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The Effect of Biological Fertilizers and Inorganic Fertilizers on Upland Rice Plants (*Oryza sativa* L.) Growth and Production

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ABSTRACT

Upland rice (*Oryza sativa* L.) is a staple food crop that produces rice, which is important in meeting Indonesia's food needs. This research aims to improve growth and increase the production of upland rice plants by providing biological fertilizer and inorganic fertilizer and getting the right combination dose for upland rice plants. This research was carried out at the experimental garden of the Faculty of Agriculture, Riau University, Bina Widya campus km 12.5, Pekanbaru. This research used a factorial completely randomized design (CRD) consisting of two factors the first factor was biological fertilizer consisting of four levels, namely: H_0 : Control, H_1 : 0.18 g of Agrimeth fertilizer, H_2 :0.41 g Kayabio fertilizer, H_3: 0.45 g Petro Biofertil fertilizer; The second factor is Phonska NPK fertilizer consisting of four levels, P_0 : control, P_1 : 1,4 g, P_2: 2 g, P_3 : 2.7 g per plant. The results showed that the interaction between the application of biological fertilizer and NPK Phonska fertilizer affected the number of grainy grains per panicle and the weight of milled dry grain. Providing biological fertilizer affects plant height, root dry weight, shoot dry weight, maximum number of tillers, number of productive tillers, number of grainy grains per panicle, percentage of grainy grains and weight of milled dry grains. Application of NPK Phonska fertilizer affects plant height, shoot dry weight, root dry weight, maximum number of tillers, number of productive tillers, number of grainy grains per panicle, percentage of grainy grains and weight of milled dry grains. The correct dose to improve the growth and production of upland rice plants of the Inpago 12 variety can be 0.45 g Petro Biofertil Biofertilizer with 2.7 g Phonska NPK per plant.

Keywords: *upland rice, growth, Biofertilizer, NPK Phonska*

1. INTRODUCTION

The rice plant, scientifically known as *Oryza sativa* L., is a fundamental food crop responsible for rice production, which plays a crucial role in fulfilling the food requirements of Indonesia. In Riau, rice consumption continues to rise in tandem with population growth; however, this trend contrasts with the rice production in the region, which frequently faces a decline. As reported by the Central Statistics Agency (BPS) of Riau Province (2022), there was a reduction in rice production in 2020, totaling 243,685 tons of milled dry grain (GKG), while in 2021, it decreased further to 217,458 tons of GKG, marking a production decline of 11,671 tons of GKG. This decrease in production can be attributed to the limited availability of agricultural land for rice cultivation and issues such as soil infertility and land conversion. One potential solution to address this challenge is to use dry land. The expansion of rice cultivation areas on dry land should be optimized, especially considering that there are approximately 306,507 hectares of untapped dry land in Riau, which hold the promise of boosting rice production. Upland rice, known for its drought tolerance, presents a viable option for cultivating dry land in Riau, contributing to the overall increase in national rice production. According to the Dinas Tanaman Pangan dan Hortikultura (2011), the area dedicated to upland rice cultivation in Riau spans 13,950 hectares, with a recorded production of 64.494 ton.th^{-1} in 2010, translating to a productivity rate of 2,72 t.ha^{-1} per hectare and a production contribution ranging from 5% to 6%.

Inceptisol soil, an arid land soil suitable for cultivating upland rice plants, encounters certain challenges. One of the main issues is its classification as acid soil, with a pH range of 4.6-5.6, coupled with a relatively low to moderate soil fertility level. This is primarily due to the limited availability of nutrients and organic matter (Damanik et al., 2010). However, the problem of low soil fertility can be effectively addressed by implementing appropriate fertilization techniques.

Biological fertilizer, which encompasses active microbes, plays a pivotal role in enhancing plant growth by employing biological activities that interact with the physical and chemical properties of the soil (Purba, 2021). By utilizing biological fertilizer, the availability of nutrients can be optimized as the microbes present contribute specific nutrients that prove beneficial for both the soil and the plants. Notably, there are several widely utilized biological fertilizer products for rice plants, including Agrimeth, Kayabio, and Petro Biofertil fertilizers.

