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ASSESSMENT ON SUITABILITY OF RAW AND COMPOSTED GRINDING SLUDGE FOR AGRICULTURE LAND APPLICATION

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ASSESSMENT ON SUITABILITY OF RAW AND COMPOSTED GRINDING SLUDGE FOR AGRICULTURE LAND APPLICATION

BY

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ENDORSEMENT

This project report entitled of Assessment on Suitability of Raw and Composted Grinding Sludge for Land Application is prepared by Izzah Afifah binti Ahmad Borhanuddin and submitted to the Faculty of Agriculture in the fulfillment of the requirement of PRT4999 (Final Year Project) for the award of the degree of Bachelor of Agricultural Science.

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ABSTRACT

This project was conducted to determine the suitability of raw and composted grinding sludge for land application. Grinding sludge is a waste product from the steel and bearing industries. SKF Bearing Industries (M) Sdn. Bhd produced about 480 tons per year of grinding sludge. The grinding sludge is disposed off landfill of Kualiti Alam Sdn. Bhd but the disposal cost is high. In order to utilize the waste, this experiment is conducted to investigate whether it is suitable for land application. However, raw grinding sludge may not be ideal by itself for land application. High concentration of Fe, Cr and Ni content in it may cause toxicity to human health. Therefore, composting the sludge with sawdust might help alleviate the metal toxicity problem. This study is conducted in Ladang 15's Glass house unit, Faculty of Agriculture, UPM. The experimental design for this study is Split Plot. For each set, there are 5 treatments (0, 2.5, 5, 10, 20 tons/ha) with 4 replications for SET A (raw grinding sludge), and there are also 5 treatments (0, 3.125, 6.25, 12.5, 25 tons/ha) with 4 replications for SET B (composted grinding sludge). The plant material used in this project is sweet maize variety (*Zea mays*) of Thai Super Sweet. The data collection for soil parameters were soil pH by using pH meter, soil organic matter, soil CEC, and soil EC. Determination of extractable Ni is by the DTPA Method. Determination of extractable Cr is by EDTA Method and determination of extractable Fe is by Dilute Double Acid Method, and total element content of Ni, Cr, and Fe were determined by the Aqua Regia Method. The plant tissues analysis is carried out to determine the total element content of Ni, Cr and Fe using Dry-Ashing Method. The significant difference between the treatments is analyzed using ANOVA test. Correlation analysis between soil parameter and plant analysis is conducted to see any correlation. From this study, it can be concluded that

composted sludge is more suitable on land application compared to raw sludge. Correlation study shows that there were some negative correlations. Soil pH and soil total C are negatively correlated with plant Ni concentrations. Based on overall results, the optimum rate of composted grinding sludge for land application is 3.125 t/ha. The highest yield was at this rate. There was no heavy metals toxicity problem with the application of composted sludge at this rate. The plant tissues analysis shows that Ni, Cr and Fe concentrations were still below the toxicity levels. However, the composted sludge that was applied at 3.125 t/ha gives almost the same result as the control. Since at rate 3.125 t/ha composted sludge gives the same results as the control, we can choose not to apply this sludge at. However, to reduce the disposal of this grinding sludge at the land fill, the raw grinding sludge must be composted before applying on land and only suitable to be applied at the rate of 3.125 t/ha.

ABSTRAK

Projek ini dijalankan untuk menentukan kesesuaian *grinding sludge* mentah dan *grinding sludge* yang telah dikompos apabila diaplikasikan pada tanah. *Grinding sludge* adalah bahan buangan daripada industri keluli dan logam. SKF Bearing Industries (M) Sdn. Bhd menghasilkan kira-kira 480 tan setahun *grinding sludge*. *Grinding sludge* yang terhasil dilupuskan di tapak pelupusan di Kualiti Alam Sdn. Bhd tetapi kos pelupusan tersebut adalah tinggi. Dalam usaha untuk mengurangkan kos pelupusan, projek ini dijalankan bagi mengetahui tahap kesesuaian bahan ini apabila diaplikasikan pada tanah. Walau bagaimanapun,*grinding sludge* mentah mungkin tidak sesuai untuk diaplikasikan pada tanah. Kandungan Fe, Cr dan Ni dalam *raw grinding sludge* boleh menjejaskan kesihatan manusia. Oleh itu, *grinding sludge* yang dikompos bersama dengan habuk kayu (*composted grinding sludge*) mungkin dapat membantu mengurangkan masalah tersebut. Kajian ini telah dijalankan di unit rumah kaca Ladang 15 Fakulti Pertanian, UPM. Reka bentuk eksperimen bagi kajian ini adalah Split Plot. Terdapat 5 rawatan (0, 2.5, 5, 10, 20 tan / ha) dengan 4 replikasi untuk SET A (*grinding sludge* mentah), dan juga 5 rawatan (0, 3.125, 6.25, 12.5, 25 tan / ha) dengan 4 replikasi untuk SET B (*grinding sludge* yang telah dikompos). Jenis tumbuhan yang digunakan dalam projek ini adalah varieti jagung manis (Zea Mays) Thai Super Sweet. Data bagi parameter tanah yang dikenalpasti ialah pH, bahan organik, KPK tanah, dan EC tanah. Kaedah DTPA digunakan untuk menentukan *extractable* Ni. Kaedah EDTA digunakan bagi penentuan *extractable* Cr. Penentuan *extractable* Fe adalah dengan kaedah *Double Acid.* Jumlah kandungan unsur Ni, Cr, Fe ditentukan dengan kaedah *Aqua Regia*. Analisis tisu tumbuhan dilakukan untuk menentukan jumlah kandungan unsur Ni, Cr dan Fe dengan menggunakan kaedah pengabuan kering (*dry ashing*). Perbezaan

