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Growth and yield of several Gogo rice varieties (*Oryza Sativa L.*) applicated by various P sources in Ultisol Planting Media

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Abstract

Gogo rice productivity is still low because farmers still use local varieties of Gogo rice and most of it is cultivated on marginal soils such as Ultisol. Ultisol soils contain low available P due to P fixation by Al and Fe. The existence of Gogo rice varieties that can compensate for the high Al content in Ultisol soil and can neutralize Al in plants is one of the right solutions in overcoming the problem of Al poisoning. While the constraint of the lack of availability of P nutrients in Ultisol requires the application of P fertilizer. This study aims to determine the growth and yield of several Gogo rice varieties given various P sources and to determine the best Gogo rice varieties and the best P sources in Ultisol. The research method used a Split Plot Design. The main plot is Gogo rice varieties consisting of three levels, namely; Kuku Balam, Dogor, and Inpago 10, as well as subplots are various sources of P consisting of four levels, namely; No P, 0.4 g TSP, 0.7 g rock phosphate, and 1.8 g guano. The results showed that administration of 0.4 g TSP was the best source of P in Gogo rice than without P, administration of RP, and guano on the value of P nutrient uptake, maximum tillers, productive tillers, flowering age, harvest age, number of grains per panicle, percentage pithy grain, the weight of dry milled grain per clump and the ratio of grain and straw. The Kuku Balam variety had a nutrient uptake value of P (130.91 mg/clump), the number of grains per panicle (210.63 grains) and the weight of milled dry grain per clump (42.11 g) which were the best yields compared to the Dogor and Inpago 10.

Keywords: Gogo rice varieties; Productivity; P Sources; Ultisol soil

1. Introduction

Gogo rice is a type of rice that has good adaptation to dry and acid soils such as Ultisols. Gogo rice productivity in Riau is 2.25 t.ha^{-1} which is lower than the national rice productivity, which is 3.28 t.ha^{-1}. Moreover, compared to the productivity of lowland rice, namely, 4.44 t.ha^{-1} [1]. This is due to Gogo rice farmers in Riau planting local varieties of Gogo rice and planted on marginal Ultisol lands [2].

Ultisol soil has a low pH, high Al saturation, poor nutrient content, low organic matter content, limited water storage capacity, and is susceptible to erosion [3]. Praseto et al [4] also stated that Ultisol soils were poor in organic matter and macronutrients, especially P. Plants were only able to absorb 8-13% P nutrients in Ultisol soils. The rest is bound by Al and Fe so it is not available to plants [5].

There are several Gogo rice varieties cultivated on Ultisol land by the people of Riau, especially Rokan Hulu Regency, namely the local varieties Kalpatali, Kuku Balam, Si Gudang, Dogor, and Popotali, as well as planting high-yielding varieties such as Inpago 10 [6]. Gogo rice plants local have characteristics such as low productivity, but tolerance to toxic ion stresses such as high Al saturation because they have several mechanisms, namely; 1) exclusion, plants recognize toxic ions and prevent them from absorbing them; 2) tolerance, the metabolic system in plants can neutralize

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Al without damaging the metabolic system; and 3) countermeasures, plants absorb toxic ions but can minimize their effects [7].

On the other hand, Gogo rice productivity in Ultisol soils is still constrained by the low availability of P in Ultisol soils. Therefore it is necessary to apply P fertilizer in order to provide P for plants [8]. Some of the P fertilizers used are TSP, rock phosphate (RP), and guano. TSP fertilizers have P2O5 levels around 43 - 52% and 95 - 98% water soluble [9]. Rock phosphate (RP) has a P_2O_5 nutrient content of ± 26% with P nutrient sources derived from slow release minerals [10]. Meanwhile, guano fertilizer contains P (10%), N (6.01%) and K (2.18%) nutrients which are good for use as a nutrient source in soil [11].

This study aims to determine the growth and yield of several Gogo rice varieties (*Oryza sativa* L.) on Ultisol growing media given various P sources and to find out the best Gogo rice varieties and the best P sources on several Gogo rice varieties (*Oryza sativa* L.).

2. Material and methods

2.1. Research Site and Materials of The Research

The research was carried out in Pasir Jaya Village, Rambah Hilir District, Rokan Hulu Regency, Riau Province, Indonesia which is geographically located at 0°58'59'' north and 100°16'52" east longitude. The Gogo rice varieties used were Kuku Balam variety and the Dogor variety originating from Bangun Purba Village, Rambah District, Rokan Hulu Regency, Riau Province, Indonesia as well as the Inpago 10 variety (national superior). P fertilizer used were TSP fertilizer, rock phosphate (RP), and guano fertilizer.