Agrimeth is a biological fertilizer that includes active microbes designed to enhance the growth and productivity of food and horticultural crops by utilizing N-fixing and P-solubilizing bacteria and producing phytohormones. In a study conducted by Arafah (2017), Agrimeth was applied at a rate of 400 gr.kg^{-25} of seeds, resulting in a grain yield of 8,14 t.ha^{-1}. On the other hand, Kayabio is a biological fertilizer containing beneficial microbes that improve soil fertility due to their ability to fix nitrogen and solubilize phosphorus (Kayaku Petrokimia, 2019). A research study carried out by Arafah and Ardah (2016) applied Kayabio at a rate of 45 kg.ha^{-1}, leading to a grain yield of 8,29 t.ha^{-1}. Lastly, Petro Biofertil is a biological fertilizer comprising active microbes that fix nitrogen, dissolve phosphorus, produce phytohormones, and decompose organic matter (Petrokimia Gresik, 2019). In a study by Ratela et al. (2016), applying kg.ha-1 of Petro Biofertil resulted in a grain yield of 6,95 t.ha^{-1}.

The utilization of organic fertilizers cannot replace the role of inorganic fertilizers in improving soil fertility overall to meet the needs of plants. Another effort can be made through inorganic fertilizers such as NPK fertilizers. The role of NPK Phonska fertilizer in rice plants can increase harvest yields and

grain quality because it contains the N, P, and K elements plants need during the vegetative and generative phases. According to the research by Shanti and Nirmala (2020), the application of NPK Phonska at a dosage of 300 kg.ha-1 on rice plants in irrigated fields can produce a grain weight of 6.18 t.ha-1, which is higher compared to the application of Phonska at dosages of 100 kg.ha-1 and 200 kg.ha-1, resulting in grain weights of 4.56 kg.ha-1 and 5.06 kg.ha-1 respectively. This research aims to improve the growth and increase the production of upland rice plants by applying organic and inorganic fertilizers and determining the appropriate combination dosage for upland rice plants.

2. MATERIAL AND METHODS

This research was conducted in the experimental garden of the Faculty of Agriculture, Riau University, Bina Widya campus km 12.5 Simpang Baru Village, Tampan District, Pekanbaru. This research was conducted for five months, from March to July 2023. Materials used in the research were upland rice seeds of Inpago 12 variety, inceptisol soil, Agrimeth fertilizer, Kayabio fertilizer, Petro Biofertil fertilizer, NPK Phonska fertilizer, bokasi, Decis 50 EC insecticide and polybags measuring 35 x 40 cm. The tools used were a hoe, machete, 25 mesh sieve, meter and laboratory tools.

The study employed a factorial, completely randomized design (CRD) with two factors. The first factor was the biological fertilizer with four levels: H0: Control, H1: 0.18 g Agrimeth fertilizer, H2: 0.41 g Kayabio fertilizer, and H3: 0.45 g Petro Biofertil fertilizer. The second factor was Phonska NPK fertilizer with four levels: P0: Control, P_1: 1.4 g, P_2: 2 g, and P_3: 2.7 g per plant. Combining these two factors, 16 treatments were created, each with three replications. Each experimental unit consisted of four samples, resulting in 192 upland rice plants. The parameters observed included plant height, maximum number of tillers, number of productive tillers, number of grains per panicle, percentage of filled grains, weight of 1000 seeds, and weight of milled dry grain. The data collected were statistically analyzed using analysis of variance (ANOVA) followed by the BNJ (honest significant difference) test at a significance level of 5%.

