Physical Properties Of Ultisol Soil In Pangkatan Sub-District With The Provision Of Organic Material Types

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Abstract.

This study entitled the provision of various organic materials on physical properties and ultisols in Pangkatan Sub-District Labuhan Batu Regency which was carried out in the experimental garden at the Labuhan Batu University campus, North Sumatra. This study aims to determine the best type of organic material to improve the physical properties of ultisol soil from the Rantau Selatan 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. L_0 Treatment: Control, L_1: Palm oil solid waste, L_2: Sugar factory waste, L_3: Fish waste, L_4: animal feed waste, L_5: Chicken manure, L_6: Cow manure, L_7: Leguminose compost, L_8: 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 Giving fish waste has the highest significant effect in improving soil physical properties such as reducing soil bulk density, namely 1.02 g / cm^3, and increasing the total soil pore space by 61.63%, while the highest soil permeability is obtained in the treatment of animal feed waste, which is 60.22 cm. hour while the lowest was in the Control treatment of 29.11 cm/hour.

Keywords: *Organic Materials; Ultisols; Physical Properties and Sub-Distrik Pangkatan.*

I. INTRODUCTION

Ultisol soil could be a soil that has undergone progressed weathering and comes from an awfully acidic parent fabric and an awfully moo natural matter substance (Soelaeman et al., 2012). Ultisol has moderate to direct penetrability and thickness or BD levels above 1.3 g/cm3which comes about in plant root infiltration not creating legitimately (Rauber et al., 2025). Ultisol could be a soil with an acidic argilic skyline with an soluble immersion littler than 35 % at a profundity of 1.8 m from the soil surface (Santi et al.,2022.). This soil creates from ancient parent fabric, in Indonesia it is found in zones with clay parent fabric (Akasah et al., 2025). Ultisol found in Indonesia has destitute physical, chemical and organic properties. The soil aggregate solidness of Ultisol is generally moo and the natural matter substance is exceptionally moo (< 2 %). (Listyarini et al., 2025). This can be due to the tall rate of weathering of natural matter, as well as the aggregation of clay within the lower layer, known as the argilic skyline or kandic skyline. (Mbah et al., 2024).The moo substance of natural matter and the tall clay substance in Ultisol moreover cause water bound to micropores to be troublesome for plant roots to require so that such conditions cause plant development isn't great and is regularly recognized with barren soil since the physical, chemical and natural properties are not great and natural matter nearly not exists butit can still be rectified and created for agrarian arrive with the expansion of natural matter and natural fertilizers. (Benevenute et al., 2024)

In Indonesia, as of late natural agribusiness has been socialized and actualized by utilizing different sources of organic matter as well as mechanical squander, metropolitan squander, rural squander conjointly with vegetative soil change such as generation timberlands to realize feasible horticulture and accomplish (the biological system of the region concerned (Harahap et al.,2023). civil squander compost can be made

from civil squander within the frame of showcase squander and family squander that has experienced weathering (composting) it is trusted that with the utilize of suitable compost, to be specific metropolitan squander compost, the physical properties of the soil can be progressed, to be specific the structure and soil surface through the arrangement of more steady, free totals as well as great soil air circulation and waste.Moreover, the arrive of Ultisol Pangkatan Locale, Labuhan Batu Rule ought to be utilized as natural cultivating to progress the physical, chemical and natural properties of the soil and avoid disintegration and flooding by assessing inquire about on the utilize of different sorts of the leading natural matter such as palm oil strong squander, sugar pabri squander, angle squander, creature bolster waste, chicken manure, dairy animals compost, Leguminoseae compost (Calopogonium muconuides Desv.) and metropolitan squander natural fertilizer compost . The reason of this ponder is to decide the most excellent sort of natural matter in progressing the physical and ultisol properties of Pangkatan, Labuhan Batu Rule and.

II. METHODS

Place and Time of Research

This research was carried out at the location of the Experimental Garden of the Labuhan Batu University Campus, Faculty of Science and Technology with an altitude of ± 25 m above sea level and asoil analysis was carried out at the Research and Technology Laboratory of the Faculty of Sains and Teknologi, Labuhanbatu University, Rantauprapat. This study started from October 2022 to March 2023.