2.2. Research Design

The research was conducted experimentally using a Split Plot Design consisting of 3 main plots and 4 sub plots. Main plot was Gogo rice varieties, as well as sub plots was without P and various sources of P (TSP, RP, Guano). There were 12 treatment combinations and 3 replications, obtained 36 experimental units. Each experimental unit were sampled.

2.3. Application

The application was carried out by giving P fertilizer at the time of planting according to each treatment dose. The treatment dose is equivalent to the P_2O_5 requirement per ha of rice plants, which is 36 kg. TSP fertilizer 0.4 grams/polybag (78 $kg.ha^{-1}$), RP 0.7 grams/ polybag (138.46 $kg.ha^{-1}$) and guano fertilizer 1.8 grams/polybag (360 $kg.ha^{-1}$). P fertilizer was given with a distance of 5 cm from the plant with a depth of 2 - 3 cm.

2.4. Statistical Analysis

The data obtained in this study were statistically analyzed using analysis of variance. The results of the analysis of variance which showed significant differences were then tested with Duncan Multiple Range Test (DMRT) at the 5% level.

3. Results

3.1. Yield of Gogo Rice Vegetative Components

The results of the diversity analysis showed that the interaction of several Gogo rice varieties and various P sources as well as the factors of several Gogo rice varieties significantly affected the yield parameters of the Gogo rice vegetative components except for the plant height parameter. Meanwhile, the treatment factor of various P sources significantly affected all yield parameters of the vegetative components of Gogo rice plants.

Table 1 Results of vegetative components of several Gogo rice (*Oryza sativa* L.) varieties applicated by various P sources in ultisol planting media

P Fertilizer	Gogo Rice Varieties			Sub Plot Average
	Kuku Balam	Dogor	Inpago 10	
	Nutrient Uptake P Value (mg/clump)			
Without P	44.33d	30.5c	5.14b	26.66c
TSP	130.91a	80.91a	40.16a	84.01a
RP	63.69c	58.63b	14.53b	45.62b
Guano	81.59b	64.48b	10.29b	52.12b
Main Plot Average	80.13a	58.63a	17.53b	
	Plant Height (cm)			
Without P	84.5ab	72.33b	77.31b	78.01b
TSP	77.73b	108.06a	114.14a	99.98a
RP	92.76a	91.41ab	95.24ab	93.14a
Guano	96.38a	100.21a	103.93a	100.17a
Main Plot Average	87.84a	92.98a	97.66a	
	Maximum Number of Tillers (stems)			
Without P	7.66c	7.44c	6.88d	7.33d
TSP	14.33a	12.44a	16.44a	14.4a
RP	10.44b	8.55b	11.11c	10.03c
Guano	14a	11.44a	13.44b	12.96b
Main Plot Average	11.61a	9.97b	11.97a	
	Productive Number of Tillers (stems)			
Without P	3.83d	3.66d	4.66d	4.05d
TSP	9.5a	8.83a	13.83a	10.72a
RP	5.83c	4.66c	7.66c	6.05c
Guano	8.5b	7.16b	9.83b	8.5b
Main Plot Average	6.92b	6.08c	8.99a	

The numbers in the rows followed by lowercase letters that are not the same are significantly different according to the DMRT test at the 5% level

3.2. Yield of Gogo Rice Production Components (Generative)

The results of the analysis of diversity showed that the interaction of several Gogo rice varieties and various P sources had a significant effect on the yield parameters of the Gogo rice production components (generative) except for the parameters of the percentage of pithy grain, weight of 100 grains, and the ratio of grain and straw. While the factors of several Gogo rice varieties had a significant effect on the production component (generative) except for the parameters of the percentage of pithy grain and weight of 100 grains. On the other hand, the treatment factor of various P sources significantly affected all yield parameters of the Gogo rice production (generative) components.

