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Effect of Rice Straw and Sand Residues on Peanut Plants on Several Soil Properties

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Abstract: The purpose of this study was to determine the effect of rice straw and sand residue on the second crop, namely peanut plants and some soil properties. The design used was a Randomized Block Design in the form of Factorial. The rice straw residue factor consists of 3 levels: RJ0 = without rice straw, RJ1 = 10 tons of rice straw residue ha-1, and RJ2 = 20 tons of rice straw ha-1. The sand addition residue factor consists of 3 levels: RP0 = without sand residue, RP1 = 10% sand residue and RP2 = 20% sand residue. The parameters observed: plant height, dry weight of stover, dry weight of peanut pods, dry weight of peanut seeds and several soil properties such as: soil bulk density, total porosity, nitrogen content, phosphorus, potassium, C-organic content of soil. The results of the study showed that the residue of rice straw provision had a very significant effect on the dry weight of the stover, the dry weight of the pods and the dry weight of the seeds but did not have a significant effect on the height of the plant. The residue of rice straw application of 20 tons ha-1 can increase the dry weight of the seed by 34.01% compared to the control. The residue of sand application and the interaction between the residue of rice straw application and sand did not significantly affect the growth and yield of peanut plants.

Keywords: rice straw residue; sand residue; soil properties; peanut plants

1. Introduction

Research on the effect of rice straw and sand was conducted in 2023. The results of the study showed that rice straw had a very significant effect on porang plant and soil properties. The provision of 20 tons ha-1 of rice straw can increase the dry weight of porang tubers by 119.51% compared to the control (Narka and Arthagama, 2023). Until now, there has been little research on the effect of rice straw and sand residues on plant growth and yield in the second planting. Does rice straw residue still have an effect on the second planting? Likewise, does the provision of sand have an effect on the second planting? According to Nurlaeny et al. (2012), adding sand to the soil has a long-term effect because the sand weathering process requires a relatively long time.

Research on the effects of rice straw has been widely found, but the residual effect on the second planting is still rare. The Ministry of Agriculture, Directorate General of Food Crops (2023) stated that rice straw is a

source of organic soil material that can fertilize the soil. The activity of harvesting rice as much as 5 tons of dry grain from an area of 1 ha, usually farmers can produce 7-8 tons of straw, if converted the amount of straw produced farmers will get nutrients from straw in the form of 20 kg of sulfur, 150 kg of nitrogen, 20 kg of phosphorus and 150 kg of potassium. The potassium content is very high in rice straw. Potassium is very important in the formation of tubers because it functions in the translocation of carbohydrates to tubers. This can be seen in the research of Narka and Arthagama (2023) that the provision of rice straw can increase dry weight porang tubers by 119.51% compared to the control. Lestari and Basuki (2016) added that rice straw also contains supporting nutrients, including the following: 5.6% Si, 0.4% N, 0.02% P and 1.4% K).

The effect of modification of soil condition in the form of adding sand and rice straw on the production of porang tubers has been carried out. The results of the study showed that the provision of rice straw had a very significant effect on porang tubers, while the provision of sand had no significant effect. The next study The Effect of Rice Straw and Sand Residue on Peanut Plants and Several Soil Properties is a follow-up study to determine the effect of rice straw residue on the next planting. Is there still an effect of rice straw on the next planting? The addition of sand aims to obtain a light-textured of soil (loamy sand) so that it has good aeration and drainage. The provision of rice straw, in addition to improving soil structure, can also add potassium to the soil. Potassium is very much needed by plants because potassium functions in the translocation of photosynthesis results to all parts of the plant. The hypothesis of this study is: the treatment of rice straw and sand residue still has an effect on peanuts and soil properties.

2. Methodology

This study is a follow-up pot experiment conducted in the greenhouse of the Experimental Garden of the Faculty of Agriculture, Udayana University. The form of the experiment used in this study was a factorial with a basic design of Randomized Block Design (RBD). The two factors tested were: residue of rice straw provision and residue of sand addition. The treatment of rice straw residue was given in 3 levels, namely: without rice straw (RJ0), 10 tons/ha of rice straw (RJ1), 20 tons/ha of rice straw (RJ2). The treatment of sand addition residue consisted of 3 treatment levels, namely: without sand (RP0), 10% sand (RP1), and 20% sand (RP2). The combination of the two factors tested obtained 9 treatment combinations. Each combination treatment was repeated 3 times so that there were 27 experimental unit.

