. japonicum in MO Plus caused the seeds of rice plants to have good vegetative growth, so that in this treatment the wet weight and dry weight of the plants were highest. Nitrogen is the main nutrient element that makes up amino acids and proteins. N accumulation in plant tissues between 2.0 - 5.0% N from the dry weight of plants [19]. Whereas P. polymyxa which produces antifungal peptide increases the resistance of rice plants so that they can grow well.

4. Conclusion
MO Plus and P. polymyxa isolates have the ability to produce growth hormones. MO Plus produces IAA and GA3 0.095 and 2.225 µg.l$^{-1}$ respectively, while P. polymyxa is 0.087 and 2,251 µg.l$^{-1}$, respectively. Water immersion treatment (control) gave the best influence on plant height, wet weight, dry weight, and root length. MO Plus + P. polymyxa treatment has the best influence on germination, wet weight, and dry weight of rice seeds.

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