Materials and Tools

The materials used in this study are examples of Ultisol type soil in Pangkatan District, organic materials include: Palm oil solid waste, sugar factory waste, fish waste, animal feed waste, chicken manure, cow dung, leguminous compost (*Calopogonium muconuides* Desv.) organic fertilizer compost municipal waste.The equipment used in this study is hoes, scales, polybags, ring samples, 10 mesh sieves, ovens, plastic bags and some equipment for the analysis of the physical and chemical properties of the soil.

Research Methods

Thisstudy used a Non-factorial Group Randomized Design (RAK) with a factor of 8 organic matter and 3 tests so that there were 27 pots. Experiments with the following treatment: L_0 : Control, $L_{1:}$ Palm oil solid waste (150 g / 10 kg TKO equivalent to 30 tons / ha) , L_2 : Sugar factory waste (150 g / 10 kg TKO equivalent to 30 tons / ha), L_3 : Fish waste (150 g / 10 kg TKO equivalent to 30 tons / ha), L_4 : Animal feed waste (150 g / 10 kg TKO equivalent to 30 tons / ha) $L_{5:}$ Chicken manure (150 g / 10 kg TKO equivalent to 30 tons / ha), L_6 : Cow dung (150 g / 10 kg TKO equivalent to 30 tons / ha), L_7 : Leguminous Compost (*Calopogonium muconuides* Desv.) (150 g / 10 kg TKO is equivalent to 30 tons / ha), L_8 : Compost organic fertilizer municipal waste (150 g / 10 kg TKO equivalent to 30 tons / ha) With the following metematic formula: $Y\ ij : \mu +_{\alpha i} + \beta_j + \Sigma_{ij}$, Where: Y_{ij} : Results of observations on experimental units on the i-th treatment and jth replay, μ : Average valuegeneral, α i : The influence of replayke-I, β j : Effect of deuteronomy-j, Σ_{ij} : Effect of error on i-th treatment experiment and j-th replay

Measured parameters

The physical and chemical properties of the soil are as follows: Bulk Density (g/cm^3) with Ring Sample method, Total Pore Space (%) with soil particle density, Permeability (cm/h) with De Bootd method

III. RESULTS AND DISCUSSION

Result

Bulk Density

From the average results and fingerprints in Table 1, it shows that the application of various types of organic matter has a significant effect on reducing the Bulk Density of the soil. The results of the 5% Duncan test by applying various types of organic matter to the soil Bulk Density can be seen in Table 1. Table 1 shows that by applying various types of organic matter L 3 (fish waste) the highest noticeable effect on the Bulk density of Pangkatan ultisol soil of 1.02 g / cm_3, this treatment is not significantly different from L 1 (Palm solid waste), L_2 (Sugar mill waste), L_4 (Animal feed waste), L_6 (Cow dung) and L_7 (Leguminose 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 differed markedly from

L_0 (Control), L_5 (Chicken manure) and L_8((Municipal waste organic fertilizer compost) of 1.20 g/cm 3, 1.13 g/cm 3 and 1.16 g/cm^3. The difference in soil Bulk Density values due to the treatment of various types of organic matter that is the lowest in L_3 (Fish waste) can be seen in the histogram graph presented in Figure 1. From Figure 1, it can be seen that the application of various types of organic matter in the Pangkatan ultisol soil is the L 3 treatment (fish waste) can reduce the lowest bulk density of 1.02 g / cm 3 while the highest in the L_0 (Control) treatment is 1.20 g / cm ^{3} with a decrease of 15% (Harahap et al., 2022)

Table 1. Average Bulk Density Due to The Application of Various Types of Organic Matter

Treatment	Bulk Density. ... g/cm^3.....
Lo (Control)	1.20 a
L_1 (Palm Oil Solid Waste)	1.08bcd
L_2 (Sugar Mill Waste)	1,10abcd
L_3 (Fish Waste)	1.02s
L_4 (Animal Feed Waste)	1.11abcd
L_5 (chicken droppings)	1.13 abc
L_6 (Cow dung)	1.07bcd
L_7 (Leguminous Compost)	1.05 cd
L_8 (Compost organic fertilizer for Medan city waste)	1.16 ab

Ket : The same number followed by the same letter in the same column indicates no real difference at the level of 5% DMRT

Total Pore Space

From the average results and fingerprints in Table2, it shows that the application of various types of organic matter has a noticeable effect on increasing the total pore space of the soil. The results of the uncan test of 5% administration of various types of organic matter to the total pore space of the soil can be seen in Table 2.