Table 2 Production components (generative) several Gogo rice varieties (Oryza sativa L.) applicated by various P sources in ultisol planting media

P Fertilizer	Gogo Rice Varities			Sub Plot Average
	Kuku Balam	Dogor	Inpago 10	
	Flowering Age (DAP)			
Without P	133.33a	94.33a	92.5a	106.72a
TSP	115.66d	85.33b	81d	94d
RP	125.83b	92a	89.33b	102.38b
Guano	121.66c	92.16a	86.5c	100.11c
Main Plot Average	124.12a	90.96b	87.33c	
	Harvest Age (DAP)			
Without P	169a	134.16a	130a	144.38a
TSP	148.5d	119.33d	114.83c	127.55d
RP	159.16b	127.83b	125.83b	137.61b
Guano	153.33c	124.5c	123.5b	133.77c
Main Plot Average	157.5a	126.46b	123.54c	
	Number of Grains Per Panicle (grains)			
Without P	75.48d	74.54c	65.15d	71.72d
TSP	210.63a	152.25a	129.49a	164.12a
RP	117.41c	91.31b	83.99c	97.57c
Guano	154.59b	103.37b	102.82b	120.26b
Main Plot Average	139.53a	105.37b	95.36c	
	Percentage of Pithy Grain (%)			
Without P	67.41d	65.74d	66.59d	67d
TSP	88.23a	87.13a	89.78a	88a
RP	71.92c	71.52c	72.20c	72c
Guano	80.57b	80.29b	81.91b	81b
Main Plot Average	77a	76a	78a	
	Dry Milled Grain Weight per Clump (grams)			
Without P	5.4d	4.74d	5.05d	5.06d
TSP	42.11a	27.78a	37.78a	35.89a
RP	11.46c	7.72c	11.12c	10.1c
Guano	25.68b	14.04b	20.17b	19.96b
Main Plot Average	21.16a	13.57b	18.53a	
	Weight 100 grains (grams)			
Without P	2.09b	2.25a	2.21b	2.19c
TSP	2.42a	2.38a	2.5a	2.43a
RP	2.27a	2.36a	2.36b	2.33b

Guano	2.35a	2.34a	2.32b	2.34b
Main Plot Average	2.28a	2.33a	2.35a	
	Grain and Straw Ratio			
Without P	0.44c	0.46b	0.44d	0.44d
TSP	0.72a	0.67a	0.73a	0.7a
RP	0.5b	0.46b	0.57c	0.51c
Guano	0.71a	0.6a	0.64b	0.65b
Main Plot Average	0.59b	0.55c	0.6a	

The numbers in the rows followed by lowercase letters that are not the same are significantly different according to the DMRT test at the 5% level

4. Discussion

4.1. Gogo Rice Vegetative Components

4.1.1. Nutrient Uptake P Value (mg/clump)

Table 1 shows that Kuku Balam and Dogor varieties with P fertilizer were able to absorb more P than without P fertilizer. Inpago 10 varieties without P fertilizer were not significantly different from RP and guano fertilizers on the P nutrient uptake value, but significantly different with TSP fertilizer application. In general, the application of TSP fertilizer (0.4 grams) actually absorbed more P nutrients than other P fertilizers. Table 1 also shows that the Inpago 10 variety absorbs less P nutrients than the Kuku Balam and Dogor varieties.

The high value of P nutrient uptake in the three Gogo rice varieties in TSP treatment was due to the nature of TSP fertilizer which was soluble and gave a fast response to plants. This element of P dissolves and adds P to soils that have low available P (14.9 ppm) due to being bound by Al and Fe in Ultisols. The nature of TSP fertilizers is different from RP fertilizers and guano fertilizers, which are difficult to dissolve so that they are long available to plants [12].

The occurrence of differences in the value of P nutrient uptake in various Gogo rice varieties indicated a different response from various Gogo rice varieties to various P sources which were influenced by genotype traits. In line with the opinion Harjadi [13] that there are differences in physiological and morphological characters in each variety and environmental conditions where the plant grows.

4.1.2. Plant Height (cm)

Table 1 shows that the Kuku Balam variety without P fertilizer was not significantly different from the P fertilizer application to plant height parameters. The Dogor and Inpago 10 varieties without P fertilizer were not significantly different from the RP fertilizer application, but significantly different from the TSP and guano fertilizer application in increasing plant height. In general, the application of TSP fertilizer, RP fertilizer, and guano fertilizer significantly increased Gogo rice plant height compared to no P fertilizer application. Table 1 also shows that Kuku Balam, Dogor, and Inpago 10 varieties produced plant heights that were not significantly different from each other. This is because the application of P fertilizer does not affect the height growth of Gogo rice plants. Kantikowati et al [14] reported that the application of P fertilizer at a dose of 25 - 100 kg.ha-1 increased the height of rice plants but was not significantly different from without P because the element P functions to stimulate flower formation and seed maturation. Plants need more N elements to help their vegetative growth [15].

