POTENTIALITY OF PALM OIL BIOWASTE WITH COW DUNG AND POULTRY LITTER FOR COMPOST PRODUCTION

By

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LIST OF ABBREVIATIONS

POBW	Palm oil bio waste
CD	Cow dung
PL	Poultry litter
T1	Treatment 1
T2	Treatment 2
T3	Treatment 3
T4	Treatment 4
T5	Treatment 5
T6	Treatment 6
T7	Treatment 7
T8	Treatment 8
EC	Electrical conductivity
MC	Moisture content
C	Carbon
N	Nitrogen
C: N	Carbon-Nitrogen ratio
TKN	Total Kejeldal Nitrogen
Ave	Average

POTENTIALITY OF PALM OIL BIOWASTE WITH COW DUNG AND POULTRY LITTER FOR COMPOST PRODUCTION

Abstract

Malaysia is the major palm oil producing country in the world. This industry generated many types of biomass including the mesocarp fiber, shell, empty fruit bunch (EFB), oil palm frond (OPF) and oil palm bark (OPB). The application of those biomasses for value-added purposes such as composting needs to be explored and investigated. As an ultimate objective, by using easily available biowaste resources, highly efficient compost is expected to be produced from oil palm biomass with proper elucidation of its characteristics and behavior, varying composting times and conditions. The objective of this study was to evaluate the effect of poultry litter (PL) and cow dung (CD) on composting process of palm oil biowaste (POBW) and to optimize the best ratio of palm oil biowastes and PL and CD in composting process. Palm oil biowastes (EFB and frond) were mixed with PL and CD in eight different ratios and moisture content adjusted to 40% for all treatments during the composting process. The content of compost bins were mixed appropriately and placed in shade for activating decomposition mechanism up to 11 weeks. Results showed that at 1:3 ratio of POBW and cow dung had the optimum qualities of C:N ratio (≤ 25). The electrical conductivity (EC) for mature compost was 2.83 mSm^{-1} while the optimum value was below 4 mSm^{-1} in this experimentation. The pH value of this treatment at the end of composting process was 7.92. The POBW with poultry litter at 1:3 ratio showed the C:N ratio was less than ≤25, EC for mature compost was 3.7 mSm^{-1}, and pH value was 7.35. Cow dung and poultry litter addition to POBW was beneficial for ensuring nutrient balance in the compost. Therefore, such compost was suitable for further application in agriculture.

POTENSI BIOJISIM KELAPA SAWIT BERSAMA-SAMA TAHI LEMBU DAN SISA TERNAKAN DALAM PENGHASILAN KOMPOS

Abstrak

Malaysia ialah negara pengeluar minyak sawit utama di dunia. Industri ini menghasilkan banyak jenis biojisim. Penggunan biojisim untuk tujuan tambah nilai seperti pengkomposan perlu diteroka dan diselidik. Sebagai satu matlamat akhir, dengan menggunakan sumber buangan bio yang boleh didapati dengan mudah, kompos yang amat cekap dijangka dapat dihasilkan dari biojisim kelapa sawit dengan keterangan yang tepat mengenai ciri-ciri dan tingkah laku biojisim yang berbeza-beza dengan bilangan kali pengkomposan dan syarat-syarat. Objektif kajian ini ialah untuk belajar kesan sisa ternakan (PL) dan tahi lembu (CD) pada pengkomposan proses sisa bio minyak sawit (POBW) dan menentukan nisbah terbaik bahan-bahan buangan bio minyak sawit dan PL dan CD dalam proses membuat kompos. Bahan-bahan buangan bio minyak sawit (EFB dan pelepah) diadunkan dengan PL dan CD dalam lapan nisbah berbeza dan kandungan lembapan dilaraskan kepada 40% untuk semua rawatan semasa proses membuat kompos. Kandungan tong-tong kompos yang dicampur dengan tepat dan diletakkan di tempat teduh untuk mengaktifkan mekanisme penguraian sehingga 11 minggu. Hasil menunjukkan, pada nisbah 1:3 POBW dan tahi lembu telah menunjukkan nilai optimum bagi nisbah C:N (≤ 25). Kekonduksian elektrik untuk kompos matang ialah 2.83 dSm-1 manakala nilai optimum ialah di bawah 4 dSm-1 dalam percubaan ini. Nilai pH rawatan ini pada akhir proses membuat kompos ialah 7.92. POBW dengan sisa ternakan pada nisbah 1:3 telah menunjukkan C:N kurang daripada (≤ 25) serta SPR untuk kompos matang ialah 3.7 dSm-1 and pH ialah 7.35, yang merupakan

