Correlation Analysis Of Biological And Chemical Properties Of Soilin The Third Generation Of Oil Palm Plants At PT. Sinar Pandawa Labuhanbatu

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Abstract.

The mainstay commodity that can be expected to increase the income and dignity of plantation farmers and Indonesian transmigrants is Palm Oil (Elaeis Guinensis Jacq). Oil palm Soil microbes have an important role in the soil ecosystem which is responsible for the nutrient cycle to maintain soil fertility and structure, especially the biological properties of the soil. This research was carried out through 2 stages of activities, namely field activities and analysis activities. Stages of field activities were carried out at the Kebun Sinar Pandawa Palm Oil Plantation PT. Sinar Pandawa, Labuhanabtu, North Sumatra Province with a height of 28 meters. The method used in this research is a free grid measurement method at a semi-detailed survey level (observation frequency of 1 sample per 500 meters). Carrying out soil sampling at up to 5 sampling points with a distance of 100 meters in the field using a random method, spread over a predetermined area based on the base map. Research Results Land use with different vegetation produces different biological and chemical soil properties. Soil organic C was positively correlated with total microbial population, total fungal population, and respiration. The highest correlation between biological and chemical soil properties was obtained from the total microbial population with a total P of 0.714. The highest correlation was obtained from the correlation between organic C and total N levels, namely 0.947.

Keywords: *Sinar Pandawa, Generation 3, Biological Properties of Soil, Chemical Properties of Soil, Palm Oil and Nutrient Cycle.*

I. INTRODUCTION

Palm Oil (Elaeis Guinensis Jacq) is a mainstay commodity that can be expected to increase the income and dignity of plantation farmers and Indonesian transmigrants. Palm oil has apparently succeeded in becoming a commodity that can penetrate areas such as Kalimantan, North Sumatra and Lampung [1].The presence of vegetation has an influence on soil characteristics. Soil characteristics are produced by the interaction of the soil's physical, chemical and biological properties [2]. Each land use is inhabited by a variety of soil microbes with different roles [3]. Soil microbes have an important role in the soil ecosystem which is responsible for the nutrient cycle to maintain soil fertility and structure [4]. So that the presence of soil microbes can be used as a bioindicator of soil fertility. As a bioindicator, there are several criteria that need to be observed, such as soil respiration, C/N ratio, and total microbial population [5]. Soil fertility can also be determined through soil chemical indicators such as acidity [6]. Soil fertility is defined as the status of the soil in supplying nutrients in sufficient quantities for growth [8].

In connection with the function of land which is important for human life, it often undergoes modifications due to changes in priorities and needs from time to time. So policies are needed in land management to maintain the quality of the soil [9]. The diverse nature of soil is very determining in planning and managing land [12]. Improper land management has resulted in a reduction in microbial populations, biodiversity and reduced soil quality and fertility [10]. Therefore, information regarding the relationship between chemical and biological soil properties is very important for planning sustainable agricultural systems [11]. Based on the statement above, it is necessary to carry out this research to find out the correlation between the biological and chemical properties of soil in oil palm plantation areas inPT. Pandava Raysto provide information regarding the growth and development as well as the optimal potential of oil palm plants.

II. METHODS

This research was carried out through 2 stages of activities, namely field activities and analysis activities. Stages of field activities were carried out at the Kebun Sinar Pandawa Palm Oil Plantation PT. Sinar Pandawa, Labuhanabtu, North Sumatra Province with a height of 28 meters above sea level in Figure 1. Stages of laboratory activities, namely soil sample analysis carried out at the Soil Biology Laboratory, University of North Sumatra, Medan. The research was carried out in March-November 2023.

