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The effect of organic fertilizer and mount Merapi volcanic ash to land rehabilitation

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Abstract: This study aims to determine the effect of adding organic fertilizer to the ex-eruption of Mount Merapi by using an indicator plant of peanut (*Arachis hypogaea* L.) Gajah variety in order to land rehabilitation. The treatment used was the addition of volcanic ash and organic fertilizer. The organic fertilizer used comes from chicken manure. The selection of chicken manure as organic fertilizer uses the principle of sustainability, where in the research area there are many chicken farmers so that the presence of chicken manure is easy and cheap to obtain. The design of this study was based on 1 block completely randomized 2 factorial design which was repeated 3 times. With the addition of volcanic ash and chicken manure, 10 tons/ha, 20 tons/ha and 30 tons/ha, respectively. Plant parameters observed were: (1) plant height, (2) fresh weight and dry weight of roots, (3) Shoots' fresh and dry weight, (4) fresh weight and dry weight of pods, (5) Seeds' fresh weight and dry weight, (6) number of seeds and pods/plant, and (7) N uptake and root nodule number. The findings indicated that chicken manure increased plant height from 1 to 5 weeks after planting. The application of 30 tons/ha of chicken manure has raised the height of plants. The addition of chicken manure tends to enhance the peanut seeds' dry weight.

Keywords: Volcanic ash, chicken manure, land rehabilitation

Abstrak: Penelitian ini bertujuan untuk mengetahui pengaruh penambahan pupuk organik di lahan bekas erupsi Gunung Merapi dengan menggunakan tanaman indikator kacang tanah (*Arachis hypogaea* L.) varietas Gajah dalam rangka perbaikan lahan. Perlakuan yang digunakan adalah penambahan abu volkan dan pupuk organik. Pupuk organik yang digunakan berasal dari kotoran ayam. Pemilihan kotoran ayam sebagai pupuk organik menggunakan prinsip keberlanjutan, dimana di daerah penelitian terdapat banyak peternak ayam sehingga keberadaan kotoran ayam mudah dan murah didapatkan. Rancangan penelitian ini disusun berdasarkan 1 blok rancangan acak lengkap 2 faktorial yang diulang sebanyak 3 kali. Dengan perlakuan penambahan abu volkan dan kotoran ayam masing-masing 10 ton/ha, 20 ton/ha dan 30 ton/ha. Parameter tanaman yang diamati yaitu: (1) tinggi tanaman, (2) bobot segar dan bobot kering akar, (3) bobot segar dan bobot kering pucuk, (4) bobot segar bobot dan bobot kering polong, (5) bobot segar dan bobot kering benih, (6) jumlah biji dan polong/tanaman, dan (7) serapan N dan jumlah bintil akar. Temuan menunjukkan bahwa kotoran ayam meningkatkan tinggi tanaman dari 1 sampai 5 minggu setelah tanam. Pemberian pupuk kandang ayam sebanyak 30 ton/ha telah meningkatkan tinggi tanaman. Penambahan kotoran ayam cenderung meningkatkan bobot kering biji kacang tanah.

Kata kunci: Abu Vulkanik, kotoran ayam, rehabilitasi lahan.

INTRODUCTION

In order to promote food security and boost bioenergy production, marginal lands play a vital role in crop productivity support. One of the widely dispersed marginal areas in Indonesia is comprised of young, very fertile, and productive volcanic soils. Nevertheless,

ecosystem services, environmental concerns, and sustainability have been frequently emphasized in relation to the usage of marginal land. The land is a production center for various commodities (Ekroos et al., 2016; Graesser et al., 2018; Silveira et al., 2017). What needs to be done is to carry out good management of marginal lands so that the buffering capacity of the environment is maintained. Optimization strategy for the food crop development of marginal land use to support land rehabilitation (Awasthi et al., 2017; Hussain et al., 2020; Sari et al., 2020; Schröder et al., 2018). Knowledge about the quality of marginal lands and their evaluation and management is limited and varied.

Mount Merapi is a volcano 30 kilometers north of Yogyakarta. It is the most active volcano in Indonesia, erupting every four years on average. On the slopes of Mount Merapi in Yogyakarta, one of the new volcanic soils may be found. Since the big eruption that occurred in September 2010, a significant amount of volcanic ash has blended with the surrounding soil. In the form of dust, molten rock, and gravel, volcanic ash is the byproduct of volcanic eruptions. On the slopes of Mount Merapi, the soil conditions were dominated by new earth. According to Utami et al. (2018) there is no problem of chemical nature for plant growth on land with volcanic ash material, although there are elements of aluminum (Al) and silica (Si) if dissolved in water at an acidic pH which can cause poisoning for plants. Al can theoretically be neutralized with organic fertilizers, one of which is manure.

