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Effect Combination of Nitrogen Fertilizer Doses and Plant Growth Promoting Rhizobacteria (PGPR) Concentrations on Growth and Yield of Rice (*Oryza sativa* L.) Inpari 32 Variety

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Abstract. The research was conducted to obtain the right combination of N fertilizer doses and PGPR concentrations for the growth and yield of Inpari 32 rice in Ampeldento Village, Karangploso District, Malang Regency, East Java, from May until September 2023. This used Randomized Block Design (RBD) consisted of 10 treatments, namely: P1(no fertilization), P2(50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR), P3(50 kg.ha^{-1} N + 10 ml.l^{-1} PGPR), P4(50 kg.ha^{-1} N + 20 ml.l^{-1} PGPR), P5(100 kg.ha^{-1} N + 5 ml.l^{-1} PGPR), P6(100 kg.ha^{-1} N + 10 ml.l^{-1} PGPR), P7(100 kg.ha^{-1}N + 20 ml.l^{-1} PGPR), P8(150 kg.ha^{-1} N + 5 ml.l^{-1} PGPR), P9(150 kg.ha^{-1} N + 10 ml.l^{-1} PGPR), and P10(150 kg.ha^{-1} N + 20 ml.l^{-1} PGPR), and repeated three times. The variables observed were plant height, number and area of leaves, number of tillers, dry weight of the plant, number of panicles, number of filled grains per clump, percentage of empty grain, number of milled dry grain, and grain yield per hectare. The experimental results showed that the treatment of 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR (P2) significantly affected the growth component and greater yield and yield component. In grain yields per hectare treatment of 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR (P2) gave significantly different result namely 8.03 tons ha^{-1}, but not significantly different from other treatments.

Keywords: growth; nitrogen fertilizer; PGPR; rice; yield

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the main food commodities in Indonesia. Indonesian people consume rice to fulfill their carbohydrate needs. Rice production must continue to increase because population growth in 2045 is estimated to reach 321.4 million (Setiadi *et al*., 2020). In accordance with data from Badan Pusat Statistik (2023), rice production in 2021 decreased by 0.23 million tons. Factors affecting rice production are the reduction in land area due to land conversion, cropping systems, continuous monoculture, and soil conditions that have decreased soil fertility (Nurzannah *et al*., 2020).

Rice cultivation carried out by farmers mostly uses inorganic fertilizers to get maximum yields. The use of inorganic fertilizers as a source of nutrients for rice plants, if done continuously and over a long period of time without paying attention to soil conditions, will have a negative impact on soil fertility. This happens because inorganic fertilizers will leave residues in the soil resulting in hard soil that will interfere with the activity of soil microorganisms that play an important role in maintaining soil fertility. One of the inorganic fertilizers often used by farmers in rice cultivation is urea fertilizer. In 2021, the use of urea fertilizer reached 5,738,365 tons (Asosiasi Pengusaha Pupuk Indonesia, 2022).

Dependence on inorganic fertilizers must be reduced in order to maintain soil fertility. Excessive use of inorganic fertilizers can cause degradation of soil structure and decrease soil aggregation so that nutrients in the soil are easily lost through soil leaching. This will reduce fertilizer efficiency (Williams *et al*., 2013). Laboratory test results for soil N content before treatment were 0.22%. These results are included in the moderate category. One way to reduce inorganic fertilizers is by utilizing biofertilizers. Biofertilizer is a group of living organisms that form colonization around the plant root (rhizosphere) or the inside of the plant which plays a role in increasing the availability of nutrients needed for plant growth and spurring growth (Sriwahyuni & Parmila, 2019). One example of biofertilizer is Plant Growth Promoting Rhizobacteria (PGPR). PGPR plays a role in triggering plant growth and acts as an antagonistic agent

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against pathogens that interfere with plant growth. Some examples of rhizobacteria that live in the root system of host plants are *Azotobacter* sp., *Azospirilium* sp., *Pseudomonas fluorescence,* and *Bacillus* sp (Nezaret & Gholami, 2008).

