AGROSAINS
Jurnal Penelitian Agronomi
pISSN: 1411-5786; eISSN: 2655-7339

Agrosains : Jurnal Penelitian Agronomi 25(1): 1-4, 2023
https://jurnal.uns.ac.id/agrosains/article/view/55026
DOI: http://dx.doi.org/10.20961/agsjpa.v25i1.55026

Giving Types of Organic Materials on The Effect of Physical Properties of Ultisol Soil, South Rantau Sub-District

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ABSTRACT

This study entitled the provision of various organic materials on physical properties and ultisols in South Rantau District Labuhan Batu Regency was carried out in the experimental garden at the Labuhan Batu University, North Sumatra. This study aims to determine the best type of organic material to improve the physical properties of ultisol soil from the South Rantau land at the Labuhan Batu. This study used a non-factorial randomized block design (RBD) with a treatment factor of 8 types of organic matter and 3 replications so that there were 27 experimental units. L0 Treatment: Control, L1: Palm oil solid waste, L2: Sugar factory waste, L3: Fish waste, L4: animal feed waste, L5: Chicken manure, L6: Cow manure, L7: Leguminose compost, L8: Compost organic waste fertilizer Medan city with a dose of each organic material 150g / 10 kg TKO. After incubation, bulk density (g /cm^3) was taken using the Ring Sample method, Total Pore Space (%) with soil particle density and permeability (cm/hour) using the De Bootd method. Research results fish waste has the highest significant effect in improving soil physical properties, such as reducing soil bulk density, namely 1.02 g / cm3, and increasing the total soil pore space by 61.63%. In contrast, the highest soil permeability is obtained in the treatment of animal feed waste, which is 59.51 cm/hour while the lowest was in the control treatment of 28.18 cm/hour. The application of fish waste had the highest significant effect in improving the physical properties of the soil, such as reducing the bulk density of the soil.

Keywords: marginal land; types of organic fertilizer; soil nutrients.

Cite this as: Harahap, F. S., Manurung, I. R., Arman, I., Harahap, N., Syawaluddin, A., & Yana, R. F. (2023). Giving Types of Organic Materials on The Effect of Physical Properties of Ultisol Soil, South Rantau Sub-District. *Agrosains: Jurnal Penelitian Agronomi, 25*(1), 1-4. DOI: http://dx.doi.org/10.20961/agsjpa.v25i1.55026

INTRODUCTION

Ultisol is a soil that has undergone advanced weathering and comes from parent material that is very acidic and has very low organic matter content (Bockheim et al., 2014). Ultisol has slow to moderate permeability and a density level or BD above 1.3 g/cm3, which results in plant root penetration not being able to develop properly (Naldo, 2016). Ultisol is soil with an acidic argillic horizon with a base saturation of less than 35% at a depth of 1.8 m from the soil surface (Ambarsari and Yulina, 2018.).

This soil develops from old parent material; in Indonesia, it is often found in areas with clay rock as the parent material (Hardjowigeno, 1993). Ultisol found in Indonesia has poor physical, chemical, and biological properties.

The soil aggregate stability of ultisol is relatively low, and the organic matter content is very low (< 2%). (Yusnaini et al., 2004). This is due to the high rate of weathering of organic material, as well as the accumulation of clay in the lower layer, which is known as the argillic horizon or kandic horizon (Novak et al., 2012).

Ultisol also has low base saturation, namely <35%, with an acid soil pH (Manuputty and Jacob, 2018). The low stability of ultisol aggregates causes the aggregates to break easily into fine particles that cover the pores, and the soil is easily eroded (Kasno, 2019).

The low organic matter content and high clay content in ultisol also make it difficult for the water bound to the micro pores to be taken up by plant roots. Hence, this condition causes poor plant growth and is often identified with infertile soil because its physical, chemical, and biological properties are not good as well as organic matter almost no longer exists but this can still be improved and developed for agricultural land by adding organic materials and organic fertilizers (Eddiwal et al., 2014).

In Indonesia recently organic farming has been socialized and implemented by utilizing various sources

of organic materials as well as industrial waste, municipal waste, agricultural waste and also by vegetative soil improvement such as production forests to realize sustainable agriculture and achieve the ecosystem of the area concerned (Syawal and Rauf, 2017). Syawal et al. (2017) city waste compost can be made from city waste in the form of market waste and household waste that has undergone weathering (composting). It is hoped that by using appropriate compost fertilizer, namely city waste compost, the physical properties of the soil can be improved, namely the structure and soil texture, through the formation of more stable, loose aggregates as well as good soil aeration and drainage.

