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The Application of Municipal Waste Compost to Improve the Physical Properties of Soil and Palm Oil Production in Silinda District, Serdang Bedagai

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The Application of Municipal Waste Compost to Improve the Physical Properties of Soil and Palm Oil Production in Silinda District, Serdang Bedagai

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Abstract. This research had been done in Agricultural faculty of north sumatera university, medan on april until oktober 2009. The aim of this research are studied The Application of Municipal Waste Compost to Improve the Physical Properties of Soil and Palm Oil Production in Silinda District, Serdang Bedagai. This research was designed by 2 factors and 4 replications. The first factor are uses a separate plot design (RPT) with 2 factors and 4 replications as follows: Main plot consists of 2 levels of treatment, namely: T1: 5 years of planting, T2: 20 years of planting. Child Plots consist of 3 levels of treatment, namely: K1: Without Conservation Measures + Without Giving Compost, K2: Concave Plate + Compost, K3: Individual Rorak + Compost, and numbers of reports: 4 replications (each planting). This result showed that the application of Municipal Waste Compost not significant to the Physical Properties such as, bulk density, porosity, permeability.

1. Introduction

Oil palm has an important role for the national economy, especially providing employment and as a source of state income [1]. The area of oil palm plantations in the North Sumatra province of Serdang Bedagai District in 2014 reached 12.7 million ha / year with fresh fruit bunches production of 40.89 million tons / ha / year so that it can be said that one area with low oil palm production if compared with the production of fresh fruit bunches in Deli Serdang district which reached 42.8 million tons / ha / year [2].

Palm oil grows in podsolic, latosol, gray hydromorphic, alluvial or regosol types. The optimum pH value is 5.0-5.5. Palm oil requires loose, fertile, flat soil well drained and has a deep solum layer without padas [3]. The topographic conditions of oil palm plantations should be no more than 25%, meaning that the difference in height between two points is 100 m not more than 25 m. The problem of farming in sloping areas is the erosion that is getting bigger if it is not accompanied by conservation techniques [4]. Erosion is very detrimental to land productivity because in a short time the fertile topsoil will disappear. Soil damage due to loss of nutrients can be improved by adding the right fertilizer, but if the damage is caused by loss of production and hydrological functions then repairing it takes a long time.

Conservation is the management of natural resources or the whole environment of an ecosystem to prevent over-utilization, pollution or neglect for the preservation of natural resources [5]. Soil conservation is an effort to keep the land productive or repair damaged land due to erosion to make it better [6]. The steepness of the slope can increase the amount of surface flow, but it also increases the transport energy of water. The number of soil grains splashed down by the collision of rain grains will



be even greater if the slope is getting bigger [7]. This is due to the greater gravity due to the increasingly sloping surface of the ground from the horizontal plane, so that the more eroded topsoil. The amount of erosion per unit area becomes 2.0-2.5 times more if the slope of the land surface is twice as steep.

Organic matter is an important ingredient in creating soil fertility both in physical, chemical and biological terms [8]. Organic matter is a soil aggregate that is unmatched. About half of the cation exchange capacity (CEC) comes from organic material. It is a source of plant nutrients. Besides that organic matter is the energy source of most soil organisms. In playing these roles organic matter is very much determined by the source and its composition, because of the smooth decomposition and the results of the decomposition itself. The benefits of organic matter in the soil are: Increase the content of organic matter, macro nutrients, micro nutrients, proteins, organic acids and colloids in the soil. Improve soil structure, increase soil in storing water, increase soil in cation exchange capacity, reducing phosphate fixation by Al and Fe on the soil, increasing the activity of biology or microorganisms in the soil such as bacteria, fungi, earthworms and algae, reducing bulk density, improve crop quality [9]. Addition of organic material from manure and plant remnants or the results of planting such as *Mucuna* sp. can improve soil physical properties such as available water pores, aggregate stability index, and soil density. Giving organic material both from plant debris and deliberately planted does not cause problems for farmers. Based on the problems stated above, the authors are interested in conducting a study entitled the application of municipal waste compost to improve the physical properties and production of oil palm on sloping land

2. Methods

This study uses a separate plot design (RPT) with 2 factors and 4 replications as follows:

Main plot consists of 2 levels of treatment, namely:

T1: 5 years of planting

T2: 20 years of planting

Child Plots consist of 3 levels of treatment, namely:

K1: Without Conservation Measures + Without Giving Compost

K2: Concave Plate + Compost

K3: Individual Rorak + Compost

So that there were 6 combinations of treatments, namely:

Treatment of Conservation Engineering (K)

Planting Year (T) T1K1 T2K1

 T1K2 T2K2

 T1K3 T2K3

Number of treatments: 6 treatments

Number of Reports: 4 replications (each planting year)

Total Plant Sample Overall: 24 plants

The mathematical model of the Separate Plot Design (RPT) is:

$$Y_{ijk} = \mu + \rho_k + \alpha_i + \beta_j + y_{ik} (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where:

Y_{ijk} : Observation on the first experimental unit that obtained a combination of planting year treatment level i from factor a and treatment of conservation method level j of factor b

μ : Actual Average Value (population average)

ρ_k : Additive effect from group k

α_i : Additive effect of i-level of factor A

β_j : Additive effect of j-level of factor B

$(\alpha\beta)_{ij}$: Additive effect of i-level of factor A and j-level of factor B

y_{ik} : The random effect of the main plot that appears at the first level of factor A in the k-group is often called the main plot error

ϵ_{ijk} : Random influence from the first experimental unit that gets a combination of ij treatment. Often referred to as sub-plot errors.