PGPR acts as a biofertilizer by increasing the availability of nutrient absorption by associating with plant roots, such us *Azospirilium* bacteria or Fe absorption by *Pseudomonas* bacteria. Another act of PGPR is as a biostimulant. PGPR stimulates growth by synthesizing growth regulators needed by plants such as IAA, gibberellins, cytokinins, and ethylene. In addition, PGPR acts as a bioprotectant by controlling pathogens from the soil by producing siderophores, glucanase, chitinase, and antibiotic compounds. Therefore, the use of PGPR in plant cultivation can reduce the use of inorganic fertilizers. Based on the result of research by (Muhayat *et al*., 2020), the use of PGPR with a concentration of 9.5 ml^{-1}, can increase the yield of Ciherang rice by producing milled dry grain weight of 7 tons ha^{-1}.

Useful as a biofertilizer, PGPR helps provide the nitrogen needed by plants. Adding high doses of nitrogen fertilizer does not guarantee high yields. Continuous application of nitrogen fertilizer can cause soil damage, one of the effects of soil damage is that nutrients are easily susceptible to leaching of nutrients. Therefore, PGPR is needed to substitute nitrogen fertilizer. Nitrogen fertilizer and PGPR are combined because PGPR can provide the nitrogen needed by plants so that nitrogen fertilizer application can be reduced. So, this research was conducted to obtain information related to the combination of nitrogen fertilizer doses and PGPR concentrations that are appropriate for the growth and yield of Inpari 32 rice.

METHODS

The research was conducted from May until September 2023, located in the village of Ampeldento District, Karangploso, Malang Regency, East Java. Material used in the research: Inpari 32 rice seeds, urea fertilizer, PGPR, SP36, KCl fertilizer, and cow manure. The research used randomized block design (RBD) consisting of 10 treatments that were repeated three times. The treatments were: P1 : control (without fertilization); P2 : 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR; P3 : 50 kg.ha^{-1} N + 10 ml.l^{-1} PGPR; P4 : 50 kg.ha^{-1} N + 20 ml.l^{-1} PGPR; P5 : 100 kg.ha^{-1} N + 5 ml.l^{-1} PGPR; P6 : 100 kg.ha^{-1} N + 10 ml.l^{-1} PGPR; P7 : 100 kg.ha^{-1} N + 20 ml.l^{-1} PGPR; P8 : 150 kg.ha^{-1} N + 5 ml.l^{-1} PGPR; P9 : 150 kg.ha^{-1} N + 10 ml.l^{-1} PGPR; P10 : 150 kg.ha^{-1} N + 20 ml.l^{-1} PGPR.

The research area was 359.3 m^2 with a plot size of 2.25 m x 3 m. Nursery was conducted in 2 m x 1 m plots until the seedlings were 14 days after sowing. Then transplanting was done with a planting distance of 25 cm x 25 cm and 2 seedlings per planting hole. Maintenance activities include replanting, weeding, irrigation, pest and disease control, and fertilization. In fertilization activities, SP36 and KCl fertilizers were given at a dose of 100 kg.ha^{-1} and 75 kg.ha^{-1}. SP36 fertilizer contains 36 percent of the phosphorus needed by rice plants for the formation of rice panicles so that high yields are obtained. Meanwhile, KCl is useful for improving tillering and increasing grain size and weight. In addition, N fertilizer, namely urea, was given according to the treatment at a dose of 50 kg.ha^{-1}, 100 kg.ha^{-1}, and 150 kg.ha^{-1}. PGPR is given according to the treatment, namely the concentration of 5 ml.l^{-1}, 10 ml.l^{-1}, and 20 ml.l^{-1}. Rice plants are harvested 120 days after planting.