Likewise, ultisol land in South Rantau Sub-District, Labuhan Batu Regency should be used as organic farming to improve the physical, chemical, and biological properties of the soil and prevent erosion and flooding. This can be done by conducting evaluation research on the use of various types of the best organic materials such as solid palm oil waste, sugar factory waste, fish waste, animal feed waste, chicken manure, cow manure, leguminoseae compost (*Calopogonium muconuides* Desv.) and municipal waste organic fertilizer compost. This research aims to determine the best type of organic material in improving the physical properties and Ultisol of South Rantau, Labuhan Batu Regency as well.

MATERIAL AND METHODS

Place and time of research

This research was carried out at the Experimental Garden location, Labuhan Batu University Campus, Faculty of Science and Technology, at a height of ± 25 m above sea level and soil analysis was carried out at the Research and Technology Laboratory, Faculty of Agriculture, University of North Sumatra, Medan. This research started from January 2021 to June 2021.

Materials and tools

The materials used in this research are samples of ultisol-type soil in South Rantau Sub-District. Organic materials include solid palm oil waste, sugar factory waste, fish waste, animal feed waste, chicken manure, cow manure, legume compost (*Calopogonium muconuides* Desv.), and municipal waste organic fertilizer compost.

The equipment used in this research was a hoe, scales, polybags, ring samples, 10 mesh soil sieve, oven, plastic bags, and several equipment for analyzing the physical and chemical properties of soil.

Research methods

This research used a non-factorial randomized block design with treatment factors of 8 organic materials and 3 replications so there were 27 pots.

Experiment with the following treatments:

L0 = Control

L1 = Palm oil solid waste (150 g/10 kg TKO equivalent to 30 tons/ha) L2: Sugar factory waste (150 g/10 kg TKO equivalent to 30 tons/ha)

L3 = Fish waste (150 g/10 kg TKO equivalent to 30 tons/ha)

L4 = Animal feed waste (150 g/10 kg TKO equivalent to 30 tons/ha)

L5 = Chicken manure (150 g/10 kg TKO equivalent to 30 tons/ha)

L6 = Cow manure (150 g/10 kg TKO equivalent to 30 tons/ha)

L7 = Leguminous Compost (*Calopogonium muconuides* Desv.) (150 g/10 kg TKO equivalent to 30 tons/ha)

L8 = Municipal waste organic fertilizer compost (150 g/10 kg TKO equivalent to 30 tons/ha) with the following mathematical formula:

$Yij = \mu + \alpha i + \beta j + \Sigma ij$

Where:

Yij = Observation results on the experimental unit in the i-th treatment and j-th replication

μ = General average value

αi = Effect of repetition i

βj = Effect of repetition j

Σij = Effect of error in the i-th treatment experiment and j-th replication

Parameters Measured

The physical and chemical properties of soil are as follows:

- Bulk Density (g/cm^3) using the RingSample method
- Total Pore Space (%) with soil particle density
- Permeability (cm/hour using the De Bootd method

RESULTS AND DISCUSSION

Bulk Density

The results of the average and variance results in Table 1 show that the application of various types of organic material has a significant effect on reducing the bulk density of the soil. The results of the 5% Duncan test with the application of various types of organic material to the bulk density of the soil can be seen in Table 1. Table 1. shows that the application of various types of organic material L3 (fish waste) has the highest significant effect on the bulk density of South Rantau ultisol soil by 1 .02 g/cm3, this treatment is not significantly different from L1 (palm oil solid waste), L2 (sugar factory waste), L4 (animal feed waste), L6 (cow manure) and L7 (leguminous compost) of 1.08 g /cm^3, 1.10 g/cm^3, 1.11 g/cm^3, 1.07 g/cm^3 and 1.05 g/cm^3, but significantly different from L0 (control), L5 (chicken manure) and L8 (compost fertilizer organic municipal waste) of 1.20 g/cm^3, 1.13 g/cm^3 and 1.16 g/cm^3.

Providing various types of organic material in conservation efforts for ultisol land in South Rantau has a significant effect on bulk density and total pore space. From the research results, it can be seen that providing various types of organic material on ultisol land in South Rantau has a significant effect on reducing soil bulk density, especially in the L3 treatment (fish waste) and L7 (legume compost) reached 1.02g/cm^3 and 1.05g/cm^3 which is in line with an increase in total soil pore space of 61.63 and 60.37%.