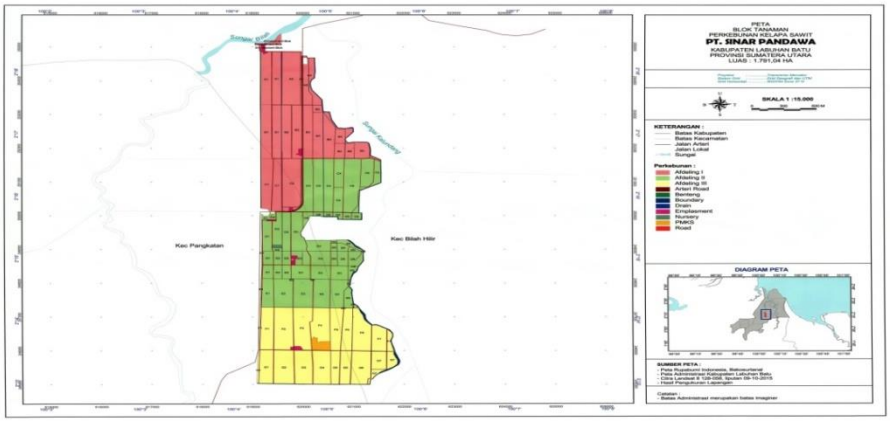

Fig 1. Research Location

The tools used include digital cameras, calculators, sieves, tarpaulins, polybags, sample rings, hoes used for digging soil, machetes, rulers, ovens, Erlenmeyer. The materials used in this research are Ultisol soil samples, biochar. , polybag, water.The method used in this research is a free grid measurement method at a semi-detailed survey level (observation frequency of 1 sample per 500 meters). Take soil samples from up to 5 sampling points with a distance of 100 meters in the field using a random method, spread over a predetermined area based on the base map as shown in Figure 3 [4].Sampling was carried out using a random sampling method at predetermined points in each block, sampling was carried out from two depths, namely from a depth of 0-30 cm and from a depth of 30-60 cm, 5 samples each at the same two depths for chemical content examination. explore the properties of the soil with certain predetermined criteria,

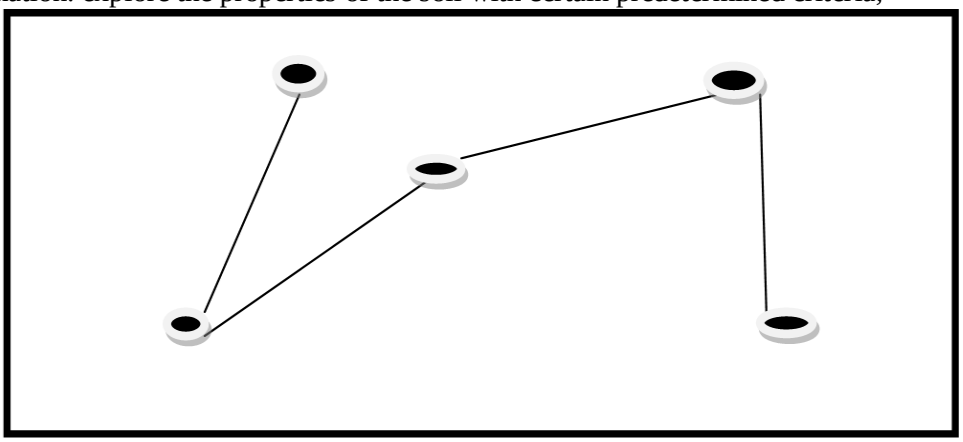

Fig 2. Taking soil sample points in the field

Observed Parameters

The parameters observed were soil pH using the electrometric method with a pH meter, C-organic using the Walkley and Black method, N-total using the Kjeldahl method, P-total and K-total using the 25% HCl extraction method, and the C/N ratio. The soil samples analyzed were air-dried soil. Analysis of soil biological properties includes Total Microbes (CFU/ml), Total Fungi (CFU/ml), Mycorrhizal Spore Density, Respiration. Total Microbial Population. and soil fungi were counted using the TPC (Total plate count) method. The first stage is making a dilution series, for Azotobacter sp. use dilutions 10-3 and 10-4 while for fungi dilutions are 10-4 and 10-5. Then 1 mL of the dilution result was taken and cultured in a petri dish using NFM (Nitrogen free mannitol) media for Mycorrhizal Spore Density. and PDA (Potato dextrose agar) media for fungal culture. Determination of soil respiration was carried out using the Verstraete method (1981).

Correlation test

The data obtained from laboratory analysis was then subjected to statistical analysis, namely a correlation test using Minitab 21 with the aim of measuring the strength of the two observed variables. Positive correlation (+) means that the values of the two variables are directly proportional. If the value of variable A increases, the value of variable B will also increase. Negative correlation (-) means that the values of the two variables are opposite or inversely proportional. If the value of variable A increases, the value of variable B will decrease.

III. RESULTS AND DISCUSSION

The results of land use analysis show that oil palm plantations have an acidic pH with very low levels of organic C and total N. The low organic C is caused by the type of soil, namely Ultisol, which is made from parent material*ypic haplduls*. Apart from being influenced by the parent soil material, organic C levels in the soil are also influenced by climate, namely temperature, especially rainfall [15]. In bamboo fields that have an acidic pH but only have medium C-organic content and low total N. Total N levels are low in bamboo fields because the soil type is predominantly sand. So that the soil on oil palm land has high aeration, the nitrogen in the soil will be leached more quickly.