The research observation variables were growth observations, including plant height, number of leaves, leaf area, number of tillers, and plant dry weight. Yield observations include: number of panicles, number of filled grains per clump, percentage of empty grains, grain weight per clump, milled dry grain weight, 1000 grain weight, and yield per hectare.

The data obtained were tested using analysis of variance (F test) at the 5% level.

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If the test results have a significant effect, it will be continued with the Honestly Significant Difference (HSD) test at the 5% level. The software used for statistical testing is the DSAASTAT application and Microsoft Excel.

RESULT AND DISCUSSION

Plant Growth

The result of plant height can be seen in Table **1**. Treatment of 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR (P2) gave high results in the observation of plant height when compared to P1 (without fertilization) but not different from the treatments P3, P4, P5, P6, P7, P8, P9, and P10. PGPR application can increase plant growth such as plant height, yield, and improve grain quality (Giri *et al*., 2023). In addition, nitrogen nutrients available to plants will activate and stimulate cell division at the point of plant growth so that plants experience an increase in plant height (Zhao *et al*., 2023).

Leaf growth is supported by nitrogen. Nitrogen plays an important role in the synthesis of several compounds such as amino acids, proteins, enzymes, and nucleic acids. In addition, high N concentrations will increase leaf cell number and leaf cell size. Nitrogen provided through fertilization helps the growth of rice plant leaves. Nitrogen plays an important role in the synthesis of various plant compounds, such as nucleic acids, enzymes, amino acids, and proteins. This will increase overall leaf production as well as plant biomass yield (Chrysargyris *et al*., 2016).

In **tables 2 and 3**, the application of 50 kg.ha^{-1} N gave high growth results of leaf number and leaf area. Sufficient nitrogen will produce good leaf growth. Therefore, adding nitrogen to high doses will not be different from the dose that suits the plant's needs. In **table 8** can be seen that The highest N content in the tissue was in rice plants that were fertilized with 50 kg N ha^{-1} + 10 ml l^{-1} PGPR and 50 kg.ha^{-1} N + 20 ml l^{-1} PGPR which is 2.80%.

The observation of the number of tillers in **table 4** showed that the P2 treatment (50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR) gave high results when compared to the treatment without fertilization (P1), but not different from the treatments P3, P4, P5, P6, P7, P8, P9, and P10. The results show that the application of 50 kg.ha^{-1}N has been able to provide a high number of tillers while treatments with higher N applications, namely 100 kg.ha^{-1} and 150 kg.ha^{-1} show results that are not significantly different. One of the factors that affect the formation of tillers is nitrogen. This is in accordance with (Leghari *et al*. 2016), that the nitrogen application can increase the number of tillers in rice plants resulting in high yields. In addition, the result of research by (Suwarto *et al*., 2021), stated that upland rice variety IPB 9G produced a high number of tillers when N 138 and 184 N fertilizers were applied (300 and 400 kg.ha^{-1} urea) Nitrogen is a component of hormone and enzyme formation that is important for shoot formation. In addition, PGPR has a good effect on tiller growth. Microorganism activity can increase nitrogen and phosphorus absorption, trigger meristem tissue, and provide metabolites that function to regulate plant growth (Widodo & Damanhuri, 2021).

PGPR acts as a biofertilizer that helps accelerate the absorption of nutrients needed by plants. The high amount of nutrient uptake will affect photosynthesis in plants so that they can produce high photosynthesis. This happens because nutrients absorbed by plants will be synthesized into various organic compounds that are important for plant metabolism *(Widiyawati et al*., 2014)

In **table 5**, it can be seen that treatment P2 (50 kg.ha^{-1} N + 5 ml l^{-1} PGPR) gave high plant dry weight results when compared to the treatment P1 (without fertilization) but not different from treatments P3, P4, P5, P6, P7, P8, P9 and P10. This is supported by the result of research by Utami *et al*. (2018), which explained that the highest plant dry weight result was obtained in the treatment with the addition of microorganisms.

