Dynamics of K, Ca, Mg in Spodosol Land that is Applied Oil Palm Empty Fruit Bunch on Oil Palm Cultivation Land (Elaeis guineensis Jacq.) In Central Kalimantan

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Abstract. The purpose of this study was to evaluate the application dosage of oil palm empty fruit bunch and the most efficient application area in contributing to maintaining soil nutrients, especially bases K, Ca, Mg. This research was conducted at PT. Sawit Graha Manunggal (SGM), Paju Epat Subdistrict, East Barito Regency, Central Kalimantan Province, which has a dominant type of soil Spodosol (Typic plachortod). This research uses a factorial split-plot design with 2 treatment factors. The first factor is where the application of oil palm empty fruit bunches as the main plot consists of 2 levels, namely G1 = palm inter-row, G2 = palm circle. The second factor is the dose of oil palm empty fruit bunches as subplots consisting of 3 levels namely, E1 = 30 mt / ha, E2 = 35 mt / ha, E3 = 40 mt / ha. The analysis was carried out after the application of oil palm empty fruit bunches for five years. The results showed that the most efficient application site was in the oil palm inter-row and the best application of oil palm bunches was 30 mt / ha.

Keywords: Exchange bases, oil palm empty fruit bunches, place of application, application dosage

1 Introduction

The development of the area of oil palm plantations in Indonesia is estimated to have an area of around 12.30 million hectares, an increase of 9.80% from 2016 which amounted to 11.20 million hectares, accompanied by an increase in palm oil production (CPO) of 34.47 million tons or by 9, 46 percent from 2016 amounted to 31.49 million tons [1]. The expansion of oil palm plantations today leads to marginal (sub-optimal) lands, one of which is spodosol soils which have low potential and soil fertility, because these species generally have low nutrient reserves, are acidic, have interchangeable base bases. low, low wet saturation and high (very high) Aluminum (Al) saturation [2].

Spodosols are soil formed from sand or coarse clay material and acid. This soil is characterized by the presence of a spodic B horizon or accumulated horizon of organic and

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aluminum amorphous materials, with or without iron [3]. The dominant distribution of Spodosols is found in alluvial and coluvial plains which is a transitional area between structural / tectonic plains of quartz sandstone and marshy / peat plains which are commonly found on Kalimantan Island. The largest distribution of Spodosols is in the province of Central Kalimantan covering 1.51 million hectares, West Kalimantan 0.42 million hectares and East Kalimantan 0.15 million hectares [4]. Spodosol soil is nutrient-poor soil [2,5]. This can be seen from the characteristics of the carbon content (C) which is rather low (0.11-1.31%) and rather high (4.62%) at the spodic horizon. It has low to moderately low Nitrogen (N) content (0.10-0.11%), C / N ratio is rather low (0.10-0.11%) in the upper layer and high in the spodic layer (46.2%). Having low available phosphorus (P) (1-8 ppm) in all layers, cation exchange capacity (CEC) classified as low to moderate in the entire horizon (7.64-14.98), low base saturation (KB) (1-3) %) in all layers, has a acidic pH (pH 3.7-4.5) [6]. Spodosol soils have two weight limiting factors that need attention: the depth of the spodic layer and the texture of sandy soil. The depth of the spodic layer is related to the ease of roots in penetrating the soil, whereas sandy soil texture will result in the low ability of the soil to retain water and the chance of leaching nutrients is also greater. Other limiting factors that can potentially inhibit plant growth are poor drainage and soil acidity [5][7]. According to Surianto [8] that the soil texture of all Spodosol soil profiles is located at PT. Sawit Graha Manunggal (SGM) East Barito regency, dominated by sand with the parameters of Bulk Density (BD) of medium category and soil permeability categorized rather quickly to quickly. Soil chemical parameters including pH, N (%), C (%), C / N, CEC, P-total and available P and exchange bases show low to very low categories.

As it is known that one of the by-products of the palm oil processing industry in the form of solids namely oil palm empty fruit bunches (OPEFB) also has a high potential in ameliorating sandy soils. Amelioration of sandy soil using oil palm empty fruit bunches has chemical and physical function approaches where high concentrations of organic matter will reduce the level of leaching of soil nutrients, especially K, Ca, Mg soils which are very easily washed.

Oil palm empty fruit bunches is a rich source of organic matter, N, P, K and Mg. The number of oil palm empty fruit bunches is estimated at 23% of the total number of processed fresh fruit bunches. In each ton of oil palm empty fruit bunches containing 1.5% N nutrients, 0.5% P, 7.3% K and 0.9% Mg that can be used as fertilizer substitutes for oil palm plants [9][10] research results showed that oil palm empty fruit bunches (OPEFB) are organic materials containing 0.80% N, 0.22% P2O5, 2.90% K2O, [11] determined the dose for the plot given EFB mulch around 200 kg (fresh weight) EFB per staple per year, applied in a circle around the base of the plant at the time of planting. In addition, oil palm empty fruit bunches (EFB) can also be applied between 4 points for one point on mature plants at a dose of 250 kg/staple [12]. Meanwhile, according to [13] that to increase the capacity to hold water and increase the exchange of cautions in the soil carried out the addition of oil palm empty cage (EFB) of 200 kg/staple.

Therefore, taking into account the aspect of fertilizing the garden regime (Spodosol soil), it can be evaluated at which application dosage of Oil Palm Empty Fruit Bunch (TKKS) (30, 35, 40 tons/ha) and in which application area (palm inter-row or palm circle) which can most efficiently contribute to maintaining soil nutrients, especially soil bases K, Ca, Mg.