Table 1. Soil Chemical Properties Parameters

Parameter	Land Location				
	I	II	III	IV	V
pH H2O	5.21 (m)	4.81 (m)	4.21 (m)	4.82 (m)	4.74 (m)
C-organic (%)	1.17(r)	1.17(r)	1.63(r)	1.85(r)	1.43(r)
N-total (%)	0.20(r)	0.25(s)	0.30(s)	0.75 (st)	0.45 (st)
C/N	10.85(r)	12.68(s)	8.77(r)	9.13(r)	9.23(r)
P-total (mg 100 g-1)	3.70 (sr)	8.33 (sr)	6.28 (sr)	6.57 (sr)	6.67 (sr)
K-total (mg 100 g-1)	1.55 (sr)	1.91 (sr)	1.83 (sr)	2.07 (sr)	2.17 (sr)

Soil carbon and nitrogen are major factors in various soil functions including biomass production[12].Through the mass ratio of carbon and nitrogen or C/N, the speed of the organic material decomposition process and nutrient immobilization in the soil can be determined[13].The C/N ratio value is inversely proportional to the availability of nutrients in the soil. If the C/N ratio value is low, the available nutrients in the soil are high. Table 1 shows that only sengon has a moderate C/N ratio. This means that most land uses have a fast rate of organic material decay and high nutrient availability. Phosphorus and potassium nutrients in five land locations have very low criteria.

Biological properties of soil

Soil microbes have an important role in the decomposition of organic matter and providing nutrients for plant growth [11]. So the total microbial population is often an index of soil fertility and environmental health[14]. Soil microbial populations will increase with favorable ecological conditions. Microbial abundance is largely determined by soil organic matter levels and environmental factors (pH, soil moisture, vegetation and temperature[13]. Apart from having a role as decomposers, soil microbes also play an important role in the soil N cycle and regulating the nitrogen available to plants[12]. Microbial growth is influenced by the availability of organic material, humidity and soil pH. Table 2 shows that the microbial population obtained was not too large.

Table 2. Soil Chemical Properties Parameters

No	Sample Code	Total Microbes (CFU/ml)	Total Mushrooms (CFU/ml)	Mycorrhiza Spore Density/50 gr	Respiration (mg CO2/day)
1	I	16×10^5	3.1×10^4	5	0.571
2	II	6×10^5	2.0×10^4	3	0.857
3	III	9.75×10^5	2.8×10^4	5	0.571
4	IV	11.05×10^5	34.5×10^4	8	0.971
5	V	4.0×10^5	33.5×10^4	12	0.514

The highest microbial population was found in land IV of11.05x 104 CFU g-1. The lowest population in bamboo fields was 6 x 104 CFU g-1. The low population on the bamboo land is equivalent to the total N content which has low criteria. The results of the research show that dragon fruit fields have the

highest fungal populations, namely34.5x 104 CFU g-1. The lowest population was obtained in bamboo fields, namely 0.37 x 104 CFU g-1. The high total population of fungi in dragon fruit fields is due to the environmental conditions on the land being supportive and having high levels of c-organic. Fungi do not have chlorophyll so they depend on organic material for their energy and carbon needs. Soil respiration is a measurement of microbial activity through measuring the CO2 produced. The results showed that most of the soil microbial activities did not differ much in different land uses. Land has the highest respiration. The lowest soil respiration was obtained in bamboo fields at 6.229 mg C-CO2 g-1 day-1. This microbial activity is the main factor in increasing the availability of plant nutrients in the soil through the process of decomposition of organic matter and mineralization[10]

Correlation between chemical properties and biological properties of soil

Correlation tests of soil biological and chemical properties show that microbial, fungal and spore populations and respiration values are most correlated with total soil P content. The correlation value for the total fungal population was highest with total N content of 0.427, while fungi had a negative correlation with pH and C/N ratio. This is in accordance with[16], which states that the correlation between the number of soil microbes in this study is that total fungi have low values for pH and the C/N ratio. Apart from that, soil organic C is also positively correlated with all parameters related to biological activity, namely Azotobacter population, total fungal population, and respiration. The highest correlation was obtained from the correlation between organic C and total N levels, namely 0.947. This is in line with research[17],which stated that the highest correlation was found between soil organic matter and nitrogen content.

Table 3. Correlation of soil chemical and biological properties.

Parameter	Total Microbes	Total fungi	Respiration	pH	C-organic	N-total	C/N	P-total	K-total
Azotobacter	1								
Total Fungi	0.315	1							
Respiration	0.11	0.134	1						
Ph	0.441	-0.124	0.192	1					
C-organic	0.023	0.345	0.192	-0.543	1				
N-total	0.054	0.427	0.225	-0.622	0.976	1			
C/N ratio	-0.136	-0.400	-0.018	0.145	-0.072	-0.333	1		
P-total	0.722	0.283	0.491	0.423	0.233	0.151	0.240	1	
K-total	0.038	0.243	0.012	-0.018	0.397	0.422	0.045	0.311	1

IV. CONCLUSION

Land use with vegetation in oil palm plantations at PT. Sinar Pandawa Labuhnabatu produce different biological and chemical soil properties. Soil organic C was positively correlated with total microbial population, total fungal population, and respiration. The highest correlation between biological and chemical soil properties was obtained from the total microbial population with a total P of 0.714. The highest correlation was obtained from the correlation between organic C and total N levels, namely 0.947.

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