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Table 1. Plant height due to the effect of combination of N fertilizer and PGPR concentration

Treatment	Plant height (cm) at observation age			
	14 DAP	28 DAP	42 DAP	56 DAP
P1	23.55	33.27 a	49.06 a	54.58 a
P2	27.36	47.30 b	72.07 b	79.56 b
P3	28.43	48.97 b	73.13 b	81.45 b
P4	28.17	49.80 b	75.00 b	86.76 b
P5	26.91	50.27 b	71.73 b	84.25 b
P6	27.92	49.13 b	72.47 b	80.50 b
P7	28.45	48.90 b	74.60 b	83.13 b
P8	27.85	50.80 b	76.47 b	85.32 b
P9	25.83	50.30 b	78.20 b	86.18 b
P10	26.79	49.27 b	79.72 b	87.35 b
HSD 5%	Ns	13.71	22.47	24.36
CV (%)	10.36	9.80	10.62	10.30

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P3 = 50 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P4 = 50 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P5 = 100 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P6 = 100 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P7 = 100 $kg.ha^{-1}$ N+ 20 $ml.l^{-1}$ PGPR, P8 = 150 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P9 = 150 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, dan P10 = 150 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, DAP= days after planting, CV=coefficient of variation

Table 2. Number of leaves due to the effect of combination of N fertilizer and PGPR concentration

Treatment	Number of leaves (blade) at observation age			
	14 DAP	28 DAP	42 DAP	56 DAP
P1	11.67	32.13 a	61.67 a	81.40 a
P2	13.00	54.07 b	100.07 bc	116.53 b
P3	14.40	57.73 b	91.40 bc	131.00 bc
P4	13.40	60.83 b	119.20 c	148.67 bc
P5	15.80	59.20 b	93.20 bc	130.53 bc
P6	15.60	57.33 b	92.33 bc	130.13 bc
P7	14.87	61.00 b	97.07 bc	135.00 bc
P8	14.27	53.27 b	94.27 bc	138.80 bc
P9	16.00	61.27 b	90.00 b	139.13 bc
P10	15.60	56.07 b	95.00 bc	151.80 c
HSD 5%	Ns	20.84	27.87	35.02
CV (%)	13.89	12.87	10.19	9.18

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P3 = 50 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P4 = 50 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P5 = 100 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P6 = 100 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P7 = 100 $kg.ha^{-1}$ N+ 20 $ml.l^{-1}$ PGPR, P8 = 150 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P9 = 150 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, dan P10 = 150 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, DAP= days after planting, CV=coefficient of variation

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Table 3. Leaf area due to the effect of combination of N fertilizer and PGPR concentration

Treatment	Leaf area (cm^2) at observation age			
	14 DAP	28 DAP	42 DAP	56 DAP
P1	39.09	313.80 a	1002.81 a	1509.55 a
P2	48.22	451.20 b	2070.40 bc	2576.21 b
P3	42.18	451.20 b	1824.83 bc	2222.17 b
P4	42.24	439.87 b	1925.78 bc	2696.34 b
P5	46.62	463.80 b	2516.06 c	2901.07 b
P6	50.65	476.93 b	1962.05 bc	2468.03 b
P7	45.61	445.07 b	1905.01 bc	2345.60 b
P8	49.11	436.00 b	1934.50 bc	2504.37 b
P9	49.87	439.73 b	1847.72 bc	2456.66 b
P10	46.30	448.93 b	1769.51 b	2390.24 b
HSD 5%	Ns	119.90	731.41	698.92
CV (%)	10.41	9.38	13.32	10.04

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P3 = 50 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P4 = 50 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P5 = 100 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P6 = 100 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P7 = 100 $kg.ha^{-1}$ N+ 20 $ml.l^{-1}$ PGPR, P8 = 150 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P9 = 150 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, dan P10 = 150 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, DAP= days after planting, CV=coefficient of variation

Table 4. Number of tiller due to the effect of combination of N fertilizer and PGPR concentration

