Journal of Chemical Natural Resources Vol. 04, No. 02, 2022 | 126 - 131

JCNaR

Journal of Chemical Natural Resources

Determination of Copper and Zinc Content in Soil Based on Soil Position and Depth in Palm and Rambutan Garden Area

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Abstract. The determination of copper and zinc in soil based on the position and depth at the application land of palm oil in the Rambutan garden. Part of control land, between rorak and plant, and rorak at a depth of 0-20 cm, 20-40 cm and 40-60 cm. Each 3 g soil sample was destructed with 10 mL of HNO_3 concentrated at 180ºC for 20 minutes. Cu and Zn's content was determined using Atomic Absorption Spectroscopy (AAS) at wavelength 324,7 nm and 213,9 nm, respectively. The analysis shows that Cu and Zn metal increase rorak at 84.0% and 57.7%, and soil between rorak and plant at 76.9% and 42.4%.

Keywords: Destruction, Oil Palm, Application Land, Rorak.

Received [27 April 2022] | Revised [21 July 2022] | Accepted [14 August 2022]

1 Introduction

A large amount of palm oil production causes an increase in the weight of waste that must be disposed of. It is a problem for the environment, industry, and government. If this situation is not addressed, it will cause a decrease in the carrying capacity of the environment for the continuity of life caused by pollution. In this regard, efforts to manage and handle waste need special attention, even though palm oil mill effluent is organic and non-toxic.

According to Pamin et al. (1996), palm oil mill effluent that is not processed when it is channelled into river bodies or soil will cause water bodies or earth as receiving bodies to run out of dissolved oxygen which causes eutrophication for anaerobic organisms. This results in the death of aerobic water or soil organisms.

To deal with a large amount of palm oil waste, several plantations and palm oil mills have utilized this waste in plantation areas. The liquid waste is first processed in a ponding system. After a

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Journal Homepage: http://jcnar.usu.ac.id

decrease in pollution, this waste is channelled to plantation land (Land Application System), which aims to add nutrients to the soil (Loebis & Tobing, 1989).

In the rambutan oil palm plantation, before the land application (control soil) was carried out, it already contained metals. Factory liquid waste Oil palm also contains copper and zinc metals which are then channelled into oil palm lands, referred to as application lands. From the results of laboratory water quality testing for environmental quality testing in 2018, it was found that the content of copper metal was 0.01 mg/L and zinc metal was 0.004 mg/L in palm oil wastewater. Therefore, a study was conducted on the Determination of Copper and Zinc Content In Soil Based On Soil Position and Depth In Palm Oil Application Land In Kebun Rambutan to determine the addition of copper and zinc added to the application area.

2 Materials and Methods

2.1 Equipment

The tools used in this study include Atomic Absorption Spectrophotometry (AAS), aquades bottle, analytical balance, spatula, stir bar, plastic bottle, glass funnel, dropper pipette, measuring flask, glass beaker, volume pipette, oven, porcelain cup, desiccator, pestle and mortar, soil sieve, filter paper, hot plate.

2.2 Materials

In this study, material used were Oil palm empty fruit bunches, aquadest, yeast, $CuSO_4.5H_2O$, ethanol 99.9%, $Fe(NH_4)_2(SO_4)_2.6H_2O$, $FeSO_4.7H_2O$, glucose, $H_2SO_{4(c)}$, KH_2PO_4, $K_2Cr_2O_7$, $MgSO_4.7H_2O$, NaOH, Na_2SO_4, $HNO_{3(c)}$, $HCl_{(c)}$, $NaNO_3$, ferroin indicator, sodium citrate, sodium hypochlorite, potassium sodium tartrate, $Na_2HAsO_4.7H_2O$, $(NH_4)_6Mo_7O_{24}.4H_2O$, $NaHCO_3$, 1,10-O-phenanthroline.

2.3 Sampling Method

Soil samples were taken from oil palm plantations that were not drained by palm oil wastewater (control soil) and from application areas (rorak soil and soil between rakes and plants) based on the position and depth of the soil.

2.4 Drying of Soil Samples

Taken at a depth of 0-20 cm, 20-40 cm, 40-60 cm in control soil positions, between rorak and plants, and rorak soil. The drying process should not be carried out directly in the sun. The length of the drying process for each soil sample is different, and this depends on the type of soil sample.

