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Effect of N,P,K Fertilizer Rate and Biofertilizer on Growth and Yield of Grendel Rice Variety

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Abstract
The research was carried out in the rice fields of Jaya Mukti Village, Blanakan District, Subang Regency, with a height of 10 meters above sea level and a type of rainfall (Appendix 1). The trial will be carried out from August 2022 to November 2022. This study aims to learn about the interaction of the influence of N, P, K fertilizer and biological fertilizer doses on the growth and yield of Grendel rice paddy crops. This experiment uses a Random Group Design (RAK) experimental design of a factorial pattern consisting of two factors, the first factor is 3 levels of N, P, K (p) fertilizer and the second factor is Biological Fertilizer (h) as many as 3 levels, both factors are repeated 3 times. There were 9 treatment combinations that were randomly placed on each replicate. The results of the study showed that the administration of N, P, K fertilizer and biological fertilizer had an effect on growth (plant height 21 DAP and number of saplings 28 DAP), yield (grain weight per clump). The application of N, P, K fertilizer has an effect on the yield components (number of productive saplings, panicle length and weight of 1000 grains). The N,P,K dose of 60 % indicates the best panicle length and weight of 1000 grains. A dose of 30 kg ha -1 biofertilizer showed good results on plant growth.

Keywords: Rice, NPK Fertilizer, Biological Fertilizer

1. Introduction

Rice (Oryza sativa L.) is an important food crop besides wheat and corn, which is one of the plants that is widely cultivated in Asia, especially Indonesia.(Rahmatica & Sari, 2020),(Puspitasari, 2021),(Hamakonda & Bhara, 2022). Rice can produce rice where rice is the most important staple for the majority of the Indonesian population, rice can provide 45-55% protein and 40-80% of the total calories needed by humans(Muslim, 2011),(Apriyanto, 2022). Grendel rice is a type of irrigated rice seed that comes from a derivative of the cere variety, has a harvest age of 120 days and produces a production of 10 tonnes/ha, is resistant to planthopper pest attacks.(Baehaki & Mejaya, 2014),(Akas, nd). Planting Grendel rice seeds must use the jajar legowo system, because this system has the advantage of making it easier for sunlight to enter to help the photosynthesis process, in the fertilization process and can increase the growing rice population.(SUHENDRA, 2022),(Rusdiyana, Sampurno, & Sanyoto, 2022). The use of fertilizer is one of the key factors in increasing food production and achieving rice self-sufficiency in Indonesia(Mubarokah & Miftah, 2023),(Konyep, 2020). Applying inorganic fertilizer to the soil will increase the chemical fertility of the soil because it can provide nutrients quickly for plant growth, but if it is excessive it will damage soil fertility both chemically, physically and biologically.(Widyaningrum, 2020),(Suprapti et al., 2023). Biological fertilizer can be defined as an inoculant made from active living organisms which functions to fix certain nutrients or facilitate the availability of nutrients in the soil for plants. Functional microbes that are generally used as biofertilizers consist of groups of microbes that fix N, solubilize phosphate and produce growth hormones(Nadhifah, 2021),(Mansyur, Pudjiwati, & Murtilaksono, 2021).

2. Methods

The experiment was carried out in the rice fields of Jaya Mukti Village, Blanakan District, Subang Regency, at a height of 10 meters above sea level. The experiment will be carried out from August 2022 to November 2022. The materials used in the experiment are Grendel variety rice seeds (Appendix 2), Urea fertilizer (45% N), SP-36 (36% P2O5), KCl (60% K2O) and Biological Fertilizers (Pantoea sp, Azospirillum sp, Aspergillus niger, Penicillium sp, Streptomyces sp). The equipment used is a tractor, hand sprayer, hoe, rice thresher, sickle, measuring tape, stationery, ruler, calculator, analytical scale, sample paper, sample plastic and documentation tools. This experiment used a Randomized Group Design (RAK) factorial pattern consisting of two factors, namely the first factor was N, P, K (p) fertilizer at 3 levels and the second factor was Biological Fertilizer (h) at 3 levels, both factors were repeated 3 times. There were 9 treatment combinations that were randomly assigned to each replication.