Treatment	Number of tillers (piece) at observation age			
	14 DAP	28 DAP	42 DAP	56 DAP
P1	2.73	8.07 a	14.47 a	23.33 a
P2	2.80	13.67 b	24.80 b	37.27 b
P3	3.13	14.63 b	23.73 b	38.07 b
P4	3.33	16.13 b	25.20 b	39.20 b
P5	3.13	15.40 b	24.73 b	43.40 b
P6	3.00	15.33 b	22.07 b	41.13 b
P7	3.20	14.60 b	23.27 b	40.93 b
P8	3.27	13.53 b	22.53 b	39.33 b
P9	2.93	13.93 b	23.60 b	39.13 b
P10	2.87	13.13 b	21.13 b	38.20 b
HSD 5%	Ns	4.11	4.56	12.14
CV (%)	8.36	10.16	6.91	10.91

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P3 = 50 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P4 = 50 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P5 = 100 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P6 = 100 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P7 = 100 $kg.ha^{-1}$ N+ 20 $ml.l^{-1}$ PGPR, P8 = 150 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P9 = 150 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, dan P10 = 150 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, DAP= days after planting, CV=coefficient of variation

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Table 5. Dry weight of plants due to the effect of combination of N fertilizer and PGPR concentration

Treatment	Plant dry weight (g.clump^{-1}) at observation age			
	14 DAP	28 DAP	42 DAP	56 DAP
P1	0.35	9.49 a	19.71 a	42.69 a
P2	0.43	15.71 b	29.81 b	66.89b c
P3	0.47	15.92 b	30.23 b	63.58 b
P4	0.48	17.24 b	31.24 b	67.81 bc
P5	0.69	16.44 b	34.13 b	73.27 bc
P6	0.67	19.34 b	35.91 b	75.03 bc
P7	0.71	18.44 b	37.24 b	67.35 bc
P8	0.57	19.61 b	32.64 b	71.72 bc
P9	0.53	18.75 b	33.50 b	78.33 bc
P10	0.71	18.48 b	34.97 b	85.29 c
HSD 5%	Ns	6.16	8.03	20.47
CV (%)	25.52	12.42	18.61	10.10

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P3 = 50 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, P4 = 50 kg.ha^{-1} N + 20 ml.l^{-1} PGPR, P5 = 100 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P6 =100 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, P7 = 100 kg.ha^{-1} N+ 20 ml.l^{-1} PGPR, P8 = 150 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P9 = 150 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, dan P10 = 150 kg.ha^{-1} N + 20 ml.l^{-1} PGPR, Ns= non significant, DAP= days after planting, CV=coefficient of variation

Outcomes and Outcome Components

The results showed that the P2 treatment (50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR) gave high results in the observation of the number of panicles and the number of filled grains can be seen in **table 6**. The formation of female panicles is stimulated by the availability of nitrogen at the stage of separation of panicle neck primordia cells. This will produce primary or secondary branches on which the fruit stalk grows (Widodo & Damanhuri, 2021). PGPR will make it easier for rice plants to absorb nitrogen in the soil through the process of mineralization and transformation for use by plants. In addition, PGPR provides phosphorus nutrients to improve metabolism.

The number of panicles produced affects the number of filled grains. The higher the rate of photosynthesis, the higher the photosynthetic yield that can be translocated so that it will affect grain weight (Urairi *et al*., 2016). The addition of PGPR will support the increase in the number of grains that affect the number of filled grains (Muhayat *et al*., 2020). The number of filled grains in rice plants is influenced by the photosynthesis process carried out by plants starting from the growth period to the seed filling period. The seed filling process is controlled by genetic factors and environmental factors. Genetic factors are related to the ability of rice to maximize and regulate filling seeds with appropriate allocation of assimilation results, while environmental factors that What is meant is the influence of absorbed nutrients and water availability and the light needed by plants. The number of empty grains in rice plants is influenced by the amount of nutrients absorbed by plants. In **table 6**, it can be seen that P1 (without fertilization) has the highest percentage of empty grain compared to other treatments which amounted to 28.17%. Factors that affect seed filling are nitrogen, phosphorus and potassium nutrients. Empty grain in rice plants is influenced by the translocation process of assimilation results to seeds. According to (Wang *et al*., 2017), the percentage of empty

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grain in rice plants can also be influenced by the time of seed release which is not simultaneous, so that at harvest time there are still seeds that have not been entirely filled so that they become empty seeds.