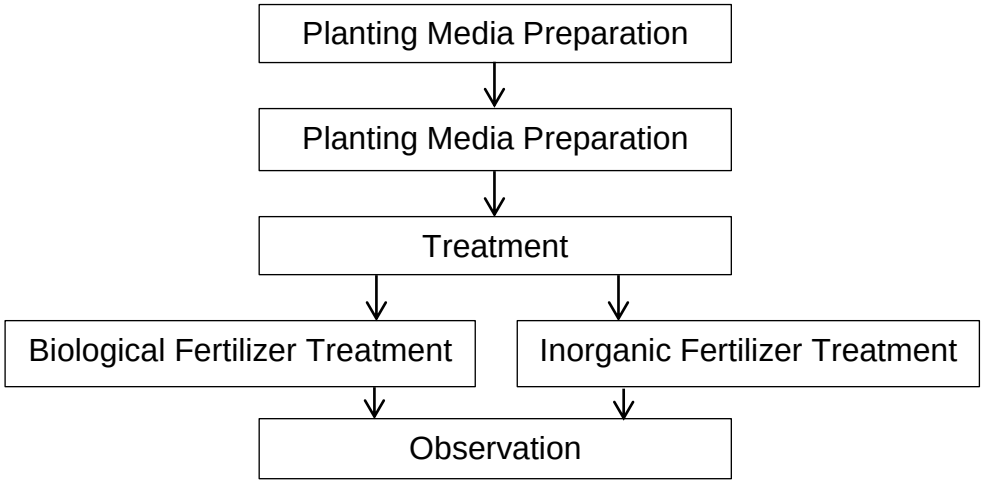

Figure 1. Research flow diagram

3. RESULT AND DISCUSSION

3.1 Plant Height

The analysis of plant height data revealed that the combination of biological fertilizer and Phonska NPK fertilizer did not have any impact on the height of upland rice plants. However, the individual factors of applying biological fertilizer and NPK Phonska fertilizer influenced the height of upland rice

plants. The findings from additional BNJ tests conducted at a significance level of 5% are presented in Table 1, providing further insights into the plant height.

Table 1 illustrates that there is no significant difference in the height of upland rice plants when using a combination of Biofertilizer and NPK Phonska fertilizer in various treatments. This lack of difference can be attributed to the fact that the total nitrogen element available in all treatment combinations falls within the medium category. Consequently, adding nitrogen elements through the fertilization combination does not have a noticeable impact. The final soil analysis results (Appendix 8) indicate that the increase in N-total content for each treatment combination is relatively similar. As a result, the response regarding the increase in rice plant height is insignificant due to the similarity in category. This finding aligns with the research conducted by Patti et al. (2013), which suggests that an increase in N-total content within the same category does not lead to a significant increase in the height of paddy rice plants.

Nitrogen is a crucial nutrient that plays a significant role in promoting the vegetative growth of plants, including roots, stems, and leaves. Sutedjo (2008) highlighted the importance of nitrogen in enhancing plant growth. The total nitrogen content in the soil indicates its capacity to absorb the nitrogen nutrients supplied. NPK Phonska fertilizer is essential to meet the plants' nitrogen requirements, as using biological fertilizer alone may not optimize the nutrient absorption process. In the study, plants treated with bokashi as an organic fertilizer showed an increase in nitrogen supply to the soil, albeit in small quantities (0.92%).

Table 1. Height of upland rice plants when applied with Biofertilizer and NPK Phonska fertilizer

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (cm)				
Without (Control)	117,76 a	117,86 a	118,06 a	118,40 a	108,01 b
Agrimeth (0,18)	117,83 a	118,00 a	118,43 a	118,86 a	108,29 a
Kayabio (0,41)	117,96 a	118,06 a	119,16 a	119,43 a	118,65 a
Petro Biofertil (0,45)	118,03 a	118,33 a	119,26 a	120,10 a	118,93 a
Mean	117,91 b	118,05 b	118,73 a	119,20 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

The utilization of Agrimeth, Kayabio, and Petro Biofertil Biofertilizers resulted in a noticeable increase in the height of upland rice plants, distinguishing it significantly from the treatment where Biofertilizer was not applied. It is hypothesized that the introduction of biological fertilizer contains biological agents that actively enhance the microbial population in the soil. These agents work diligently to provide essential nitrogen (N) nutrients in the soil, thereby ensuring the availability of N nutrient requirements to support the growth of rice plants and promote an increase in their height. Conversely, plants not subjected to applying biological fertilizer in the planting medium experience limited nutrient availability. The scarcity of N nutrients in these plants hampers their optimal growth and prevents them from achieving their maximum height potential. The biological fertilizer comprises N-fixing microbes, specifically *Azotobacter*, *Pantoea*, and *Azospirillum*, which effectively supply N elements in the soil,

thereby stimulating the growth of rice plants in terms of height. This finding aligns with the research conducted by Setiawati et al. (2016), which affirms that the presence of *Azotobacter* and *Azospirillum* microbes can enhance the height of rice plants.