According to International Rice Research Institute [16], the criteria for Gogo rice plant height are divided into three, namely short (<90 cm), medium (90-125 cm), and high (>125 cm). Based on the criteria, the height of Gogo rice varieties of Kuku Balam was low, while Dogor and Inpago 10 were classified as medium.

In the three Gogo rice varieties, the application of guano fertilizer was able to increase plant height. This is because in addition to having 10% P_2O_5, guano fertilizer also contains N (6.01%) and K (2.18%), so that the application of guano fertilizer has sufficient nutrients in the soil for plant height growth [17].

4.1.3. Maximum Number of Tillers (stems)

Table 1 shows that the three Gogo rice varieties with P fertilizer were able to produce a maximum number of tillers more than those without P fertilizer. Table 1 also shows that the Dogor variety had fewer maximum tillers than the Kuku Balam and Inpago 10 varieties. Las et al [18] stated that the criteria for the maximum number of tillers were divided into four, namely few (<10), moderate (10-15), many (16 - 20) and very many (>20). Based on Table 1, the average number of maximum tillers of the three varieties was moderate.

Rice is difficult to grow in Ultisol soils with high Al saturation due to P fixation by Al so that the available P-nutrients are slightly absorbed by plants [19]. With the application of P fertilizer, the low P-available Ultisol soil (14.9 ppm) can be increased and absorbed by plants to increase the maximum number of tillers. The application of TSP fertilizer was better in increasing the maximum number of tillers due to the nature of TSP fertilizer which was easily soluble compared to RP (Rock Phosphate) which had low solubility [12]. As for Kuku Balam and Dogor, guano was also able to increase the number of tillers because it had P (10%), N (6.01%) and K (2.18%) nutrients, so it could add macro nutrients to increase growth as well. crop yields [20]. Munawar [21] also stated that nutrient P functions as an activator in various enzyme reactions needed for the process of cell division and elongation.

4.1.4. Number of productive tillers (stems)

Table 1 shows that the three Gogo rice varieties with P fertilizer were able to produce more productive tillers than those without P. P fertilizer gave different responses to the three Gogo rice varieties, but TSP fertilizer produced more productive tillers than the three Gogo rice varieties. application of RP fertilizer and guano fertilizer. In addition, from Table 1 it can be seen that the Inpago 10 variety had more maximum tillers than the Kuku Balam and Dogor varieties. This is because TSP fertilizer is fast soluble so that it is more quickly and easily available to plants with a fairly high P_2O_5 level, which is 46%. Meanwhile, RP and guano have varying P_2O_5 content and long soluble [22].

According to [16], the criteria for the number of productive tillers consist of; 1) very little (<5), a little (5-9), moderate (10-19), a lot (20-25), and very much (>25). Based on the results of the study, the average number of productive tillers of the three varieties was relatively small. The number of productive tillers produced by the three Gogo rice varieties with TSP was in line with the amount of P nutrient uptake (Table 1). According to Rauf et al [23], P nutrient deficiency causes rice plants to have few tillers, slow ripening and low crop production.

4.2. Gogo Rice Production Components (Generative)

4.2.1. Flowering Age (DAP)

Table 2 shows that the Kuku Balam and Inpago 10 varieties with P fertilizer application faster than those without P. Meanwhile, the Dogor variety without P was not significantly different from RP fertilizer and guano fertilizer, but significantly different from TSP fertilizer. The response of several Gogo rice varieties was different for each application of P fertilizer. The application of TSP fertilizer bloomed faster than the application of RP fertilizer and guano fertilizer. Table 2 also shows that the Inpago 10 variety blooms faster than the Kuku Balam and Dogor varieties. This is related to the P function, namely accelerating the formation of flowers, seeds and fruit [23]. According to Nurjaya [22], P sources derived from artificial fertilizers have more soluble properties than natural P fertilizers, thereby increasing the P supply for plants.

The Inpago 10 variety blooms faster than the Kuku Balam and Dogor varieties. The age of flowering in the three varieties is different. This proves that genetic factors affect flowering age more than environmental factors. As stated Sihotang[24] that certain traits possessed by each plant variety are different due to genetic differences of the variety.