Table 1. Treatment Variables

Variable Type	Sub Variable	Variable Indicator
Independent Variable (Treatment)	N,P,K fertilizer	p1 =N,P,K 100% (Urea 300 kg ha-1 + SP-36 50 kg ha-1 + KCl 50 kg ha-1)
		p2 =N,P,K 60% (Urea 180 kg ha-1 + SP-36 30 kg ha-1 + KCl 30 kg ha-1)
		p3 =N,P,K 20 % (Urea 60 kg ha-1 + SP-36 20 kg ha-1 + KCl 20 kg ha-1)
	Biological Fertilizer	h0 =Biological Fertilizer 0 kg ha-1
		h1 =Biological Fertilizer 15 kg ha-1
		h2 =Biological Fertilizer 30 kg ha-1

Table 2. Combination Treatment of N, P, K Fertilizer and Biological Fertilizer

N,P,K Fertilizer (p)	Biological Fertilizer (h)		
	h0	h1	h2
p1	p1 h0	p1 h1	p1 h2
p2	p2 h0	p2 h1	p1 h2
p3	p3 h0	p3 h1	p1 h2

Table 3. Dependent Variable

Variable Type	Sub Variable	Indicator
Dependent Variable (Response)	1. Growth Characteristics	1. Plant Height 2. Number of Cubs
	2. Result Components	1. Number of Productive Tillers 2. Panicle Length 3. Grain Weight per Malai
	3. Rice Crop Results	1. Harvested dry grain weight per Clump 2. Weight of 1000 items

Table 4. List of Random Variance Analysis Group Factorial Patterns

Variety Source	DB	JK	KT	F. Hit	F.05
Deuteronomy (r)	3	∑Xi..2/tX...2/rt	JKr/BDr	Ktr/KTg	4.46
Treatment (t)	9	∑X.jh2/rX...2/rt	JKt/BDr	KTt/KTg	3.44
NPK Fertilizer (p)	3	∑Xj2/rn-X...2/rt	JKp/BDh	KTh/KTg	4.46
Biological Fertilizer (h)	3	∑X..k2/rz-X...2/rt	JKi/DBp	ID card/KTg	4.46
L x H	9	∑JKt-JKh-JKp	JKpi/DBhp	KThp/KTg	3.84
Error (G)	27	∑JKtotal-JKt-JKt	JKg/DBg	-	-
Total (T)	54	∑Xijk2-X…2/rt	-	-	-

Source: Toto Warsa and Cucu SA (1982).

3. Results and Discussion

3.1 Observation of Plant Height

The results of the independent test analysis showed that the application of N, P, K fertilizer and biological fertilizer showed significantly different results on the height growth of plants aged 21 DAT and 35 DAP.

Table 5. Effect of N, P, K fertilizer and biological fertilizer on plant height Age, 14, 21, 28 and 35 HST

Treatment	Average Plant Height (cm)			
	14 HST	21 HST	28 HST	35 HST
N,P,K fertilizer				
p1 (100 %)	19.23 a	36.28 a	49.71 a	52.54 a
p2 (60 %)	18.41 a	38.44 b	50.06 a	52.11 a
p3 (20%)	20.00 a	35.89 a	47.49 a	50.78 a
Biological Fertilizer				
h0 (0 kg ha-1)	18.44 a	35.40 a	47.64 a	50.33 a
h1 (15 kg ha-1)	19.51 a	37.43 b	49.68 a	52.16 ab
h2 (30 kg ha-1)	19.69 a	37.78 b	49.93 a	59.94 b

Note: Average numbers followed by the same letter in the same column are not significantly different based on the Duncant Multiple Range Test at a 5% Significance Level.

3.2 Observation of the Number of Tillers

The results of the independent test analysis showed that the application of N, P, K fertilizer and biological fertilizer showed significantly different results on the number of tillers aged 28 HST.

Table 6. Effect of N, P, K fertilizer and biological fertilizer on the number of tillers Age, 14, 21, 28 and 35 HST

Treatment	Average Number of Tillers (clump)			
	14 HST	21 HST	28 HST	35 HST
N,P,K fertilizer				
p1 (100 %)	6.00 a	12.11 a	18.67 ab	28.67 a
p2 (60 %)	5.67 a	12.67 a	20.67 c	29.67 a
p3 (20%)	4.33 a	11.44 a	17.11 a	28.33 a
Biological Fertilizer				
h0 (0 kg ha-1)	4.78 a	11.00 a	17.67 a	28.33 a
h1 (15 kg ha-1)	5.56 a	12.22 a	18.00 ab	28.33 a
h2 (30 kg ha-1)	5.67 a	13.00 a	20.78 c	30.00 a

Note: Average numbers followed by the same letter in the same column are not significantly different based on the Duncant Multiple Range Test at a 5% Significance Level.