The use of organic fertilizers is highly dependent on the abundance and availability of biomass in the local area. Manure from chicken manure is possible on the slopes of Mount Merapi because of its abundant availability. The method of giving chicken manure is one of the efforts that can improve and change the physical condition of the soil as a place to grow plants (Hilwa et al., 2020; Yunanto et al., 2022). Chicken manure fertilization is thought to boost production by enhancing the soil's physical, chemical, and biological qualities. The function of chicken manure is as a source of energy and food for soil microorganism so that it can increase the activity of soil microorganism which are very useful in providing plant nutrient. Thus, the application of chicken manure will increase plant growth and production (Marlina et al., 2015).

However, there is a problem with the thickness of the volcanic ash material which is positioned in different places. If the thickness of volcanic ash is less than 5 centimeters, the soil may be immediately treated for agriculture. However, in locations where the thickness of volcanic ash exceeds 10 centimeters, extremely thorough soil processing is necessary so that the original soil is combined with the volcanic ash. One of the tolerant plants that can be used as an indicator of soil improvement for plant growth is the type of legume that can provide additional nitrogen (N) in the soil (Farooq et al., 2021; Huang et al., 2022; Stagnari et al., 2017; Utami et al., 2018).

In Indonesia, peanuts are the most important secondary crops second only to soybeans and is a money-producing crop cash is important for farmers. Peanut productivity in relatively low farm level due to genotype planting low yielding peanuts, pest attack and

disease, or due to environmental stress conditions, especially drought (Singh et al., 1990). The nitrogen content in the soil that has been mixed with volcanic ash is very low, legume plants are needed to be able to fix nitrogen, either as intercrops, ground cover or by adding nitrogen fixing microbes (Utami et al., 2018). The growth and development of peanuts is strongly influenced by environmental factors, namely soil, temperature, air, solar radiation, rain and other environmental factors. One of that factor that influence most is adding nitrogen fixing microbes from manure. This research shows us the number of chicken manure needed significant increase in the observed traits.

METHOD

This experiment is a pot experiment in a greenhouse, where the soil used is Regosol Volcanic Ash soil which has been mixed with volcanic ash from the eruption of Mount Merapi. The material added is chicken manure. While the indicator plants in this experiment were arranged in a completely randomized design with two factors and each combination was repeated 3 times (Syamsudin & Baharsyah, 1995).

The first factor is the dose of chicken manure which consists of 4 levels, namely:

A0 = no chicken manure

A1 = 10 tons/Ha (26.6 g/pot)

A2 = 20 tons/Ha (53.2 g/pot)A3 = 30 tons/Ha (79.8 g/pot)

The second factor is volcanic ash which consists of 4 levels, namely:

B0 = no volcanic ash

B1 = 10 tons/Ha (26.6 g/pot)

B2 = 20 tons/Ha (53.2 g/pot)

B3 = 30 tons/Ha (79.8 g/pot)

Thus it is obtained

Block I : 4 x 4 =16

Tabel 1. Sample plot plan

A0B0	A0B1	A0B2	A0B3
A1B0	A1B1	A1B2	A1B3
A2B0	A2B1	A2B2	A2B3
A3B0	A3B1	A3B2	A3B3

Each treatment combination was repeated 3 times so that there were 48 experimental pots. Each experimental pot was given a peanut (Arachis hypogaea L.) plant variety Gajah.

The experiment was carried out for a period of 5 months by observing the growth and yield of peanut plants, namely: (1) plant height (cm), (2) fresh weight and dry weight of roots (g/plant, number of pods/plant), (3) Shoots' fresh and dry weight (g/plant), (4) fresh

weight and dry weight of pods (g/plant), (5) Seeds' fresh weight and dry weight (g/plant), (6) number of seeds and pods/plant, and (7) N uptake and root nodule number.

Data analysis used analysis of variance according to the design used. If the treatment variance showed a significant effect at the 5% level, then to find out the difference between treatments, it was analyzed with DMRT. If the real interaction will be tested for the simple influence of one other factor and the closeness of the relationship between the two factors is tested by regression and correlation (Syamsudin & Baharsyah, 1995). To find out between the observed parameters, correlations were made between the parameters.

RESULTS AND DISCUSSION

Organic materials affects physicals, chemical and biological characteristic of the soil. Chicken maure is one of the organic fertilizers used to improve soil properties, which directly improve the growth of peanut. From the preliminary analysis of research materials showed us that the volcanic ash quality is quite good; based on score of each parameter. Therefore treatment of adding chicken manure and volcanic ash on plant growth we can observe that the addition of chicken manure has a positive correlation.