Table 1. Average Bulk Density Due to the Application of Various Types of Organic Materials

Treatment	Bulk Density (g/cm$^{3)}$
Lo (Control)	1.20 a
L1 (Palm Palm Solid Waste)	1.08 bcd
L2 (Sugar Factory Waste)	1.10 abcd
L3 (Fish Waste)	1.02 d
L4 (Animal Feed Waste)	1.11abcd
L5 (Chicken Manure)	1.13 abc
L6 (Cow Manure)	1.07 bcd
L7 (Leguminous Compost)	1.05 cd
L8 (Organic fertilizer compost from Medan city waste)	1.16 ab

Note: The same number followed by the same letter in the same column indicates that it is not significantly different at the 5% DMRT level

Organic materials cause this in each treatment that has undergone complete decomposition, which can increase the activity of microorganisms, which can reduce soil density organic material is material that comes from the remains of dead plants and animals and when decomposed in the soil it can form stable soil aggregates. This is in accordance with the opinion of Shinta et al. (2018), that if soil density decreases, it can increase soil pore space, especially in ultisol soil. So the applied organic material can increase the activity of microorganisms, thereby reducing soil density.

Total Pore Space

The results of the average and variance results in Table 2 show that the application of various types of organic material has a significant effect on increasing the total pore space of the soil. The results of the Duncan test of 5% application of various types of organic material to the total pore space of the soil can be seen in Table 2.

Table 2 shows that by providing various types of organic materials, L3 (fish waste) has the highest significant effect on the total pore space of South Rantau ultisol soil at 61.63%. This treatment is not significantly different from L1 (palm oil solid waste), L2 (solid waste). sugar factory), L4 (Animal feed waste), L6 (Cow dung) and L7 (Leguminous compost) amounting to 59.12 %, 58.49, 58.11, 59.75 and 60.37 %, but different real with L0 (Control), L5 (Chicken manure) and L8 (Organic fertilizer compost from Medan city waste) of 54.71% and 57.36 and 56.10%. The difference in the value of Total Soil Pore Space due to the treatment of various types of organic material is highest in L3 (fish waste)

Permeability

Plant The results of the mean and variance results in Table 3 show that the application of various types of organic material has no significant effect on increasing soil permeability. The results of the 5% Duncan test by administering various types of organic materials on permeability can be seen in Table 3.

Table 2. Average Total Pore Space Due to the Application of Various Types of Organic Materials

Treatment	Total Pore Space (%)
Lo (Control)	54.71d
L1 (Palm Palm Solid Waste)	59.12 abc
L2 (Sugar Factory Waste)	58.49abc
L3 (Fish Waste)	61.63a
L4 (Animal Feed Waste)	58.11 abc
L5 (Chicken Manure)	57.36bc
L6 (Cow Manure)	59.75 abc
L7 (Leguminous Compost)	60.37ab
L8 (Organic fertilizer compost from Medan city waste)	56.10 c

Note: The same number followed by the same letter in the same column indicates that it is not significantly different at the 5% DMRT level

Table 3. Average Soil Permeability Due to Application of Various Types of Organic Material

Treatment	Permeability cm/hour
Lo (Control)	28.18
L1 (Palm Palm Solid Waste)	32.37
L2 (Sugar Factory Waste)	37.18
L3 (Fish Waste)	51.93
L4 (Animal Feed Waste)	59.51
L5 (Chicken Manure)	41.61
L6 (Cow Manure)	49.56
L7 (Leguminous Compost)	54.38
L8 (Organic fertilizer compost from Medan city waste)	31.86

Table 3 shows that the application of various types of organic materials has no significant effect on the permeability of the South Rantau ultisol soil. The highest soil permeability value was obtained in the L4 (animal feed waste) treatment, namely 59.51 cm/hour, while the lowest was in the L0 (control) treatment, 28.18 cm/hour, with an increase of more than 100%.

The application of various organic materials had a significant effect on reducing the bulk density and increasing the total pore space of the soil, but had no significant effect on increasing the permeability of the South Rantau ultisol soil. This is because of the organic material applied has not fully increased the activity of microorganisms or the organic material has not been completely absorbed by the soil so that the total pore space formed and stable soil aggregates have not been able to transfer and store water properly in the South Rantau ultisol land. Even though organic materials do not significantly influence permeability, permeability increases compared to L0 (Control) with an increase of 89.42%. This is in accordance with the opinion of Susanto et al. (2014), that organic material that has not fully increased the activity of microorganisms or organic material cannot be absorbed by the soil so that the total pore space formed and soil aggregates are in a stable condition.