The grain weight produced is influenced by the number of panicles produced. High grain yield is influenced by the number of tillers and panicles that plants can form (Sukendah *et al.*, 2023). To store the harvest for a certain period, it is done by drying the grain until the moisture content is around 14% (Herdiyanti *et al*., 2021). In **table 7**, it can be seen that the P2 treatment (50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR) showed high results i n dry grain weight per clump and dry milled grain weight. This is under the research of Aryanto *et al*. (2015), which states that the provision of organic fertilizers in upland rice planting can reduce inorganic fertilizers by 50%. In **table 7**, the observation of 1000 grain weight can be seen there is no significant effect. According to Gong *et al*. (2023), genetic factors affect the volume of lemma and palea in grain. Translocation of photosynthetic products into grain will affect the grain weight plants produce. The 1000 grain weight will also affect the number of grains per harvest plot and yield conversion per hectare.

Table 6. Number of panicles, number of filled grain per clump, and percentage of empty grain

Treatment	Number of panicles (piece)	Number of filled grain per clump (grains)	Percentag of empty grain (%)
P1	28.13 a	1760.80 a	28.17 c
P2	41.47 b	3123.20 b	18.47 b
P3	42.47 b	3228.80 b	12.26 ab
P4	43.80 b	3568.73 b	8.64 a
P5	45.47 b	3120.07 b	13.04 ab
P6	46.40 b	3061.20 b	16.89 ab
P7	40.73 b	3425.87 b	12.19 ab
P8	41.93 b	3102.93 b	17.95 ab
P9	47.20 b	3049.27 b	10.57 ab
P10	44.20 b	3388.40 b	11.84 ab
HSD 5%	8.18	1141.84	9.57
CV (%)	6.62	12.65	21.79

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P3 = 50 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, P4 = 50 kg.ha^{-1} N + 20 ml.l^{-1} PGPR, P5 = 100 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P6 = 100 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, P7 = 100 kg.ha^{-1} N+ 20 ml.l^{-1} PGPR, P8 = 150 kg.ha^{-1} N + 5 ml.l^{-1} PGPR, P9 = 150 kg.ha^{-1} N + 10 ml.l^{-1} PGPR, dan P10 = 150 kg.ha^{-1} N + 20 ml.l^{-1} PGPR, DAP= days after planting, CV=coefficient of variation

According to Rahmad *et al*. (2022), rice yield is determined by the number of tillers, the number of grains per panicle,and the weight of 1000 grains. In **table 7**, the results showed that in the observation of yield per hectare, treatment P2 (50 kg.ha-1 N + 5 ml.l-1 PGPR) had a high yield when compared to treatment P1 (without fertilization), but not different from treatment P3, P4, P5, P6, P7, P8, P9, and P10 which were 8.03 tons ha-1. PGPR utilization requires organic fertilizer as an energy source. Microorganisms require organic matter for metabolic processes (Subowo, 2015). In the research field, the results of laboratory analysis showed that the soil organic C content was 3.39% or included in the low category. Therefore,the addition of PGPR up to a concentration of 20 ml.l-1 becomes less effective due to soil conditions that do not provide energy sources for microbes in PGPR.