paling hampir pH semula jadi. Tahi lembu dan sisa ternakan diadunkan dengan POBW bagi memastikan satu keimbangan nutrien dalam matriks kompos untuk aplikasi lebih lanjut dalam pengeluaran pertanian.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Growing concerns relating to land degradation, threat to eco-systems from over and inappropriate use of inorganic fertilizers, atmospheric pollution, soil health, soil biodiversity and sanitation have been rekindled the global interest in organic recycling practices like composting. The natural decomposition process in the soil is regulated and speeded up by human activities. Organic material is collected and preferably stacked in a heap where the decomposition process is more intensive and the conditions are more favorable, due to the heap is made up almost entirely of organic matter. The end product is strongly decayed organic matter with humus and nutrients. In general, this is known as compost. Compost is used as an organic fertilizer that added to the soil for improvement of nutrients and water holding capacity (Arslan et al., 2008).

The potential of composting to turn on-farm waste materials into a farm resources make it an attractive proposition (Kala et al., 2009). Inappropriate use of fertilizers accelerated good outputs for a mean time however in the long run showed bad impacts on soil, water and air as well as ecosystem. Farmers are interested to use chemical fertilizers and pesticides rather than organic fertilizers due to easily accessible and rapid growth response for plants however using organic fertilizers are useful to improve the physical, chemical and biological quality of soil. Continuance of inorganic fertilization caused to damage the soil structure, decrease in the organic material and finally reducing the soil aggregation strength, which restricted the

productivity of field crops. Therefore using of the organic fertilizers instead of chemical fertilizers should be as a culture (Hella, 2007; Ghoneim, 2008).

1.1.1 Compost

Composting is an aerobic process in which microorganisms convert a mixed organic substrate into carbon dioxide, water, minerals and stabilized organic matter under controlled condition, particularly moisture and aeration are required. (Bernal et al., 2009; Kala et al., 2009). This process has many advantages including sanitation, mass and bulk reduction and decrease of C/N ratio. The stabilized compost produced should benefit the plant growth and be suitable for agricultural applications (Hella, 2007).

1.1.2 Fertilizing

Fertilizing with compost means, apart from fertilizing the plants, also making use of the good properties of organic material as mentioned in the section above. Adding compost to sandy soils increase the water retention capacity. This means that water remains longer in the soil and thus remains available to plants for a longer time in periods of drought. All non-toxic, organic materials are used for making compost. Superfluous and/or waste materials are often applied and in this way made use of again or recycling resources (Santos, 2007).

Compost is an organic fertilizer which is made on the farm at very low cost (Inckel et al., 2005). Compost is decomposing organic matter, such as crop residues and/or animal manure. Most of these ingredients are easily found around the farm.

Due to soil fertility problems, crop returns often decrease and the crops are more susceptible to pests and diseases intensification due to inappropriate nutrients uptake as well as bad resistivity conditions. In order to increase soil fertility in the short run, nutrients have to be added to the soil. This is often done by applying chemical fertilizers, however, chemical fertilizers are expensive to purchase for most of the small and marginal scale farm level. Preparation and use of compost might be a solution to overcome that problem.

To really improve soil fertility in the long term, it is necessary to improve the soil structure and to increase the organic matter contents of the soil. Compost is a good organic fertilizer due to it contains nutrients as well as organic matter. Using compost as the only means to maintain soil fertility is possible, however in that case it needs a very large quantity of compost. It is advised to apply several practices at the same time in order to maintain the soil fertility in the long term. Some of these methods to improve soil fertility are such as crop husbandry methods including mulching, green manure, agro forestry and improved fallow. The other method is applying organic manures such as compost, liquid manure and animal manure. If animal manure is applied it should have matured for some time, other-wise it might damage the plants. Composting animal manure makes it a better organic fertilizer (Inckel et al., 2005; Sarwar et al., 2007; García-de-la-Fuente et al., 2011).

1.1.3 Compost Sources

Many agricultural by-products have little or no economic value and some, such as bark and sawdust, which are produced in large quantities in lumber mills, often present a disposal problem. If these byproducts could be used, as compost, both the

environment and agriculture would benefit, as contaminated streams would be cleaned, and a new market would be opened for the main industry. Most biomasses could be in the form of side-agricultural products, such as wastes from the production of wool, rice straw, coconuts shaving, peat, waste of tea leafs, shells of nuts or waste sugar production (Sharma and Forster, 1995). Various biomasses have been reported to show the ability for composting.