Table 2. Average Total Pore Space Due to The Application of Various Types of Organic Matter

Treatment	Total Pore Space (%)
Lo (Control)	54.71s
L_1 (Palm Oil Solid Waste)	59.12 abc
L_2 (Sugar Mill Waste)	58.49abc
L_3 (Fish Waste)	62.63a
L_4 (Animal Feed Waste)	58.11 abc
L_5 (chicken droppings)	57.36BC
L_6 (Cow dung)	59.75 abc
L_7 (Leguminous Compost)	60.37ab
L_8 (Compost organic fertilizer for Medan city waste)	56,10 c

Ket : The same number followed by the same letter in the same column indicates no noticeable difference at the level of 5% DMRT

Table 2 shows that with the provision of various types of organic matter L3 (Fish waste) the highest noticeable effect on the total pore space of the South Ultisol soil by 62.63% this treatment is not significantly different from L1 (Palm solid waste), L2 (Sugar mill waste), L4 (Animal feed waste), L6 (Cow dung) and L7 (Leguminous compost) by 59.12%, 58.49%, 58.11%, 59.75% and 60.37%, but it differs markedly from L0 (Control), L5 (Chicken manure) and L8 (Compost organic fertilizer for Medan municipal waste) by 54.71% and 57.36% and56.10( ) %. The difference in the value of the Total Soil Pore Space due to the treatment of various types of organic matter is the highest in L3 (Fish waste)

Permeability

From the average results and fingerprints in Table 3, it shows that the application of various types of organic matter has an unreal effect on increasing soil permeability. The results of the 5% Duncan test by applying various types of organic matter to permeability can be seen in Table 3.

Table 3. Average Soil Permeability Due to Giving Various Types of Organic Matter

Treatment	Permeability
Lo (Control)	29.11
L_1 (Palm Oil Solid Waste)	32.37
L_2 (Sugar Mill Waste)	37.18

L_3 (Fish Waste)	51.93
L_4 (Animal Feed Waste)	60.22
L_5 (chicken droppings)	41.61
L_6 (Cow dung)	49.56
L_7 (Leguminous Compost)	54.38
L_8 (Compost organic fertilizer for Medan city waste)	31.86

Table 3 shows that the application of various types of organic matter has an unreal effect on the permeability of the ultisol soil of Pangkatan. The highest soil permeability value was obtained in the L_4 treatment (Animal feed waste) which was 60.22 cm / hour while the lowest in the L 0 (Control) treatment was 29.11 cm / hour with an increase of more than 100%.

Discussion

The provision of various types of organic matter in an effort to conserve Ultisol land in Pangkatan has a real effect on Bulk density, Total Pore Space, From the results of the study, it can be seen that the provision of various types of organic matter on Pangkatan ultisol land has a real effect on reducing soil Bulk Density, especially in the treatment of L 3 (fish waste) and L 7 (Leguminous compost) reached 1.02g/cm 3 and 1.05g/cm^3 which is in line with the increase in total soil pore space by 61.63% and 60.37%. This is because the organic matter applied can increase the activity of microorganisms that can reduce soil density where organic matter is material derived from plant residues and animals that have died and if decomposed in the soil it can form a stable soil aggregate This is in accordance with the opinion of Shinta *et al.*, (2018) s soil density decreases and increases soil pore space in ultisol fields so that the organic matter applied can increase the activity of microorganisms that can reduce soil density.

The application of various organic matter has a significant effect on reducing bulk density and increasing the total pore space of the soil, but has no real effect on increasing the permeability of the ultisol soil in Pangkatan. This is thought to be because the organic matter applied has not fully increased the activity of microorganisms or organic matter has not been fully 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 Pangkatan ultisol land. Although permeability is not significantly affected by organic matter, permeability increases compared to L_0 (Control) with an increase of 89.42% This is in the opinion of (Matos *et al.*, 2022), organic matter that has not fully increased the activity of microorganisms or organic matter has not been able to be absorbed by the soil so that the total pore space formed as well as the soil aggregate stable condition

IV. CONCLUSIONS AND SUGGESTIONS

Conclusion

The provision of fish waste has the highest real effect in improving the physical properties of the soil such as reducing the Bulk Density of the soil, which is 1.02 g / cm^3 and increasing the Total Soil Pore Space which is 61.63% while the highest soil Ermeability P is obtained in the treatment of Animal feed waste, which is 60.22 cm / hour while the lowest in Control treatment of 29.11 cm/h

Suggestion

It should be necessary to conduct further research by increasing the dose of organic matter administration to get better results in improving the ultisol land of Pangkatan.

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