1. Preliminary analysis of research materials

Preliminary analysis was used to determine the characteristics of the materials used, namely Regosol Volcanic Ash, Chicken Manure and Volcanic Ash.

Table 2. Soil properties analysis of volcanic ash regosol

Parameter	Unit	Score
Specific gravity	g/cm 3	2,06
Volume weight	g/cm3	1,17
Texture (USDA)	-	sandy loam
Electrical conductivity	-	0,23
C-organic	%	1,72

Tabel 3. Chicken manure analysis result

Paremeter	Unit	Score
Soil moisture	%	17,27
C-Organic	%	37,57
Organic material	%	75,14
N total	%	2,08
Ratio C/N	-	17,67

Table 4. Volcanic ash analysis result

Paremeter	Unit	Score
specific gravity	g/cm3	0,61
volume weight	g/cm3	1,62
texture (USDA)	-	loamy sand
electrical conductivity	-	4,92
Al2O3	%	17,53
SiO2	%	53,80

From the results of the analysis of the properties of the Volcanic Ash Regosol soil used in this study, we can know that the soil density is 2.06 g/cm3, the soil volume is 1.17 g/cm3, the soil texture is loamy sand, the value of Electrical Conductivity (DHL) is 0, 23 with 1.72 C-Organic content. From the analysis of chicken manure used in the study, it was found that the moisture content was 17.27%, the C-Organic content was 37.57%, the organic matter content was 75.14%, the total N value was 2.08 and the C/N ratio was 17.67. From the value of the C/N ratio obtained, it can be seen that the chicken manure used in the study has met the requirements as organic fertilizer (Yuliatiningsih et al., 2022). From the analysis of volcanic ash used in the study, it was found that the specific gravity was 0.61%, the volume weight was 1.62%, the texture was sandy loam, the DHL value was 4.92, the Al2O3 content was 17.53% and the SiO2 content was 53.80%. These data indicate that the quality of volcanic ash is quite good. The action that needs to be done is the need for rinsing to remove basic cations in the soluble salt.

2. Effect of chicken manure and volcanic ash on plant growth parameter

The results of the analysis of variance from the study showed that the dose of chicken manure and volcanic ash had a significant effect on the height of peanut plants significantly. This can show us that the application of chicken manure on the ex-Merapi eruption area will improve nutrient intake for plants. The dry weight of plant shoots did not show a significant effect after being given soil mixed with chicken manure, but the dry weight of peanut seeds showed a significant difference with the addition of chicken manure. The results of the analysis of nitrogen levels followed by analysis of variance with a significance level of 5% gave significant results in the treatment of adding chicken manure and volcanic ash. Some studies show that chicken manure and volcanic ash have a good effect on plant growth (Aipa & Michael, 2018; Arangote et al., 2019; Kantikowati et al., 2019; Mahmoud et al., 2019; Suwignyo et al., 2022)

Based on Table 3. Treament of adding chicken manure and volcanic ash on plant growth we can observe that the addition of chicken manure has a positive correlation with plant height, number of pods/plants, number of seeds/plant and N uptake. This correlation will significantly increase the weight of peanuts, which means it will increase productivity. Provision of chicken manure has an effect on vegetative and generative growth in peanuts, but from several parameters observed more positive correlations on generative growth.

Table 3. Treatment of adding chiecken manure and volcanic ash on plant growth

Parameter	Interaction
plant height (cm)	positive
fresh weight and dry weight of roots	negative
Shoots' fresh and dry weight	negative
fresh weight and dry weight of pods	negatif
fresh weight and dry weight of seeds	negatif
number of seeds/plant	positive
number of pods/plant	positive
N uptake	positif

CONCLUSION

Efforts to improve marginal land are needed to improve the environment. One of the marginal lands that are widely available in Indonesia is the land of former mountain eruptions. This study uses soil samples from the eruption of Mount Merapi, organic fertilizer and indicator plants of Gajah variety peanut as indicator plants to determine environmental conditions in the area. The organic fertilizer used is from chicken manure. The selection of chicken manure in this study uses the principle of sustainability, where on the slopes of Mount Merapi there are many chicken farmers. In this study, the use of chicken manure up to a dose of 30 tons/ha did not significantly increase the dry weight of nuts, although there was a tendency to increase the dry weight of peanuts. Therefore treatment of adding chicken manure and volcanic ash on plant growth we can observe that the addition of chicken manure has a positive correlation with plant height, number of pods/plants, number of seeds/plant and N uptake . This correlation will significantly increase the weight of peanuts, which means it will increase productivity. Further research is needed to obtain a dose of chicken manure so that there is a significant increase in the observed traits. Another effort that needs to be done is to diversify the added organic fertilizer, according to the potential of the area.

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