4.2.2. Harvest Age (DAP)

Table 2 shows that the three Gogo rice varieties with the application of P fertilizer harvested faster than without the application of P. The responses of several Gogo rice varieties were different for each application of P fertilizer. The application of TSP fertilizer harvested faster than the application of RP fertilizer and guano fertilizer. Table 2 also shows that the Inpago 10 variety harvested faster than the Kuku Balam and Dogor varieties. Based on the classification, in general the age of rice plants was divided into five, namely in (>151 DAP), medium (125-150 DAP), early (105-124 DAP), very early (90-104 DAP), and ultra early (<90 DAP) [25]. From the results of the research, the age of the Kuku Balam variety was classified as deep, the age of the Dogor variety was classified as medium, and the Inpago 10 variety was classified as early.

The application of TSP fertilizer of 0.4 grams per polybag accelerated the age of harvest compared to other treatments for Gogo rice plants of Kuku Balam, Dogor and Inpago 10 varieties. However, Inpago 10's harvest age was faster than Kuku Balam and Dogor. In addition to genetic factors, environmental factors, namely the application of P through fertilizers are also an important step in accelerating harvest age, so that plants lacking P elements will appear stunted and the flowering and harvesting ages will be longer [26].

4.2.3. Number of Grains Per Panicle (grains)

Table 2 shows that all Gogo rice varieties with TSP fertilizer produced more grain per panicle than without P. The response to P fertilizer was different for the three varieties, but TSP fertilizer was able to produce more grain per panicle than fertilizer application. RP and guano fertilizer. Table 2 also shows that the Kuku Balam variety produced more grain per panicle than the Dogor and Inpago 10 varieties.

The application of P fertilizer was able to increase the number of grain per panicle in each variety compared to no P application because the application of P was able to increase the available P of the soil (14.9 ppm) due to its fixation by acidic cations such as Al and Fe in Ultisol. According to Lakitan [27], the optimal availability of P elements will increase the rate of photosynthesis so that the resulting photosynthate will be allocated for grain yields.

The number of grains per panicle of Gogo rice Kuku Balam, Dogor and Inpago 10 with TSP fertilizer application was more than the application of RP, guano, and no P fertilizers. As explained by Sutejo and Mulyani [28], that in addition to genetic factors, phosphate fertilizers are slow release causes it to not be fully utilized by plants.

4.2.4. Percentage of Pithy Grain (%)

Table 2 shows that all Gogo rice varieties with the application of P fertilizer produced a higher percentage of pithy grain than without the application of P. The response to the application of P fertilizer was different in the three varieties, but the application of TSP fertilizer resulted in a higher percentage of pithy grain than the application of RP fertilizer and guano fertilizer. On the other hand, the percentage of pithy grain of the Kuku Balam variety was not significantly different from that of the Dogor and Inpago 10 varieties. According to International Rice Research Institute [16], the criteria for the percentage of pithy grain were divided into five, namely very fertile (>90%), fertile (75-90%), partially fertile (50-74%), sterile (<50%), and infertile (0%). Seen from Table 2, the average percentage of pithy grain of the three varieties is classified as fertile.

The percentage of pithy grain in each variety was not significantly different. This was due to the different genotypic characters of the three Gogo rice varieties and the impact of giving P. Administration of P would increase the available low P nutrient (14.9 ppm) in Ultisol soil which had high Al saturation (46.22%) due to binding by Al. and Fe so that it cannot be absorbed by plants. Sutejo and Mulyani [29] stated that nutrient P is used in the process of photosynthesis which is then translocated to the seeds and fruit.

In Kuku Balam, Dogor and Inpago 10, the application of TSP fertilizer showed a higher percentage of pithy grain than the application of RP, guano, or without P. Rochayati et al [30] reported that artificial fertilizers such as TSP, SP-18, SP-36, and SSP has soluble properties. Meanwhile, natural P fertilizer does not dissolve quickly in water, so it is slowly available, but has a long residual effect.

4.2.5. Weight of Milled Dry Grain Per Clump (grams)

Table 2 shows that in all Gogo rice varieties with P fertilizer application the weight of milled dry grain per clump was higher than without P. The response to P fertilizer was different in the three varieties, but TSP fertilizer application resulted in higher milled dry grain weight per clump. than other P fertilizers. The Dogor variety produced a lower dry grain weight per clump than the Kuku Balam and Inpago 10 varieties.