The application of Phonska NPK fertilizer at a rate of 2 g and 2.7 g per plant resulted in a significant increase in the height of upland rice plants compared to the treatment with a dose of 1.4 g and without NPK. It is hypothesized that the doses of 2 g and 2.7 g of NPK fertilizer adequately fulfilled the nutritional requirements of nitrogen (N), phosphorus (P), and potassium (K) in the soil, particularly the N nutrient, which plays a crucial role in promoting plant height. Conversely, providing Phonska NPK at a dose of 1.4 g and without NPK led to suboptimal plant height. This suggests that plants' absence of N elements hampers their growth during the vegetative phase. Nitrogen is essential for protein formation, vital for cell division in plant organs, facilitating optimal growth in stems, leaves, branches, and other plant parts. This finding aligns with a study conducted by Wu et al. (2020), which demonstrated that adequate nitrogen supply in rice plants stimulates shoot elongation and results in the desired plant height.

3.2. Maximum Total Tillers

The analysis results of the maximum number of seedlings show that the interaction between Biofertilizer and NPK Phonska fertilizer has no significant effect on the maximum number of rice seedlings. The individual factor of Biofertilizer and NPK Phonska fertilizer impacts the maximum number of seedlings. The advanced BNJ test results at a 5% significance level regarding the maximum number of seedlings are presented in Table 2.

Table 2 shows no significant difference between the various combinations of organic fertilizers and NPK fertilizers in increasing the maximum number of tillers. It is suspected that the combination of organic fertilizers and NPK Phonska fertilizers given may not have been at the appropriate dosage, resulting in a non-significant difference in the maximum number of tillers in each combination. Fertilizing with the correct dosage will affect fertilization efficiency and nutrient balance in the soil, thereby showing the impact of fertilizer application. NPK Phonska fertilizer contains 15% nitrogen and is highly soluble, making plant nutrients readily available. The high availability of nitrogen causes a decrease in microbial effectiveness in the soil, and environmental factors also influence microbial activity mechanisms. This aligns with the research by Margaret et al. (2016) that combining organic and inorganic fertilizers has a non-significant effect on the maximum number of tillers.

The application of Kayabio and Petro Biofertil Biofertilizers resulted in a significant increase in the maximum number of tillers compared to not using any Biofertilizer, although there was no significant difference compared to the use of Agrimeth fertilizer. It is hypothesized that the higher application rates of Kayabio and Petro Biofertil biological fertilizers, as per recommended guidelines, led to an increase in the population of nitrogen-fixing microbes in the soil. This increase allowed for the provision of nitrogen nutrients, ultimately enhancing the maximum number of tillers. Plants that did not receive biological fertilizers exhibited the lowest number of tillers due to the absence of nutritional support from functional microbes capable of fixing nitrogen to fulfill the plant's nutrient requirements. The supply of nitrogen nutrients from microbes plays a crucial role in boosting the maximum number of rice tillers, as nitrogen nutrients are essential during the vegetative phase and promote the growth of tillers. This finding aligns with the study by Lingga and Marsono (2008), which suggests that nitrogen in the soil can

stimulate root development, enhance photosynthesis rates, and consequently influence plant vegetative growth, including the maximum total tillers.

Table 2. Maximum total tillers of upland rice under the application of biological fertilizer and NPK Phonska fertilizer

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (Stem)				
Without	20,66 a	22,00 a	22,00 a	23,00 a	21,91 b
Agrimeth	21,00 a	22,33 a	22,33 a	24,00 a	22,41 ab
Kayabio	21,00 a	23,00 a	24,66 a	25,33 a	23,50 a
Petro Biofertil	21,33 a	23,33 a	24,33 a	26,00 a	23,75 a
Mean	21,00 b	22,66 ab	23,33 ab	24,58 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

The application of Phonska NPK fertilizer at a rate of 2.7 g per plant resulted in a significant increase in the maximum number of tillers compared to the control group without NPK fertilizer. However, this increase was not significantly different from the groups treated with doses of 1.4 g and 2 g per plant. This phenomenon can be attributed to the fact that administering 2.7 g of fertilizer enhances the availability of nutrients in the soil, which are then absorbed by the plant roots, thereby promoting the growth of tillers. Conversely, the treatment without Phonska NPK fertilizer did not yield optimal results in tiller growth due to the lack of additional nutrients to support maximum tiller development. The nutrients N, P, and K are crucial in influencing offspring growth. As Kasno (2009) noted, nitrogen (N) serves as a component of chlorophyll in plants, playing a vital role in photosynthesis and ultimately contributing to tiller growth. Phosphorus (P) is essential in the growth phase as it stimulates root development and increases the number of tillers. Potassium (K) plays a key role in protein and carbohydrate synthesis, strengthening plants and promoting plant growth.