2.5 Mash and grind the soil sample

The soil sample was pounded and crushed with a pestle and mortar. Then the soil sample was sieved with a size of 10 mesh. The sifted soil is then put into a beaker glass.

2.6 Preparation of Standard Copper Solution 100 ppm

A total of 10 mL of 1000 ppm copper mother liquor was put in a 100 mL volumetric flask and filled with 0.05N HNO_3 solution up to the marked line and homogenized.

2.7 Preparation of Standard Copper Solution 10 ppm

As much as 10 mL of 100 ppm copper solution was put into a 100 mL volumetric flask, filled with 0.05 N HNO_3 solution up to the marked line, and homogenized.

2.8 Preparation of Copper standard series solutions 0.00; 0.03; 0.05; 0.10; 0.30; 0.50; 0.80 and 1.00 ppm

As much as 0.00; 0.03; 0.05; 0.10; 0.30; 0.50; Put 0.80 and 1.00 mL of 10 mg/L copper standard solution into a 100 mL volumetric flask and fill with 0.05 N HNO_3 solution up to the marked line and homogenize.

2.9 Preparation of Standard Zink Solution 100 ppm

A total of 10 mL of 1000 ppm zinc mother liquor was put into a 100 mL volumetric flask, filled with 0.05 N HNO_3 solution up to the marked line, and homogenized.

2.10 Preparation of Standard Zink Solution 10 ppm

10 mL of zinc solution 100 ppm was put into a 100 mL volumetric flask, filled with 0.05 N HNO3 solution up to the marked line, and homogenized.

2.11 Preparation of Zinc standard series solutions 0.00; 0.02; 0.05; 0.08; 0.10; 0.20; 0.30 and 0.50 ppm

As much as 0.00; 0.02; 0.05; 0.08; 0.1 0; 0.2 0; 0.3 0, and 0.5 0 mL 10 ppm zinc standard solution was put into a 100 mL volumetric flask and filled with 0.05 N HNO_3 solution up to the marked line and homogenized.

2.12 Creation of Calibration Curve of Copper Standard

As much as 100 mL of 0.00 ppm copper standard series solution, the absorbance was measured using Atomic Absorption Spectrophotometry (AAS), and the same was done for λ=324,7 nm 0.03 copper standard series solution; 0.05; 0.1 0; 0.3 0; 0.5 0; 0.8 0, and 1.0 0 ppm.

2.13 Creation of Calibration Curve of Zinc Standard

As much as 100 mL of a 0.00 ppm zinc standard series solution, the absorbance was measured by Atomic Absorption Spectrophotometry (ASA) on λ=213,9 nm and carried out. the same for zinc standard series solutions 0.02; 0.05; 0.08; 0.10; 0.20; 0.30 and 0.50 ppm.

2.14 Determination of Copper and Zinc Content of Soil

A total of 3.00 g of dry soil sample <10 mesh was put into a 250 mL beaker glass, added 10 mL of HNO 3(p), then heated on a hot plate while stirring with a stirrer at 180°C for 20 minutes, cooled then added with 50 mL aquadest and then filtered using Whatman filter paper no.42 . The resulting filtrate was put into a 100 mL measuring flask, added with distilled water up to the marked line, and then analyzed using an atomic absorption spectrophotometer.

3 RESULTS AND DISCUSSION

3.1 Determination of Correlation Coefficient for Copper Metal

The intensity measurement results from a series of standard copper solutions were plotted against the concentrations of the standard solutions to obtain a calibration curve in the form of a linear line.

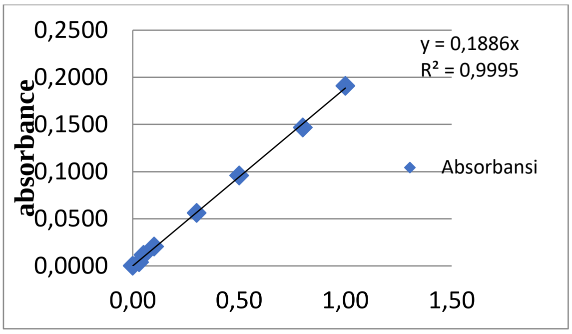

Figure 1. Calibration Curve for Copper Metal Standard Series Solutions (ppm)

3.2 Determination of Copper Metal Content

The calculation of mg/kg for soil samples is based on the following formula :

$$\frac{\text{content}\left(\text{mg—L}\right)\text{x desruction volume}}{\textit{mass of sampel}}\text{x } 10^6 \text{ mg/kg}$$

Notes: For the depth and position of the soil rake and the part of the soil between the rakes and plants, the same calculation is carried out.

