Journal of Agriculture (JoA)
Volumes: 1 | Number: 1 | March 2022 | E-ISSN: 9999-999x | DOI: doi.org/JoA.v1n1.1391

ANALYSIS OF SOIL CHEMICAL CHARACTERISTICS IN PABATU SERDANG BEDAGAI UNIT OIL PALM PLANTATIONS

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Received: 2022-02-22
Accepted: 2022-03-09
Publication: 2022-03-09

Abstract
Soil is a natural medium that is one aspect of supporting the life of all living things, including plants. Soil chemical properties greatly affect the growth process of oil palm plants, especially in the production process of oil palm fruit bunches. The purpose of this study was to determine the soil's *chemical properties* in oil palm plantations. The method used in this study is a descriptive method by conducting surveys and laboratory analysis. Soil samples were taken randomly at a depth of 0-20cm at four points of plantation land. Several parameters have been analyzed, such as pH, total N, CEC and exchangeable Al (Al-dd). Soil samples were analyzed at the Laboratory of Soil Research Indonesian Oil Palm Research Institute (PPKS) Medan. *Determination of the criteria for assessing soil chemical properties* based on the soil fertility standards issued by the Soil Research Center (BPT) Bogor (2009). *The results of the analysis showed that the soil pH was slightly acidic, total N was low, CEC was low and Al-dd was very low.*

Keywords: *Oil palm, production, soil fertility status*

Introduction

Oil palm is a plantation crop that can produce vegetable oil in addition to beans and corn. Processing of palm fruit will obtain the main product in the form of CPO (*Crude Palm). Oil*), PKO (*Palm Kernel Oil*) and its by-products in the form of shells, pulp, and empty fruit bunches. CPO can be used as raw material for the cooking oil, butter, and soap industries (Setyamidjaja, 2006).

The demand for palm oil tends to increase every year. This encourages oil palm plantations to continue to increase the planted area. Until 2020, the area of oil palm plantations is estimated to be around 14.9 million hectares with oil palm fruit production of 48.3 million tons (BPS, 2020). Efforts to ensure the stability of oil palm production must be followed by increased maintenance in the field with the application of good agricultural technology (good agricultural practices) which includes aspects of maintenance, which play an important role in achieving increased production and productivity. According to Soekartawi (2002), one of the internal factors that influence the production of agricultural products is biological factors such as agricultural land with the type and level of fertility.

The land is one of the important production factors in the activities of the agricultural production process because the land is the natural and cultural environment where the agricultural

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production process takes place. Soil is one of the basic components in the development of oil palm plantations. An understanding of soil characteristics in oil palm plantations is needed as a basis for determining technical cultural actions to be taken to ensure the sustainability of land productivity (Firmansyah, 2014). According to Darlita *et al* (2017), soil chemical properties such as N-total, CEC, and Al-dd are parameters that increase the number of bunches per tree.

Research Method

The research was conducted from June 2021 to September 2021. The research was carried out in the Pabatu unit of oil palm plantations. Soil analysis was carried out at the Central Laboratory of Palm Oil Research (PPKS) in Medan. The method used in this research is a descriptive method by conducting surveys and taking soil samples. Soil samples were taken randomly at a depth of 0-20cm at four points of plantation land. Soil samples that have been taken are then put into a container and given a sample number. Then the analysis was carried out in the laboratory with the analyzed parameters, namely soil pH (electrometric method), N-total soil (Kjeldahl method), soil CEC (Kjeldahl method), and soil Al-dd (KCL 1N method). The determination of the criteria for assessing soil chemical properties is guided by the soil fertility standards issued by the Bogor Soil Research Institute (BPT (2009)).

Results and Discussion

Primary data obtained from laboratory analysis is then determined by the status of soil chemical properties based on soil fertility standards issued by the Bogor Soil Research Institute (BPT (2009), which can be seen in Table 1.

Table 1. Results of analysis of soil pH, N-total, CEC and Al-dd

Sample Number	Soil parameters			
	pH	N-total (%)	CEC (me/100g)	Al-dd (me/100g)
1	5.1 (S)	0.30 (S)	27.66 (T)	0.06 (VL)
2	6.6 (N)	0.08 (SR)	8.59 (L)	0.02 (VL)
3	6.4 (SS)	0.15 (L)	12.15 (L)	0.03 (VL)
4	4.5 (S)	0.17 (L)	11.81 (L)	0.91 (VL)
Average	**5.65 (SS)**	**0.175 (L)**	**15.05 (L)**	**0.26 (VL)**

Description: S=Sour; SS=Slightly Sour; N=Neutral; VL=Very Low; L=Low; T=High (criteria based on the criteria for assessing soil properties, Bogor Soil Research Institute, 2009)

1. Soil pH

The results of the analysis obtained are the average pH value of 5.65 (Table 1) this indicates that the pH of the soil at the study site is classified as slightly acidic. In general, the pH value of the soil increases with the depth of the soil, as well as the saturation value of Al3 $^{+}$ and Al can be exchanged. The presence of Al can cause acid soil. According to Hong (2008), the low pH can be caused by the leaching of alkaline cations that occurs from the top layer to the inner layer which leaves H $^{+}$ and Al $^{3+\ cations}$ in the top layer which determines soil acidity.