3.3. Total Productive Tillers

The results of data analysis on the number of productive tillers showed that the interaction of biological fertilizer and NPK fertilizer did not affect the number of productive tillers. The single factor of biological fertilizer and NPK Phonska fertilizer affects the number of productive tillers. The results of the BNJ further test at the 5% level on the number of productive tillers are presented in Table 3.

Table 3 shows that the combination of organic fertilizer and NPK Phonska fertilizer does not significantly differ in increasing the number of productive tillers. This is suspected to be due to the acidic nature of the soil being used, causing the given fertilizer combination not to be optimally absorbed by the plants, resulting in a suboptimal increase in productive tillers. When the soil pH is not optimal, it can disrupt the enzymes microbes produce and hinder plant growth. In acidic soil conditions, nutrients provided may not be maximally absorbed by plants due to chemical reactions that bind nutrient ions. Hindered microbial activity disrupts the decomposition of organic matter, making it difficult for roots to absorb nutrients. This is consistent with the study by Ma'sum et al. (2017), which found that low soil pH hampers the activity of

decomposing microbes, thereby reducing the decomposition of organic matter.

The application of Agrimeth, Kayabio, and Petro Biofertil biological fertilizers increases the number of productive tillers of upland rice plants, significantly different from that without applying biological fertilizers. It is suspected that Agrimeth, Kayabio and Petro Biofertil Biofertilizers contain microbes producing phosphatase enzymes that can convert organic P into inorganic P available to plants and support the increase in productive tillers. Phosphorus dissolved by P-fixing microbes plays a significant role in the growth of the vegetative phase of rice plants. This is in line with the research of Setiawati (2016), which states that providing high-level psolubilizing Biofertilizers can increase the number of productive tillers of rice.

Table 3. Total productive tillers of upland rice under the application of biological fertilizer and NPK Phonska fertilizer

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (Stem)				
Without	19,53 a	19,76 a	20,26 a	20,96 a	20,13 b
Agrimeth	19,66 a	20,06 a	20,86 a	21,00 a	20,40 a
Kayabio	19,66 a	20,63 a	21,00 a	21,53 a	20,70 a
Petro Biofertil	19,66 a	20,86 a	21,33 a	22,10 a	20,99 a
Mean	19,63 c	20,36 bc	20,86 ab	21,40 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

Application of Phonska NPK fertilizer at a rate of 2.7 g per plant resulted in a significant increase in the number of productive tillers compared to a rate of 1.4 g and no NPK, although it did not show a significant difference compared to a rate of 2 g per plant. The 2.7 g dose of NPK fertilizer is believed to enhance the availability of essential N, P, and K nutrients, enabling plants to utilize them to promote productive tillers. The treatment with a 1.4 g dose and absence of NPK Phonska fertilizer demonstrated a suboptimal increase in productive tillers due to the lack of additional N, P, and K nutrients, hindering plant nutrient absorption necessary for enhancing productive rice tillers. The provision of NPK fertilizer plays a role in the photosynthesis process by supporting plant growth through the production of carbohydrates. An increase in tillers leads to a higher production of photosynthate, thereby facilitating the growth of productive tillers. This finding is consistent with the study conducted by Sasminto and Sularno (2017), which suggests that applying NPK fertilizer can promote the formation of more efficient, productive tillers. The maximum tiller count influences the quantity of productive tillers. As mentioned by Rasyad (1997), productive tillers develop into panicles, indicating that the formation of productive tillers can be determined by the number of tillers produced.

3.4 Number of Rice Grains Per Panicle

The results of data analysis on the number of rice grains per panicle showed that the interaction of Biofertilizer and NPK Phonska fertilizer affected the number of rice grains per panicle, as did the single factor of providing Biofertilizer and NPK Phonska fertilizer. The results of the BNJ further test at the 5% level on the number of grainy grains per panicle are presented in Table 4.