3.3 Observation of the number of productive offspring

The results of the independent test analysis showed that the application of N, P, K fertilizer showed significantly different results on the number of productive tillers.

Table 7. The effect of N, P, K fertilizer and biological fertilizer on the number of productive tillers

Treatment	Average Number of Productive Tillers (clump)
N,P,K fertilizer	
p1 (100 %)	17.78 a
p2 (60 %)	18.56 b
p3 (20%)	15.53 a
Biological Fertilizer	
h0 (0 kg ha-1)	16.33 a
h1 (15 kg ha-1)	17.00 a
h2 (30 kg ha-1)	18.56 a

Note: Average numbers followed by the same letter in the same column are not significantly different based on the Duncant Multiple Range Test at a 5% Significance Level.

3.4 Panicle Length Observations

The results of the independent test analysis showed that the application of N, P, K fertilizer showed significantly different results on the number of productive tillers.

Table 8. Effect of N, P, K fertilizer and biological fertilizer on panicle length

Treatment	Average Panicle Length (cm)
N,P,K fertilizer	
p1 (100 %)	20.03 ab
p2 (60 %)	22.36 b
p3 (20%)	18.80 a
Biological Fertilizer	
h0 (0 kg ha-1)	19.87 a
h1 (15 kg ha-1)	20.12 a
h2 (30 kg ha-1)	21.20 a

Note: Average numbers followed by the same letter in the same column are not significantly different based on Duncant's Multiple Range Test at 5% Significance Level

3.5 Observation of Grain Weight per Panicle

The results of the independent test analysis showed that the application of N, P, K fertilizer and Biological Fertilizer showed insignificantly different results on grain weight per panicle.

Table 9. Effect of N, P, K fertilizer and biological fertilizer on grain weight per panicle

Treatment	Average Number of Grain Weights Per Panicle (g)
N,P,K fertilizer	
p1 (100 %)	2.13 a
p2 (60 %)	2.10 a
p3 (20%)	1.86 a
Biological Fertilizer	
h0 (0 kg ha-1)	1.97 a
h1 (15 kg ha-1)	2.01 a
h2 (30 kg ha-1)	2.12 a

Note: Average numbers followed by the same letter in the same column indicate that they are not significantly different based on the Duncant Multiple Range Test at Level of Significance 5%

3.6 Observation of Grain Weight per Clump

The results of the independent test analysis showed that the application of N, P, K fertilizer and Biological Fertilizer showed significantly different results on the weight of grain per hill.

Table 10. Effect of N, P, K fertilizer and biological fertilizer on grain weight per hill

Treatment	Average Total Weight of Grain Per Clump (g)
N,P,K fertilizer	
p1 (100 %)	83.43 b
p2 (60 %)	84.37 b
p3 (20%)	79.87 a
Biological Fertilizer	
h0 (0 kg ha-1)	80.56 a
h1 (15 kg ha-1)	82.33 ab
h2 (30 kg ha-1)	84.78 b

Note: Average numbers followed by the same letter in the same column indicate that they are not significantly different based on the Duncant Multiple Range Test at Level of Significance 5

3.7 Observation of the Weight of 1000 Items

The results of the independent test analysis showed that the application of N, P, K fertilizer showed significantly different results for the weight of 1000 grains in the p2 treatment (60%) showed the highest results compared to other treatments, while the application of biological fertilizer had no significant difference for the weight of 1000 grains.

Table 11. The effect of N, P, K fertilizer and biological fertilizer on the weight of 1000 grains

Treatment	Average Total Weight of 1000 Items (g)
N,P,K fertilizer	
p1 (100 %)	24.62 b
p2 (60 %)	25.98 b
p3 (20%)	22.16 a
Biological Fertilizer	
h0 (0 kg ha-1)	23.68 a
h1 (15 kg ha-1)	23.82 a
h2 (30 kg ha-1)	25.26 a

Note: Average numbers followed by the same letter in the same column are not significantly different based on the Duncant Multiple Range Test at a 5% Significance Level.

4. Conclusion

Providing doses of N, P, K fertilizer and biological fertilizer affected growth (plant height 21 DAP and number of tillers 28 DAP), yield (grain weight per hill). The application of N, P, K fertilizer affects the yield components (number of productive tillers, panicle length and weight of 1000 grains). The N, P, K dose of 60% shows the best panicle length and weight of 1000 grains. Biofertilizer dosage of 30 kg ha -1 shows good results on plant height.

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