ketara antara rawatan akan dianalisis menggunakan ANOVA. Analisis korelasi antara parameter tanah dan tumbuhan dijalankan untuk mendapatkan sebarang korelasi. Daripada kajian ini, dapat disimpulkan bahawa *grinding sludge* yang telah dikompos adalah lebih sesuai diaplikasikan ke tanah berbanding *grinding sludge* mentah. Kajian korelasi menunjukkan bahawa terdapat beberapa korelasi negatif. pH tanah dan kandungan C tanah dikaitkan dengan kepekatan Ni. Berdasarkan keputusan keseluruhan, kadar optimum *grinding sludge* yang telah dikompos untuk diaplikasikan ke tanah adalah 3,125 t/ha. Hasil tertinggi ialah pada kadar ini. Tiada masalah ketoksikan logam berat dengan penggunaan *grinding sludge* yang telah dikompos pada kadar ini. Analisis tisu tumbuhan menunjukkan bahawa kepekatan Ni, Cr dan Fe masih di bawah tahap ketoksikan. Walau bagaimanapun, *grinding sludge* yang telah dikompos yang digunakan pada kadar 3,125 t/ha memberikan keputusan yang hampir sama dengan keadaan yang dikawal (*control*). Oleh kerana pada kadar 3,125 t/ha *grinding sludge* yang telah dikompos memberikan hasil yang sama seperti keadaan yang dikawal (*control*), kita boleh memilih untuk tidak mengaplikasikan *grinding sludge* ini. Walau bagaimanapun, untuk mengurangkan kadar pelupusan *grinding sludge* di tapak pelupusan, *grinding sludge* mentah perlulah dikompos terlebih dahulu sebelum diaplikasikan ke tanah dan hanya sesuai untuk diaplikasikan pada kadar 3,125 t/ha.

CHAPTER 1

INTRODUCTION

Grinding sludge is a waste product formed from steel and bearing industries. SKF Bearing Industries (M) Sdn. Bhd produced about 480 tons per year of grinding sludge. Raw grinding sludge may not be ideal by itself for land application. The high concentration of Fe, Cr and Ni contents in it may cause toxicity to human health. Therefore, composting the sludge with sawdust might help alleviate the metal toxicity problem. The Fe, Cr and Ni contents in composted grinding sludge is slightly lower than the raw grinding sludge. Therefore, the composted grinding sludge may be more suitable for agriculture land application compared to the raw grinding sludge as soil amendement.

Maize (*Zea mays*) is from the family Gramineae with other cereal crops such as wheat, rice and sorghum. Maize is a monoecius plant that reproduced through pollination of cross-breed. Maize was originated from Central America and was introduced in Malaysia as sweet maize in the early seventies (70's). Sweet maize is a short-term crop that is popular among smallholders. Thai Supersweet is one of the sweet maize hybrid varieties. Hybrids have long been used for maize crops. There are three categories of hybrids that are commonly used in the commercial production of maize. The advantages derived from hybrid varieties have been proven, where the hybrid is capable of giving high and uniform yields.

1.1 Objectives

The general objective of this study is to determine whether composted grinding sludge is more suitable for land application.

The specific objectives are:

1. To determine the iron, chromium and nickel concentration uptake by maize plants applied with raw and composted grinding sludge.
2. To study the correlation between soil parameter with plant tissue content analysis.

1.2 Hypothesis

The composted grinding sludge is more suitable than raw grinding sludge for agriculture land application.

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