The relatively low soil pH value is thought to be due to the influence of parent material in locations that have not been weathered much, this can also benefit plant growth because the nutrient content tends to be balanced in the soil (Hikmatullah, 2010). In the natural environment,

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soil pH has a major influence on soil biogeochemical processes. Soil pH value is described as the "main variable" affecting various biological, chemical and physical properties of the soil as well as influencing plant growth processes and biomass production (Minasny *et al*, 2016).

2. Total Nitrogen Content (N-total)

The average value of total nitrogen content is 0.175% (Table 1), this indicates that the total soil nitrogen content in the study area is low. The low nitrogen is thought to be because nitrogen is lost easily through washing or evaporation (Darlita et al, 2017). Nitrogen elements from the soil come from the decomposition of organic matter and plant and animal remains, fertilization (especially urea and ammonium nitrate) and rainwater (Hanafiah, 2005).

According to Barchia (2009), soil acidity greatly affects the availability of inorganic N, where at low pH the activity of microorganisms to decompose organic N is inhibited. Damanik *et al* (2011) stated that nitrogen deficiency can cause all plants to have a pale yellow color, slow and stunted growth, incomplete fruit development and premature ripening. Meanwhile, excessive nitrogen results in excessive vegetative growth, thus slowing down the harvest (Effendi, 1981).

Organic matter given together with inorganic fertilizers is better than giving inorganic fertilizers alone. The addition of organic matter containing P can also increase the available P content of the soil and can increase the rate of N mineralization in the soil (Nuryani *et al* , 2010).

3. Cation Exchange Capacity (CEC)

The cation exchange capacity (CEC) of soil is defined as the capacity of the soil to absorb and exchange cations. CEC is usually expressed in milliequivalents per 100 grams. The cations that are adsorbed are not accompanied by anions. However, the free cations may be attracted and carry with them the counter anion, so that the anions can be analyzed together with the exchangeable cations. The ions from the free salt must be subtracted to get the true CEC (Tan, 1998). Soil with a high CEC can to absorb and provide nutrients better than soil with a low CEC. Because the nutrients are present in the colloid adsorption complex, these nutrients are not easily washed off by water (Soewandita, 2008).

The average CEC value obtained was 15.05 me/100g with low status (Table 1). According to Sposito (2010), soils dominated by the oxide-hydrate fractions of Al and Fe usually have a low negative charge on the colloidal surface, so the CEC value of the soil is usually low. The CEC value of soil is influenced by the level of weathering of the soil, the content of soil organic matter and the number of alkaline cations in the soil solution. Soils with high organic matter content have a higher CEC, as well as young soils with a new level of weathering starting from soils with advanced weathering levels, have low CEC values (Tambunan, 2008).

One of the factors that affect the CEC value of the soil is the humus content of the soil and the type of clay minerals (Sufardi *et al* ., 2017). Soils with high organic matter content of clay content have higher CEC values than soils with low organic matter content or sandy soils (Hardjowigeno, 2003). According to Novizan (2002), the low cation exchange capacity of soil can be increased by adding organic matter, such as compost or manure.

4. Interchangeable Aluminum (Al-dd)

Al-dd is the level of Aluminum in the soil in an exchangeable form (Al-dd) which is generally found in acidic soils. This aluminum is very active because it is in the form of Al^{3+} , a monomer that is very detrimental by poisoning plants or binding phosphorus. The content of exchangeable aluminum (Al^{3+}) affects the amount of lime required to increase soil acidity and soil productivity.

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From the results of soil Al-dd analysis, an average value of 0.26 me/100g was obtained with a very low status. The results of the analysis showed the criteria were very low and not harmful to plant growth. According to Hanafiah (2005), high levels of Al cause disruption of the cell division process in root shoots and lateral roots, hardening of the cell walls, the occurrence of P fixation in the soil being unavailable or on the root surface, decreased root respiration, and disruption of absorption, transport. and the use of some essential elements.