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Table 7. Weight of harvested dry grain, weight of milled dry grain, 1000 grain weight, and grain yield per hectare

Treatment	Weight of harvested dry grain(g)	Weight of milled dry grain (g m^2)	1000 grain weight (g)	Grain yield per hectare (ton ha^{-1})
P1	41.00a	502.0a	27.33	5.00a
P2	55.00b	803.3b	29.33	8.03b
P3	61.00bc	907.0b	29.67	9.07b
P4	69.00c	913.3b	29.00	9.13b
P5	69.00c	896.9b	29.33	8.96b
P6	65.00bc	933.3b	27.67	9.33b
P7	60.00bc	824.7b	28.00	8.25b
P8	62.00bc	930.0b	28.33	9.30b
P9	65.67bc	846.7b	27.67	8.47b
P10	63.33bc	882.3b	29.00	8.82b
HSD 5%	12.86	182.81	ns	1.82
CV (%)	7.19	7.35	4.24	7.35

Notes: Numbers accompanied by different letters in the same column indicate differences between treatments. P1 = without fertilization, P2 = 50 kg N ha^{-1} + 5 $ml.l^{-1}$ PGPR, P3 = 50 kg N ha^{-1} + 10 $ml.l^{-1}$ PGPR, P4 = 50 kg N ha^{-1} + 20 $ml.l^{-1}$ PGPR, P5 = 100 kg N ha^{-1} + 5 $ml.l^{-1}$ PGPR, P6 = 100 kg N ha^{-1} + 10 $ml.l^{-1}$ PGPR, P7 = 100 kg N ha^{-1} + 20 $ml.l^{-1}$ PGPR, P8 = 150 kg N ha^{-1} + 5 $ml.l^{-1}$ PGPR, P9 = 150 kg N ha^{-1} + 10 $ml.l^{-1}$ PGPR, dan P10 = 150 kg N ha^{-1} + 20 $ml.l^{-1}$ PGPR, DAP= days after planting, CV=coefficient of variation

Table 8. Analysis of farming businesses in various fertilizer dose combination treatments nitrogen and PGPR concentrations

Treatment	Yields ($ton.ha^{-1}$)	Revenue (Rp)	Cost (Rp)	Benefit (Rp)	R/C
P1	4.77	28.620.000	32.932.000	-4.312.000	0.86
P2	7.65	45.900.000	33.244.500	12.655.000	1.38
P3	8.63	51.780.000	33.357.000	18.423.000	1.55
P4	8.69	52.140.000	33.469.500	18.670.000	1.56
P5	8.53	51.180.000	33.244.500	17.935.500	1.54
P6	8.89	53.340.000	33.357.000	19.983.000	1.60
P7	7.85	47.100.000	33.469.500	13.630.000	1.40
P8	8.85	53.100.000	33.244.500	19.855.500	1.59
P9	8.06	48.360.000	33.357.000	15.003.000	1.45
P10	8.40	50.400.000	33.469.500	16.930.500	1.50

Note: Selling price of milled dry unhulled rice = 6.000 kg^{-1}

N Nutrient Uptake

The soil N content before treatment was 0.22% or in the medium category. The results of the analysis of nutrient uptake of treatment P1 (without fertilization) showed lower nitrogen uptake compared to the other treatments which amounted to 0.47 g tan-1. High nitrogen uptake is in treatment P10 (150 kg.ha-1 N+20 ml.l-1 PGPR) has a nutrient uptake of 2.19 g tan-1. The nutrient uptake of the P10 treatment was high because the amount of fertilizer given was more than the other treatments, so that in the event of leaching the fertilizer given was still left for the plants. Plants absorb nitrogen fertilizer given about 30%. The factor that causes the loss of nitrogen in the soil is leaching,

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evaporation, and absorbed by plants, therefore it will affect nutrient uptake (Patti et al., 2013). The table of N content in tissues and N nutrient uptake can be seen in table 9.