Furthermore, the data was analyzed by Variant analysis on each parameter measured and tested further for real treatment using Duncan's Multiple Range Test at the 5% level.

2.1. Location survey research

Preliminary survey (Location assessment) at the location of smallholder plantations in Pagarmanik Village, Silinda Subdistrict, Serdang Bedagai District, North Sumatra Province. The method used in this study was to analyze the area of suitable research carried out by analyzing soil physics.

2.2. Preparation of municipal waste

Compost of municipal solid waste is obtained / purchased from Community Self-Help Groups (KSM) Pondok Miri Asri which provides large-scale compost and direct production with the application of Organic material used is Compost Fertilizer, with the composition of Domestic Waste Compost (Municipal Waste) + Cow / Lamb Manure + Blotong + Water Cattle Art and Laundry with a ratio of 5: 5: 1.

2.3. Stage of Activity in the Field

Work begins with a preliminary survey, namely by conducting a field orientation research such as taking coordinates. After the preliminary survey, followed by the implementation of the main survey with the main objective, composite soils were sampled. The taking of soil samples is carried out zig zag at a depth of 0-30 cm then compiled from several locations, so that some soil samples are obtained. Provide as many as two plastic bags (one for soil chemical analysis and one for soil biological analysis) at each observation point, then put the soil sample into plastic by grouping each treatment on a conventional disk, concave disks, composted individual patterns, the contour pattern composted and labeled the field in each soil samples. Every soil taken from soil sampling can be air dried to be examined in the laboratory which includes the chemical and biological properties of the soil found in the land characteristics table. This research was carried out using methods of applying organic materials and soil analysis in the Laboratory and processing data.

2.4. Application of municipal waste compost on oil palm cultivation

Excavations between plants were made by using a hoe 60 cm wide and 30 cm deep, according to the treatment. The excavated soil is placed at the edge of the excavation hole to make it easier to close the hole. Prepared organic material (municipal waste compost) After the excavation hole has been prepared, then fill the excavation hole with the organic material provided. After the excavation hole is filled with organic material according to the treatment, it can make a mark or brand in each treatment. For the rorak dimension it is adjusted to the amount of organic material that will be applied with a maximum depth of 30 cm half of the root zone of oil palm

The vertical mulch of a dish with 2 treatments is a mechanical conservation technique, that is, evenly distributed in a dish with a certain treatment (conventional) and without treatment, namely a land dish left in its original state (TM). All treatments were repeated 3 times at each different planting year both in plants that produced 1 that ranged from 3-4 years old and in plants that produced 2 that ranged from 7-8 years with a distance per each replicate of 1 row plants as a separator repeating one another.

3. Results and Discussions

3.1. Bulk density

The results of the statistical analysis showed that the effect of the conservation method was not significant, and that both interactions did not significantly influence bulk density. To find out the average of each observation is presented in table 1.

Table 1. The content of bulk density with the treatment of conservation methods and planting years

Year of planting	Conservation Method			Mean
	K1 (Conventional)	K2 (Concave disk)	K3 (Rorak)	
T1 (5 yr)	0.74	0.74	0.84	0.77
T2 (20 yr)	0.78	0.59	0.65	0.67
Mean	0.76	0.67	0.75	

In Table 1, it can be seen that the treatment of conservation methods did not significantly affect bulk density. The highest bulk density value was obtained in the treatment on conventional disk treatment (k1), that is, 0.76 and followed by individual behavior treatment (k3), that is, 0.75 and the lowest in conventional treatment (k2) is 0.67.

3.2. Porosity

The results of the statistical analysis show that the effect of the improvement of the conservation method has no significant effect, and both interactions do not significantly affect permeability. To find out the average of each observation is presented in Table 2.

Table 2. The content of porosity with the treatment of conservation methods and planting years

Year of planting	Conservation Method			Mean
	K1 (Conventional)	K2 (Concave disk)	K3 (Rorak)	
T1 (5 yr)	71.68	71.36	69.26	70.77
T2 (20 yr)	68.97	76.29	74.85	73.37
Mean	70.33	73.83	72.06	

In table 2 it can be seen that the treatment of conservation methods has no significant effect on porosity. The highest porosity value was obtained in the treatment of the concave disk + compost (k2) treatment, that is, 73.83 and followed by individual rorak treatment (k3), namely, 72.06 and the lowest in conventional treatment (k1), namely 70.33

3.3. Permeability

The results of the statistical analysis show that the effect of the improvement of the conservation method has no significant effect, and both interactions do not significantly affect permeability. To find out the average of each observation is presented in Table 3.

Table 3. The content of permeability with the treatment of conservation methods and planting years

Year of planting	Metode Konservasi			Mean
	K1 (Conventional)	K2 (Concave disk)	K3 (Rorak)	
T1 (5 yr)	11.11	10.35	9.69	10.38
T2 (20 yr)	9.74	11.76	11.92	11.14
Mean	10.43	11.05	10.81	

In table 3, it can be seen that the treatment of conservation methods has no significant effect on permeability. The highest permeability value was obtained in the treatment of the concave disk + compost (k2) treatment, that is, 11.5 and followed by the individual treatment pattern (k3), that is, 10.81 and the lowest in conventional treatment (k1) which was 10.43

4. Conclusions

The results of the statistical analysis showed that the effect of the conservation method had no significant effect, and that both interactions did not significantly affect the physical properties of the soil.

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