Table 4 shows that the combination of Petro Biofertil fertilizer and NPK Phonska fertilizer at a dose of 2.7 g

per plant shows that the results are not significantly different from the combination of Petro Biofertil fertilizer and NPK Phonska at a dose of 2 g, the combination of Kayabio fertilizer and a dose of 2.7 g and the combination of fertilizers. Kayabio and a dose of 2 g per plant, however, were significantly different from other combinations in increasing the number of grainy grains per panicle. It is suspected that the combination of biological fertilizer and NPK fertilizer has met the nutrient requirements needed by plants for growth and rice grain production. Availability of N and P nutrients in the combination of Petro Biofertil and NPK Phonska fertilizer treatments at a dose of 2.7 g, a combination of Petro Biofertil and NPK Phonska fertilizer at a dose of 2 g, a combination of Kayabio fertilizer and a dose of 2.7 g and a combination of Kayabio fertilizer and a dose of 2 g per The plants are in sufficient and balanced condition compared to other treatment combinations so that with the availability of sufficient nutrients they are able to stimulate growth, especially in producing the amount of healthy grain.

The combination of biological fertilizer and NPK fertilizer can increase the availability of nutrients plants use for growth in the vegetative and reproductive phases. The effect of the combination of fertilization is visible in the reproductive phase during fruit ripening compared to the vegetative phase. This is thought to occur because Phonska NPK fertilizer is slow to dissolve (Slow release) and is available over a long period by releasing nutrients to remain available to plants (Novizan, 2002).

Table 4. Number of grainy grains per upland rice panicle when applied with biological fertilizer and Phonska NPK fertilizer

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (Grain)				
Without	121,00 e	121,66 de	122,33 bcd	122,66 bcd	121,91 c
Agrimeth	121,33 de	122,33 bcd	122,00 de	122,66 bcd	122,08 b
Kayabio	121,66 de	122,66 bcd	123,66 abc	125,00 ab	123,25 a
PetroBiofertil	121,66 de	123,66 bcd	124,66 ab	126,00 a	123,75 a
Mean	121,41 c	122,33 b	123,16 b	124,08 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

The amount of rice grain is influenced by the supply of nutrients provided by the activity of N-fixing microbes, P-solubilizing microbes and the application of Phonska NPK fertilizer. Nutrients N and P that are available in sufficient quantities can support the growth of the number of tillers, which supports the formation of rice grain. The increase in the number of rice grains is related to the number of productive tillers formed; the more tillers are formed, the greater the number of grainy grains produced. The results showed that the highest number of rice grains (Table 4) came from the largest number of tillers (Table 3). This is in line with Susilo et al. (2018) that a high number of rice tillers results in higher rice productivity than a small number of tillers.

Application of Petro Biofertil and Kayabio Biofertilizers increased the number of grainy grains per panicle and was significantly different from Agrimeth Biofertilizer and without Biofertilizer. This is thought to be because the application of Petro Biofertil and Kayabio Biofertilizers can increase the availability of more optimal nutrients because they contain more biological agents. Hence,

the supply of nutrient availability is also greater and supports a higher increase in the number of rice grains. The application of Agrimeth Biofertilizer was able to increase the number of grainy grains per panicle, but the results were still not optimal. This happens because Agrimeth fertilizer is a fertilizer that is applied to seeds (seed treatment), so it is suspected that the nutrients provided will only meet the needs of plants in the vegetative phase (Sunendar, 2022). Apart from that, the application of Agrimeth fertilizer at a low dose and only once during the planting period shows a significant difference between Agrimeth fertilizer and other biological fertilizers. In treatment without biological fertilizer, plants do not receive additional nutrients from biological agents, causing the yield of rice grains to be low compared to other treatments.

Applying biological fertilizer can synergize to increase water availability in dry soil media. Water bound by biological fertilizer can increase the number of grains per panicle in dryland conditions. The research results of Ratela et al. (2016) stated that applying Biofertilizer can increase the amount of rice grain because Biofertilizer contains microbes that destroy organic matter (decomposition), making the soil loose so it can hold large amounts of water. Many water conditions cause roots to develop more optimally, and nutrient absorption is more effective.