Table 9. Tissue N content and N nutrient uptake due to the combination of N fertilizer and PGPR concentration

Treatment	N in tissue (%)	N nutrient uptake (g tan^{-1})
P1	2.06	0.47
P2	2.13	1.03
P3	2.80	1.23
P4	2.80	1.20
P5	2.09	1.23
P6	2.09	1.28
P7	2.62	1.59
P8	2.62	1.63
P9	2.28	1.52
P10	2.68	2.19

Notes:
P1=without fertilization, P2=50 $kg.ha^{-1}$ N+5 $ml.l^{-1}$ PGPR, P3= 50 $kg.ha^{-1}$ N+ 10 $ml.l^{-1}$ PGPR P4=50 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P5=100 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR, P6=100 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P7=100 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR, P8=150 $kg.ha^{-1}$ N + 5 $ml.l^{-1}$ PGPR P9=150 $kg.ha^{-1}$ N + 10 $ml.l^{-1}$ PGPR, P10=150 $kg.ha^{-1}$ N + 20 $ml.l^{-1}$ PGPR

High uptake will increase yield. According to Tando, (2019), one of the efforts to increase nutrient uptake is the use of *Azotobacter* bacterial isolates. Biofertilizers are able to provide nutrients needed by plants, such as nutrients N, P, K. One type of biofertilizer is PGPR (*Plant Growth Promoting Rhizobacteria*). Therefore, one way to improve and maintain soil fertility is by reducing inorganic fertilizers and adding biofertilizers.

Farming Business Analysis

Farming business analysis is used to show the value of income produced from cultivation activities. Farming analysis is also carried out to assess whether the fertilizer being tested is economically effective by calculating the R/C ratio. Calculating the R/C ratio, it will show the feasibility of the activity and whether the cultivation carried out is profitable, break-even, or detrimental. If R/C ratio value >1, then the rice farming business is feasible, R/C value ratio = 1, then the rice farming business has no profit and no loss, whereas. If the R/C ratio value is <1, then the farming is not worth running. Farming business analysis can be seen in **table 8** above. Based on the table we can see that rice plants were not given fertilizer N and PGPR have an R/C ratio <1. This shows that treatment without N fertilizer and PGPR is not worth cultivating. Additionally, on Rice plants that are not fertilized with N and PGPR do not gain benefits instead it caused a loss of IDR 4.312.000. Meanwhile, rice plants fertilized with various combinations of N and PGPR fertilizers give R/C ratio results >1, this indicates that the treatment it's worth the effort. Apart from that, treatment with fertilizer 52 N and PGPR also provide benefits. Fertilized rice plants 100 $kg.ha^{-1}$ N + 10 ml l^{-1} PGPR provides the most benefits and R/C ratio values are tall. The profit obtained was IDR 19,983,000 and the R/C ratio was 1.60. Providing inorganic fertilizer and biological fertilizer can increase land productivity and slowly improve soil fertility.

CONCLUSION

Based on the results of research that has been carried out, it can be concluded that the combination of Nitrogen fertilizer dosage and PGPR concentration has an effect on growth of rice plants Inpari 32. The treatment given provides influence on growth components, namely plant height, number of leaves, area leaves, number of tillers, plant dry weight. Apart from that, the treatment of N fertilizer dosage and PGPR concentration also influences the yield components, namely the number of panicles, the number of filled grains per hill, the percentage empty grain, weight of harvested dry grain and weight of milled dry grain per plot harvest, as well as crop yield per hectare. The fertilizer application of 50 $kg.ha^{-1}$ N+ 5 $ml.l^{-1}$ PGPR

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(P2) showed high results in the growth component, as well as greater yield and yield components. In the yield per hectare, the treatment of 50 kg.ha $^{-1}$N+ 5 ml.l^{-1} PGPR (P2) gave high results when compared to the treatment without fertilization (P1) which amounted to 8.03 tons ha^{-1}, but did not different from the other treatments. However, economically, rice plants are fertilized with 100 kg ha^{-1} N + 10 ml l^{-1} PGPR provides the highest profit and R/C ratio value with profit amounting to IDR 19.983.000 and an R/C ratio value of 1.60.

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