3.3 Calculation Analysis of Copper Metal Content in Soil

Table 1. Copper metal content analysis in soil

Soil Position	Depth (cm)	Copper metal content (mg/kg)
control	0-20	0.4865
	20-40	0.4365

	40-60	0.3882
Between rorak and plants	0-20	1.9338
	20-40	1.9076
	40-60	1.8523
Rorak	0-20	3.0983
	20-40	2.7195
	40-60	2.3856

The results of the analysis using AAS are as follows Copper metal at a depth of 0-20 cm, 20-40 cm, and 40-60 cm for control soil = 0.4865 mg/kg; 0.4365 mg/kg; 0.3882 mg/kg for soil between layers and plants = 1.9338 mg/kg; 1.9076 mg/kg; 1.8523 mg/kg for rorak soil = 3.0983 mg/kg; 2.7195 mg/kg; 2.3856mg/kg.

Copper metal can enter all strata of the environment, whether in the strata of water, soil or air (atmospheric layer). Copper included in the environmental strata can come from a variety of sources. However, the sources of input of copper metal into the general ecological strata and it is suspected that the most are from industrial activities, household activities and the combustion and mobility of fuels. (Palar, 1994).

3.4 Determination of Copper Metal Content

The results of intensity measurements from a series of standard solutions were plotted against the concentrations of standard solutions to obtain a calibration curve in the form of a linear line shown in Figure 2.

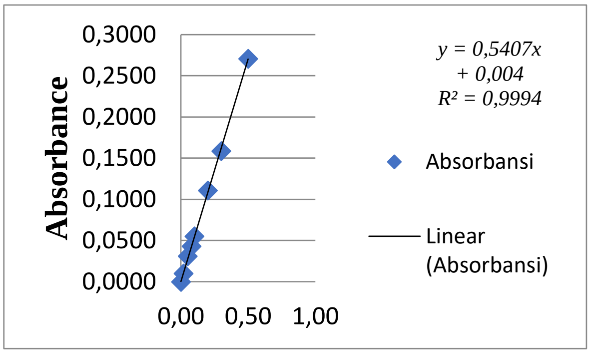

Figure 2. Zinc metal standard series solution calibration curve

Table 2 shows the content of copper and zinc is influenced by the position and depth of the soil in the application area due to the addition of liquid waste flow to the application area. Heavy metal pollution increases in line with industrial developments. Heavy metal pollution in the environment is due to its very high level of poisoning in all aspects of living things. At such low concentrations, the effects of heavy metal ions can directly affect their accumulation in the food chain.

Previous research entitled Palm Oil Waste Management (*Elaeis guineensis* Jacq.) at Angsana Estate, South Kalimantan, by Brury Marco Silalahi and Supijatno, 2017. This research was conducted in application land (rorak) and controlled land with a depth of 0-20 cm each; 20-40cm; 40-60cm; 60-80cm; 80-100 cm, and 100-120 cm. The content of Cu and Zn metals in the control area appears to be higher than in the application area for each depth. The application field occurs when complex organic bonds form chelates, namely bonds between metal cations and organic matter in ring structures (Hardjowigeno, 2003). This bond causes the metal cations to be protected by organic matter. In chemical reactions, they no longer function as cations, so their availability in the application area is lower than in the control field.

Table 2. Zinc metal content analysis in soil

Soil Position	Depth (cm)	Copper metal content (mg/kg)
control	0-20	2.7875
	20-40	2.7505
	40-60	2.7024
Between rorak and plants	0-20	4.8571
	20-40	4.8117
	40-60	4.6424
	0-20	6.6422
Rorak	20-40	6.6117
	40-60	2.7875

4 Conclusion

The content of copper metal in the soil from which the application liquid waste flows is increasing. In rorak soil, the metal increased by 84.0%; in the soil between rorak and plants, the metal increased by 76.9%. Next, the zinc metal content in the soil from which the application liquid waste flows increases. In rorak soil, the metal increased by 57.7%; in the soil between rorak and plants, the metal increased by 42.4%.

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