Providing Phonska NPK fertilizer at a dose of 2.7 g per plant increased the number of grainy grains per panicle and was significantly different from doses of 2 g, 1.4 g and without NPK. It is suspected that giving a dose of 2.7 g has provided sufficient and balanced nutrients for plants in increasing the availability of nutrients absorbed by plants to increase the number of grainy grains per panicle compared to low doses and without NPK fertilizer. Plants need P and K nutrients for growth and grain filling in upland rice plants. Plants need phosphorus to form ATP, energy in metabolism to assimilate, which is translated into seeds, thereby increasing grain production. This is in line with research by Hartatik et al. (2015), stating that applying NPK fertilizer at a dose of 300 kg.ha-1 could increase the number of rice grains, namely 150.45. Plants need the K element for protein and carbohydrate synthesis and smoother carbohydrate translocation. The metabolic products formed will be translocated throughout the plant to form seeds.

3.5 Weight of 1000 grains

The analysis results of 1000 seed weight show that the interaction between bio-fertilizer and NPK Phonska fertilizer does not affect the weight of 1000 rice seeds, nor do the individual factors of bio-fertilizer and NPK Phonska fertilizer application. Further, Tukey's Honestly Significant Difference test at a 5% significance level on the weight of 1000 seeds is presented in Table 5.

Table 5 shows that the application of biological fertilizer, NPK Phonska fertilizer, and the combination of biological fertilizer and NPP Phonski fertilizer showed that the results were not significantly different between treatments for the weight of 1000 rice grains. Treatment at each level showed relatively the same results, so it could not impact grain weight. It is suspected that genetic factors are more dominant, namely that the size and shape of the seeds are the same, so that treatment does not affect the weight of 1000 seeds. According to Mugnisyah and Setiawan (1990), the average grain weight tends to remain constant because the shape and size of the grain are the same.

Table 5 shows that the application of biological fertilizer, NPK Phonska fertilizer, and the combination of biological fertilizer and NPP Phonski fertilizer showed that the results were not significantly different between treatments for the weight of 1000 rice grains. Treatment at each level showed relatively the same results, so it could not impact

grain weight. It is suspected that genetic factors are more dominant, namely that the size and shape of the seeds are the same, so that treatment does not affect the weight of 1000 seeds. According to Mugnisyah and Setiawan (1990), the average grain weight tends to remain constant because the shape and size of the grain are the same.

Table 5. Weight of 1000 upland rice seeds when applied with biological fertilizer and Phonska NPK fertilizer

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (g)				
Without	25,37 a	25,60 a	25,44 a	25,55 a	25,49 a
Agrimeth	25,36 a	25,38 a	25,76 a	25,85 a	25,58 a
Kayabio	25,48 a	25,42 a	25,80 a	25,89 a	25,65 a
Petro Biofertil	25,70 a	25,75 a	25,79 a	26,00 a	25,81 a
Mean	25,47 a	25,54 a	25,70 a	25,82 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

The application of fertilizer did not significantly impact the weight parameters of 1000 seeds. The weight of 1000 rice seeds, approximately 26 g, aligns with the characteristics of the upland rice variety Inpago 12 described in Appendix 1. This consistency in weight is also supported by Shanti and Nirmala (2020), who found that NPK fertilizer does not influence the size or weight of rice grains due to their genetic stability. The substantial weight of 1000 rice seeds can be attributed to the adequate nutrient supply in the rice plant, facilitating efficient photosynthesis from leaves to seeds. By supplying NPK fertilizer, essential nutrients such as N, P, and K are provided to support the synthesis of proteins, carbohydrates, and sugars, which are crucial for optimal seed development.

3.6 Weight of Milled Dry Grain

The results of data analysis on the weight of dry milled grain showed that the interaction of biological fertilizer and NPK Phonska fertilizer affected the weight of dry milled grain, as well as the single factor of biological fertilizer and NPK Phonska fertilizer. The results of the BNJ further test at the 5% level on the weight of dry milled grain are presented in Table 6.

Table 6 shows the interaction between the application of Petro Biofertil Biofertilizer (0.45 g) and NPK Phonska dose of 2.7 g per plant, showing that the results are not significantly different from the combination of Petro Biofertil fertilizer and NPK Phonska dose of 2 g, the combination of Kayabio fertilizer and NPK Phonska dose 2.7 g and Kayabio and NPK Phonska at a dose of 2 g per plant, but showed significantly different results from other combinations in increasing the weight of milled dry grain. It is suspected that the combination provided has met the plant's nutrient needs to increase the weight of milled dry grain.