2 Research Method

The materials to be used in this study are oil palm plants in 2009 and 2010 planting types with planting material Socfindo and BLRS (Lonsum) and oil palm empty fruit bunches derived from the rest of the palm oil mill processing of PT. Palm Graha Manunggal which has been applied as mulch for more than five years.

This research was conducted at PT. Sawit Graha Manunggal (SGM), Paju Epat Subdistrict, East Barito Regency, Central Kalimantan Province which has a dominant type of Spodosol (Typic plachortod) soil in May-October 2019.

Specifically to determine the effect of the OPEFB treatment in two different places (palm inter-row or palm circle) on the dynamics of the base of the exchange of land (K, Ca, Mg), used factorial Split Plot Design using 3 replications, as for the second Factors studied were: The first factor, namely the locations of application of oil palm empty fruit bunches consisted of 2 locations namely G1 = gawangan, G2 = disc. The second factor, namely the application dose of oil palm empty bunches consists of 4 levels, namely E1 = 30 mt/ha, E2 = 35 mt/ha, E3 = 40 mt/ha.

3 Results and Discussion

3.1Potassium (K)

Table 1. below presents the average potassium nutrient in oil palm leaves due to differences in location and application dose of oil palm empty fruit bunches

Table 1. Average potassium nutrients in oil palm leaves due to differences in location and application dosage of oil palm empty fruit bunches

Note: Those numbers followed by the same alphabet on the same application unreal different by Duncan test Average Difference α=5%

Locations of application	Doses of application			Mean
	30 mt/ha (E_1)	35 mt/ha (E_2)	40 mt/ha (E_3)	
		….....%.....		
Palm inter-row (G_1)	1.10 a	1.15 a	1.13 a	1.13 a
Palm circle (G_2)	1.11 a	1.20 a	1.06 a	1.12 a
Mean	1.11 a	1.17 a	1.10 a	

The results of the analysis showed that the administration of oil palm empty fruit bunches did not significantly affect the percentage of potassium nutrient content in the oil palm leaf tissue. The percentage of potassium nutrient content in leaf tissue is higher in oil palm empty fruit bunches which are applied in palm inter-row (1.13%) than in the palm circle (1.12%). In addition, the provision of oil palm empty fruit bunches 35 mt / ha showed the highest percentage of potassium among other treatments, amounting to 1.17%. However, this percentage is still relatively low

compared to the critical limit of potassium nutrient levels that must be available on oil palm leaves [14] reported that the critical limit of K nutrient in the 9th fronds of oil palm was 1.25%.

3.2 Calcium (Ca)

Table 2 .below presents the average calcium nutrient in palm oil leaves due to differences in location and application dosage of oil palm empty fruit bunches

Table 2. Average calcium nutrients in oil palm leaves due to differences in location and application dosage of oil palm empty fruit bunches. Note: Those numbers followed by the same alphabet on the same application unreally different by Duncan test Average Difference α=5%

Locations of aplication	Doses of aplication			Mean
	30 mt/ha (E_1)	35 mt/ha (E_2)	40 mt/ha (E_3)	
		……..%……..		
Palm inter-row (G_1)	0.59 a	0.57 a	0.57 a	0.58 a
Palm circle (G_2)	0.62 a	0.56 a	0.62 a	0.60 a
Mean	0.60 a	0.57 a	0.59 a	

The results of the analysis showed that the highest calcium nutrient levels were found in the application of oil palm empty fruit bunches in the palm circle and the application dosage which showed the highest calcium nutrient levels was 30 mt/ha. Giving oil palm empty fruit bunches can supply nutrients both macro and micro including calcium. This is because during the decomposition process the oil palm empty mark will release base cautions such as K, Ca, Mg, and Na in the available form [15].

3.3. Magnesium (Mg)

Table 3.below presents the mean magnesium nutrients in oil palm leaves due to differences in location and application dosage of oil palm empty fruit bunches

Table 3. Average magnesium nutrients in oil palm leaves due to differences in location and application dosage of oil palm empty fruit bunches
Note: Those numbers followed by the same alphabet on the same application not really different by Duncan test Average Difference α=5%

Locations of aplication	Doses of aplication			Mean
	30 mt/ha (E_1)	35 mt/ha (E_2)	40 mt/ha (E_3)	
		……..%……..		
Palm inter-row (G_1)	0.34 a	0.32 a	0.32 a	0.32 a
Palm circle (G_2)	0.30 a	0.30 a	0.29 a	0.30 a
Mean	0.32 a	0.31 a	0.30 a	

Based on the analysis of Mg nutrient content in the palm oil leaf tissue, it can be seen that the application of the best oil palm empty fruit bunches is in the palm inter-row and the best dose which shows the highest nutrient content is 30 mt / ha.

Oil palm empty fruit bunches not only contain elements N, P, K, but also contain macro and micro nutrients, one of which is Mg. Lingga [16] stated that the Mg element plays a role in the formation of chlorophyll so that the formation of perfect leaf green for plants, besides that the Mg element plays a role in neutralizing the saturation of substances that poison the soil and plants such as excess Al, Fe and Cu.

4 Conclusion

The most efficient provision of oil palm empty fruit bunches is in the oil palm inter-row and the best dose for increasing K, Ca, Mg nutrients is 30 mt/ha. Further research is needed for soil nutrient analysis due to the provision of oil palm empty fruit bunches.

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