CONCLUSION

The application of fish waste had the highest significant effect in improving the physical properties of the soil, such as reducing the bulk density of the soil. It would be best to carry out further research by increasing the dose of organic material to get better results in improving the ultisol land in South Rantau.

REFERENCES

Ambarsari, W. & Yulina, H. (2018). Pengaruh kompos sampah kota dan pupuk kandang sapi terhadap pertumbuhan dan hasil tanaman pakcoy (*Brassica Rapa* L. Chinensis) pada aluvial Kabupaten Indramay. *Gema Wiralodra, 9*(2), 153-163. https://doi.org/10.31943/gemawiralodra.v9i2.24

Bockheim, J. G., Gennadiyev, A. N., Hartemink, A. E. & Brevik, E. C. (2014). Soil-forming factors and soil taxonomy. *Geoderma, 226,* 231-237. https://doi.org/10.1016/j.geoderma.2014.02.016

Eddiwal, A. S., Husin, E. T. & Rasyidin, A. (2014). Effect of arbuscular mycorrhizal fungi (AMF) and organic nitrogen of the forages Tithonia on glomalin production. In Makalah Seminar Internasional "1st International Conference on Development Management and Public Policy" Pascasarjana Universitas Andalas, Padang (Vol. 20).

Hardjowigeno, S. (1993). Klasifikasi tanah dan pedogenesis. Akademika Pressindo. Jakarta, 320.

Kasno, A. (2019). Perbaikan tanah untuk meningkatkan efektivitas dan efisiensi pemupukan berimbang dan produktivitas lahan kering masam. *Jurnal Sumberdaya Lahan, 13*(1), 27-40.

Manuputty, M. C. & Jacob, A. (2018). Pengaruh effective inoculant promi dan EM4 terhadap laju dekomposisi dan kualitas kompos dari sampah Kota Ambon. *Agrologia, 1*(2), 143-151.

Naldo, R. A. (2016). Sifat fisika ultisol limau manis tiga tahun setelah pemberian beberapa jenis pupuk hijau. *Jurnal Agroland, 4*(3), 227-234.

Novak, J. M., Busscher, W. J., Watts, D. W., Amonette, J. E., Ippolito, J. A., Lima, I. M., Gaskin, J., Das, K. C. Steiner, C., Ahmedna, M., Rehrah, D., & Schomberg, H. (2012). Biochars impact on soil-moisture storage in an ultisol and two aridisols. *Soil Science, 177*(5), 310-320.

Shinta, S., Hariyono, D., & Maghfour, M. D. (2018). Penggunaan kompos sampah kota dan pupuk urea terhadap pertumbuhan dan hasil tanaman pakcoy (*Brassica rapa* L.). *Jurnal Produksi Tanaman, 5*(8), 1408-1415.

Susanto, E., Herlina, N., & Suminarti, N. E. (2014). Respon pertumbuhan dan hasil tanaman ubi jalar (*Ipomoea batatas* L.) pada beberapa macam dan waktu aplikasi bahan organik. *Jurnal Produksi Tanaman, 2*(5), 412-418.

Syawal, F. & Rauf, A. (2017). Upaya rehabilitasi tanah sawah terdegradasi dengan menggunakan kompos sampah kota di Desa Serdang Kecamatan Beringin Kabupaten Deli Serdang. *Jurnal Pertanian Tropik, 4*(3), 183-189.

Syawal, F., Rauf, A., Rahmawaty, R., & Hidayat, B. (2017). Pengaruh pemberian kompos sampah kota pada tanah terdegrdasi terhadap produktivitas tanaman padi sawah di Desa Serdang Kecamatan Beringin Kabupaten Deli Serdang. *In Prosiding SEMDI-UNAYA (Seminar Nasional Multi Disiplin Ilmu UNAYA), 1*(1), 41-51.

Yusnaini, S., Arif, M. A. S., Lumbanraja, J., Nugroho, G. S., & Nonaka, M. (2004). Pengaruh jangka panjang pemberian pupuk organik dan inorganik serta kombinasinya terhadap perbaikan tanah masam Taman Bogo. *Journal of Tropical Soils, 18*, 155-162.