Biological fertilizer contains functional microbes. If the fertilizer application is given in the right amount, the microbes enter into maximum symbiosis to increase growth and optimal grain yield. Increasing the dose of Phonska NPK fertilizer maximizes the increase in the number and weight of upland rice grains due to adequate nutritional conditions. In this research, combining biological fertilizer and NPK fertilizer can significantly increase the productivity of upland rice. This aligns

with research by Noepriani et al. (2023), which found that applying biological fertilizer and NPK fertilizer increases the dry weight of harvested grain by up to 0,61 t.ha^{-1}.

Applying Petro Biofertil and Kayabio Biofertilizers increased the weight of milled dry grain and significantly differed from the treatment with Agrimeth Biofertilizer and without Biofertilizer. It is suspected that the Biofertilizers Petro Biofertil and Kayabio, which are given as inoculants, can help provide more optimal nutrients for plants. According to Wahyuni (2019), giving a larger number of microbes supports more active microbes that are symbiotic in the soil to trigger rice growth, producing more grain than when given. The application of Agrimeth fertilizer has not been optimal in increasing the dry weight of harvested grain. It is suspected that the dose given was in small amounts; apart from that, the application was given only once in the growing season, which is different from the Kayabio and Petro Biofertil biological fertilizers so that it showed significantly different results in the weight of milled dry grain.

Table 6. Dry grain weight of upland rice on Biofertilizer and NPK Phonska fertilizer application

Biofertilizer (g)	Phonska Fertilizer (g)				Average
	0	1,4	2	2,7	
	..... (g)				
Without	58,31 e	60,51 de	62,41 bcd	62,57 bc	60,95 c
Agrimeth	59,99 e	62,03 bcd	62,61 bc	62,83 bc	61,86 b
Kayabio	61,63 cde	62,09 bcd	63,29 abc	63,69 ab	62,67 a
Petro Biofertil	61,76 cde	62,40 bcd	63,47 abc	64,69 a	63,08 a
Rerata	60,42 c	61,76 b	62,94 a	63,44 a	

Note: The numbers in the rows and columns followed by the same lowercase letters indicate that they are not significantly different according to the BNJ further test at the 5% level.

Providing Petro Biofertil and Kayabio Biofertilizers to rice plants is very effective because they contain microbes that can increase the availability of N and P nutrients, which support plant growth and production, especially in increasing the dry weight of rice grain. Penicillium sp. The biological fertilizers contained in Petro Biofertil and Kayabio produce phosphatase enzymes that can dissolve organic P into inorganic P, which is available for plant absorption. Providing the microbial population of Penicillium sp. in large quantities will provide large amounts of P nutrients. According to Lingga and Marsono (2008), the availability of P nutrients helps the photosynthesis process and plays a role in the results of photosynthesis in the form of carbohydrates, which can increase the weight of milled dry grain.

Providing Phonska NPK fertilizer at a dose of 2.7 g and 2 g per plant increased the weight of milled dry grain and was significantly different from a dose of 1.4 g and without NPK. The analysis results show that the higher the dose of NPK fertilizer given, the heavier the milled dry grain produced. This is thought to be because giving high doses will increase the availability of macronutrients in the soil to support plants in carrying out the photosynthesis process. Increasing the rate of photosynthesis affects increasing plant yields. The weight of the grain affects the yield, where the high or low weight of the grain is determined by the number of panicles and the number of grainy grains per panicle. According to Prawiranta et al. (1995), grain weight is found in the

storage tissue (endosperm), which comes from the dry material in the seeds.

Increasing the K element from the NPK fertilizer can increase the carbohydrates plants produce as raw materials for forming energy used for grain formation in rice plants. Grain weight is influenced by the translocation of photosynthate into the formed grain. A high photosynthesis rate produces much photosynthesis, so when it is translocated into the rice grain, it will be larger and affect its weight (Urairi et al., 2016).

4. CONCLUSION

The combination of biological fertilizer and NPK phonska fertilizer impacts the quantity of filled grain per panicle and the weight of milled dry grain. The utilization of biological fertilizer influences various aspects of plant growth, including plant height, the maximum number of tillers, the number of productive tillers, the number of full grains per panicle, the percentage of full grain, and the weight of dry milled grain. Similarly, the application of NPK Phonska fertilizer also affects these parameters, such as plant height, the maximum number of tillers, the number of productive tillers, the number of full grains per panicle, the percentage of full grain, and the weight of dry milled grain.

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