Sopandie (2014) stated that the higher the $Al3^{+\text{ concentration}}$ in the nutrient solution, the lower the dry weight of the roots. The application of lime to achieve a neutral pH in the tropics often reduces production due to over-liming. Therefore, liming should be aimed at negating the toxic effects of $Al^{3+\text{ ions}}$ (Havlin *et al* , 1999).

Conclusion

Soil pH status in oil palm plantations in Pabatu unit is classified as slightly acidic with an average pH value of 5.65, the total nitrogen content is low with an average value of 0.175%, CEC levels are low with an average value of 15.05 me/100g and the levels of Al-dd are classified as very low with an average value of 0.26 me/100g.

References

Soil Research Institute. 2009. Chemical Analysis of Soil, Plants, Water and Fertilizers. Technical Instructions, edition 2. Bogor

Barchia, MF 2009. Acid Mineral Soil Agroecosystem. Gajah Mada University Press, Yogyakarta.

BPS. 2020. Statistics of Indonesian Palm Oil. Indonesian Central Bureau of Statistics. Jakarta.

Darlita, RR, Joy, Benny, and Sudirja, Rija. 2017. Analysis of several chemical properties of soil on increasing oil palm production on soil, sand in Selangkun oil palm plantations. J. Agriculture. 28(1):15-20

Damanik, MMB, Bachtiar, EH, Fauzi., Sarifuddin and Hamidah, H. 2011. Soil Fertility and Fertilization. USU Press, Medan.

Effendi, B. 1981. Soil Fertility Science. Medan : USU Faculty of Agriculture

Firmansyah, MA 2014. Characterization, Land Suitability and People's Oil Palm Technology in Tidal Swamp of Central Kalimantan Characteristic of Land Suitability and Farmer Oil Palm Technology in Tidal Swamp of Central Kalimantan. 14(2): 97–105.

Hanafiah, AK, 2005. Fundamentals of Soil Science. PT Raja Grafindo Persada, Jakarta.

Hardjowigeno, S. 2003. Soil Science. Pressindo Academy, Jakarta. 286 p

Havlin, JL, JD Beaton, SL Tisdale, and WL Nelson. 1999. Soil Fertility and Fertilizers: An Introduction to Nutrient Management Sixth Edition. Prentice Hall, Inc. New Jersey.

Wisdom. 2010. Soil properties developed from volcanic material in West Halmahera, North Maluku. Indonesian Journal of Agricultural Sciences. 12(1):40-48.

Hong, Kindergarten. 2008. Principles of Soil Chemistry. 2nd Ed. Marse, Dekker Inc. New York.

Minasny, B., Hong, SY, Hartemink, AE, Kim, YH, and Kang, SS 2016. Soil pH increase under paddy in South Korea between 2000 and 2012. *Agriculture, Ecosystems & Environment* , vol. 221, pp. 205–213

novice. 2002. Instructions for Effective Fertilization. Agromedia Pustaka, Jakarta

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Nuryani, S., Haji, M., and Widya, N. 2010. Nutrient Uptake of N, P, K in Rice Plants with Various Lengths of Use of Organic Fertilizer on Vertisols of Sragen. Journal of Soil and Environmental Science, Vol. 10 No. 1 p: 1 – 13.

Setyamidjaja, D. 2006. *Palm Oil* . Canisius Publishers. Yogyakarta.

Soekarno. (2002). Basic Principles of Agricultural Economics. Theory And Application. Second Edition. PT Raja Grafindo Persada. Jakarta.

Soewandita, H. 2008. Study of Soil Fertility and Analysis of Land Suitability for Plantation Commodities in Bengkalis Regency. Indonesian Journal of Science and Technology Vol.10 (2); 128-133

Sopandie, D. 2014. Physiology of Plant Adaptation to Abiotic Stress in Tropical Agroecosystems. IPB Press. Bogor.

Sposito, G. 2010. The chemistry of soils. Oxford Univ. Press., London.

Sufardi, Lukman, M., Muyassir. 2017. Cation Exchange on Several Soil Types in Dry Land, Aceh Besar District, Aceh Province (Indonesia). Proceedings of the 2017 Unsyiah Postgraduate National Seminar (SNP), April 13, 2017, Banda Aceh, Indonesia.

Tambunan, WA 2008. Study of Physical and Chemical Properties of Soil in Relation to Oil Palm (Elaeis guineensis Jacq.) Production in Kwala Sawit Plantation PTPN II. USU, Medan.

Tan, K.H. 1998. Basics of Soil Chemistry. Gadjah Mada University Press, Yogyakarta