Gogo rice varieties of Kuku Balam, Dogor and Inpago 10 with the application of 0.4 grams of TSP fertilizer became the best treatment than RP fertilizer, guano, or no P fertilizer. Wahyuningsih [31] said that rock phosphate is a natural P fertilizer which has Solubility is slow so it is long available to plants. Different from TSP and SP-36 fertilizers which are easily soluble in water [32].

The soluble nature of TSP fertilizer makes it easier to release P elements so that it is more quickly available for Gogo rice plants. According to Munawar [21], the nutrient needed to increase the percentage of seed filling and fruit formation is P element. In addition, P nutrient functions as an activator in various enzyme reactions needed for the process of cell division and elongation.

4.2.6. Weight of 100 Grains (grams)

Table 2 shows that the Kuku Balam variety with P fertilizer was able to produce 100 grains higher weight than without P. Meanwhile, the Dogor variety with P fertilizer was not significantly different from without P in increasing the weight of 100 Gogo rice plants. Then the Inpago 10 variety without the application of P was not significantly different from the application of RP and guano fertilizers, but significantly different from the application of TSP fertilizer. The treatment of various P sources gave different responses, but the application of TSP fertilizer resulted in a weight of 100 grains higher than the application of other P fertilizers. Table 2 shows that the weight of 100 grains of the Kuku Balam variety was not significantly different from that of the Dogor and Inpago 10 varieties. According to Luh [33], the weight of a grain of rice was ± 0.021 grams. Based on the description, the weight of 100 grains of Kuku Balam, Dogor, and Inpago 10 varieties was not significantly different, where the weights were 2.3 grams, 2.2 grams, and 2.4 grams, respectively.

The weight of 100 grains of Gogo rice of Kuku Balam variety with TSP, RP, and guano fertilizers had no significant effect on each other, but had a significantly different effect than without P. This was because P played a role in fertilization and seed formation. P deficiency can cause stunted plant growth, few tillers, slow ripening and low plant production [23].

Gogo rice plants of the Dogor variety in each treatment had a relatively constant weight of 100 grains. This is presumably because the application of P has not shown a significant effect on the grain weight of the Dogor rice grains. According to Manurung [34], the pithy grain weight of rice plants is relatively constant because it depends on the size of the lemma and palea that correspond to the genotype of the rice plant.

4.2.7. Grain and Straw Ratio

Table 2 shows that the Kuku Balam and Inpago 10 varieties with the application of P fertilizer produced a higher ratio of grain and straw than without P. Meanwhile, the Dogor variety without P was not significantly different from the application of RP fertilizer in increasing the ratio of grain and straw, but different. significantly with the application of TSP fertilizer and guano fertilizer. The response to the application of P fertilizer was different in the three varieties, but the application of TSP fertilizer resulted in a higher ratio of grain and straw than the application of other P fertilizers. The Inpago 10 variety produced a higher ratio of grain and straw than the Kuku Balam and Dogor varieties.

Gogo rice varieties of Kuku Balam and Dogor, the application of 0.4 grams of TSP fertilizer with 1.8 grams of guano fertilizer was not significantly different. This is because although TSP fertilizer is easily soluble and quickly available to plants [9], guano fertilizer is able to provide P (10%), N (6.01%) and K (2.18%) in Gogo rice to increase the amount of grain.

Inpago 10's grain ratio was higher than the other two varieties. This was because the vegetative part was lower than that of Kuku Balam and Dogor which grew taller. The rice-hay ratio is usually between 0.3-1.2. Superior rice varieties will have a rice straw ratio of 0.6-0.7 if under optimal conditions. Meanwhile, rice plants that have a low rice straw ratio (< 0.5) are not productive because the vegetative part grows more [35].

5. Conclusion

Kuku Balam variety responded to the provision of various P sources better than the Dogor and Inpago 10 varieties in Ultisol growing media. The application of 0.4 g TSP was superior to the application of RP fertilizer and guano fertilizer on all varieties, namely Kuku Balam, Dogor and Inpago 10. Kuku Balam was the best variety compared to the Dogor and Inpago 10 varieties. The Kuku Balam and Inpago 10 varieties showed the percentage of pithy grain, weight 100 grains, and the best ratio of grain and straw with TSP fertilizer application of 0.4 g per polybag.

Compliance with ethical standards

Disclosure of conflict of interest

All authors declare there is no conflict of interest in this paper.

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