The observed parameters include soil and plant parameters. Soil parameters consist of: soil bulk density, total porosity, nitrogen (N), phosphorus (P), potassium (K), and C-organic content of soil. Peanut plant parameters consist of: plant height, dry weight of the plant above the ground, dry weight of peanut pods and dry weight of peanut seeds

The soil analysis methods used are: determination of soil N-content of soil using the Kjeldahl method, P and K-available using the Bray 1 method, C-organic conten of soil using the Walkey & Black method, and bulk density using the ring sample method. The data obtained were analyzed by analysis of variance. The F value obtained was compared with the F table value of 5%, if the calculated F value is greater than the F table, then further testing was carried out with the LSD test.

The materials used in this study include: sand, mineral soil, rice straw, peanut seeds, and chemicals for soil analysis. While the tools used include: buckets for planting pots, sieves for sifting soil, watering tools, plant ovens, scales, and other tools for soil analysis.

3. Result and Discussions

Based on the results of the analysis of variance, the interaction between the treatment of sand residue and rice straw residue on peanut plants and some soil properties was not significant. Therefore, further discussion was carried out by looking at the single factor of sand residue or rice straw residue.

The single treatment of rice straw residue significantly affected the dry weight of the stover, the dry weight of the pods and the dry weight of the seeds (Table 1). This shows that rice straw still has an effect on the second planting. Likewise, on several soil properties such as total porosity of soil, C-organic content of soil and soil potassium content, rice straw still showed a significant effect (Table 2). The effect of rice straw on the growth and yield of peanut plants and several soil properties because rice straw adds nutrients. Herdiansyah and Trikusnanto (2015) stated that when calculated in hectares, the nutrient contribution from straw is equivalent to 170 kg of K, 160 kg of Mg, 200 kg of Si and 1.7 tons of organic C ha-1. This amount is large enough to still have an effect on the next crop.

Lestari and Basuki (2016) reported that increasing potassium fertilization can increase tuber yield and tuber size in sweet potatoes through the mechanism of increasing the number of photosynthate translocation results to tubers which is indicated by increasing the root/shoot ratio and a positive correlation between the root/shoot ratio and the harvest index value. According to Tirtoutomo (2006) the use of rice straw is an alternative in reducing chemical

fertilizers. The nutrient content of straw at harvest time depends on soil fertility. In Indonesia, the average nutrient content of straw is 0.4% N, 0.02% P, 1.4% K, and 5.6% Si. In one ton of grain of rice plants produce 1.5 tons of straw containing 9 kg N, 2 kg P, 25 kg K, 2 kg S, 70 kg Si, 6 kg Ca and 2 kg Mg.

In addition to adding nutrients, rice straw can also improve several soil properties, including: soil organic matter content, total porosity of soil and available potassium levels (Table 2). The influence of organic matter that is still significant in the second planting will affect the physical, chemical and biological properties of the soil. The physical properties of the soil, the biological properties of the soil and the chemical properties of the soil are still good and will encourage better yields o peanut crop. The provision of 20 tons ha-1 of rice straw still has an effect on the second planting, namely the dry weight of the stover, the dry weight of the pods and the dry weight of the peanut seeds. The dry weight of the peanut seeds still shows an increase of 34.01% compared to the control.

Table 1.Residue of sand and rice straw application on growth and yield of peanuts

Treatment/ Observation	Plant Height (cm)	Weight of plant above ground (g)	Dry weight of pods (g)	Dry weight of seeds (g)
RP0	47,78 a	34,77 a	50,77 a	40,38 a
RP1	48,78 a	36,02 a	51,34 a	40,31 a
RP2	46,89 a	34,49 a	46,66 a	37,23 a
LSD 5 %	-	-	-	-
RJ0	47,22 a	30,37 a	40,52 a	32,73 a
RJ1	48,33 a	35,83 b	52,67 b	41,32 b
RJ2	47,89 a	39,08 b	55,58 b	43,87 b
LSD 5 %	-	4,49	6,84	5,41

Note: The same letters in one column indicate no significant difference in the 5% LSD Test.

Table 2.Treatment of rice straw residue and sand on several soil properties

Treatment/ Observation	Bulk Density (g/cm3)	Total porosity (%)	Soil C-organic content (%)	Soil total N content (%)	P-available content (ppm)	K-available content (ppm)
RJ0	1,15 a	57,48 a	2,29 a	0,27 a	12,51 a	166,33 a
RJ1	0,99 a	59,24 ab	2,57 b	0,25 a	13,22 a	176,44 ab
RJ2	0,95 a	60,11 b	2,80 c	0,26 a	14,03 a	188,11 b
LSD 5 %	-	2,13	0,23	-	-	13,99
RP0	1,00 a	59,49 a	2,64 a	0,29 a	14,05 a	172,11
RP1	1,02 a	59,33 a	2,57 a	0,26 a	12,29 a	178,67
RP2	1,07 a	58,01 a	2,46 a	0,24 a	13,43 a	180,11
LSD 5 %	-		-	-	-	-

Note: The same letters in one column indicate no significant difference in the 5% LSD Test.

The effect of straw on the physical properties of the soil was reported by Wahjunie et.al. (2012) that the use of rice straw mulch up to 2.76 tons ha-1 showed a significant increase in infiltration capacity and there was a tendency to improve the physical properties of the soil such as bulk density, number and distribution of pores, and soil water retention. If the use of straw is increased to 15 tons/ha, it is thought to have a significant effect on bulk density, number and distribution of pores, and soil water retention.

The results of this study are similar to the results of Materechera's (2009) study which reported that peanut pod production increased by the provision of soil conditioners and straw mulch. In addition to pod production, there were an improvement in soil structure, a decrease in bulk density, and soil penetration resistance due to the provision of mulch on the soil surface. Furthermore, the results of the study by Anti et al. (2021) also showed that the treatment of rice straw mulch dosage had a significant effect on plant height, number of leaves, number of pods per plant, pod weight per plant and bean plant productivity. The treatment of rice straw mulch with a dosage of 15

tons ha-1 provided the best growth and production of beans.

Lawenga et al. (2015) showed that the provision of organic matter affects the physical properties of the soil. This can be seen from the results of observations of total porosity (Table 2). The increasing total porosity of soil causes better soil aeration and drainage, and roots can penetrate the soil more easily and tuber growth becomes better. In addition to physical properties, the chemical properties of the soil also improve with the presence of rice straw compost according to the results of research by Herman and Resigia (2018) which states that the use of rice husk biochar and rice straw compost can provide nutrients on Ultisol soil as indicated by increasing pH, N, P, K, Ca, Mg and S.

The single treatment of sand addition residue did not significantly affect all of soil properties observation parameters, namely bulk density, total porosity, C-organic content o soil, total N content, available P content and available K content (Table 2). Likewise, on the growth and yield of peanuts such as: plant height, dry weight of the stover, dry weight of the pods and dry weight of the seeds, the sand addition residue treatment did not show a significant effect. This is thought to be caused by the sand fraction in the soil used in the study, the amount of 41.45% is sufficient to create good aeration, so that the roots can easily penetrate the soil and have received sufficient aeration. Dry weight of the stover and dry weight of the pods tended to increase up to the RP1 dose (10% sand addition) but decreased again at the RP2 dose. This indicates that the function of sand still exists even though it is not statistically significant. With higher sand to a certain limit (RP1), the roots develop more easily and get better oxygen. Sand is a soil particle that is difficult to decompose, and functions as a soil framework. It is suspected that the sand content of the research soil (41.45%) is sufficient to become a good soil structure.

The interaction of the residue treatment of sand with rice straw residue in improving the soil properties which then affects the growth and yield of peanut plants has not been found in this study. The results of this study are still the same as previous studies, namely that no interaction was found between treatments. The results of study Tampubolon's (2018) on application of Merapi volcanic ash and cow dung manure reported that the interaction between these two treatments was not significant for all observation parameters during the study. Likewise, the results of this study are almost the same as the study by Adam et al. (2018) on application of sago pulp compost and Plant Growth Promotion Rhizobacteria (PGPR) on the growth and yield of peanuts (Arachis hypogeae L.) reported no interaction between the two treatments but separately the compost had a significant effect on the growth and yield of peanuts.

4. Conclusions

Based on the results of this study, several things can be concluded as follows:

1. The interaction of the residue treatment of sand and rice straw residue did not show any significant effect on the growth and yield of peanut plants and several soil properties.
2. The single treatment of sand residue did not have a significant effect on the growth and yield of peanut plants or soil properties.
3. The treatment of rice straw residue has a very significant effect on the growth and yield of peanut plants. The treatment of rice straw residue of 20 tons ha-1 can increase the dry weight of peanut seeds by 34.01% compared to the control.
4. Rice straw residue treatment had a significant effect on total porosity of soil, soil C-organic content and available potassium content of soil.

Based on the results of this study, it can be suggested that the use of 20 tons ha-1 of rice straw in the second planting does not need to be given again because its effect is still significantly present. Likewise, the use of sand cannot be recommended, because the soil is used on these experiment has a relatively high sand content, namely 41.45%, which does not show a significant effect either in the first or second planting.

Author Contributions

Conceptualization, I.W.N and I.M.A.; methodology, I.W.N and I.M.A.; software, I.W.N and I.M.A.; validation, I.W.N and I.M.A.; formal analysis, I.W.N and I.M.A.; investigation, I.W.N and I.M.A.; data curation, I.W.N and I.M.A.; writing—original draft preparation, I.W.N and I.M.A.; writing—review and editing, I.W.N and I.M.A.; visualization, I.W.N and I.M.A.. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement

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Data Availability

Not applicable

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Conflicts of Interest

The authors declare no conflict of interest

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Nomenclature

Appendix

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