Malaysia is currently the world's largest producer and exporter of palm oil. Malaysia produces about 47% of the world's supply of palm oil (Sumathi et al., 2008). Figure 1.1 shows that Malaysia is the major palm oil producer country in the world (Mohammed et al., 2011). This industry generates many types of biomass such as the mesocarp fiber, shell, empty fruit bunch (EFB), oil palm frond (OPF) and oil palm bark (OPB) (Yacob et al., 2006). Figure 1.2 shows the types of biomass produced from oil palm tree (Mohammed et al., 2011). It is estimated that 184 million tones residues in the world and about 53 million tones of residues are generated from oil palm trees every year in Malaysia and it is increasing annually by 5% (Mohammed et al., 2011). Therefore, the application of those biomasses for value-added purposes such as composting needs to be explored and investigated intensively.

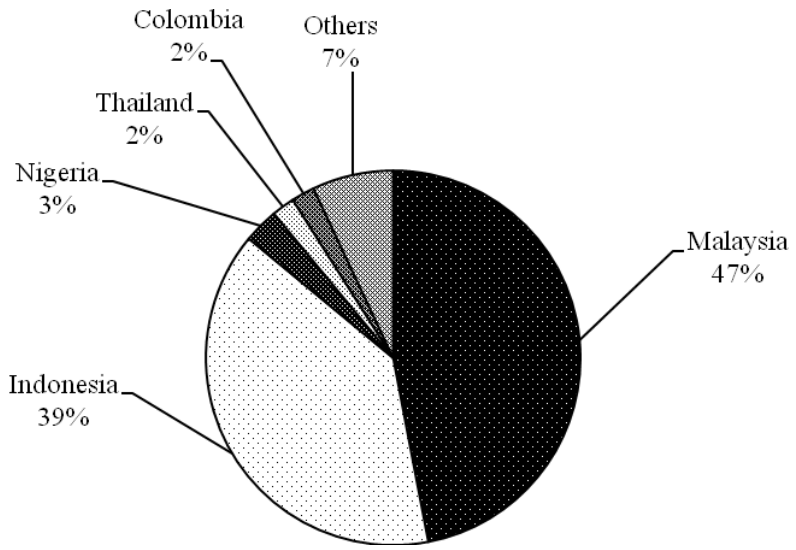

Figure 1.1 World palm oil productions in the year 2009 (Mohammed et al., 2011).

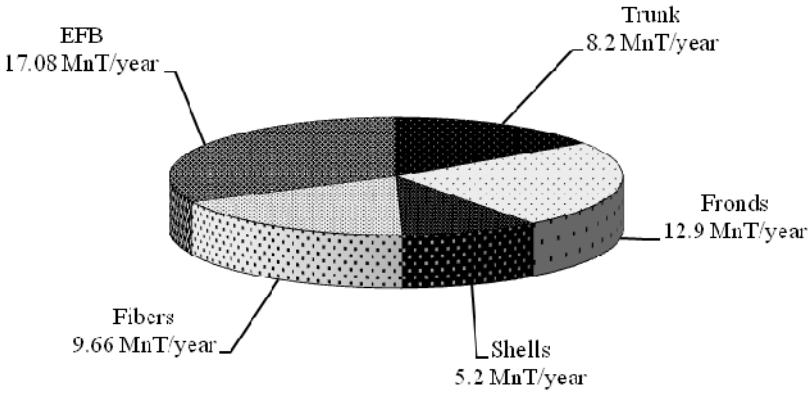

Figure 1.2 Types of oil palm biomass produce in Malaysia in 2009 in MnT/year (Mohammed et al., 2011).

The abundance and low cost of the oil palm biomasses show the justification for reusing of those by-products as potentially good for composting. Until recently, literature reports show that the use of oil palm biomasses as composting material requires more investigations. In recent years, more studies have been done on composting of palm oil bio waste which mixed with different substrate. It is required

to study effect of other substrates in various ratios with different conditions to find the best method and optimum condition for providing high quality compost. As an ultimate objective, highly efficient and low cost compost is expected to be produced from oil palm biomass with proper elucidation of its characteristics and behavior varying composting times and conditions (Sharma and Forster, 1995; Yacob et al., 2006).

1.1.4 Benefits of Using Compost

One of the direct benefits of composting waste material is providing a big savings by increase in farmers self reliance and thus, increases yields. Besides it also improves soil structure, water-holding capacity of the soil as well as improves aeration. Composting provides humus or organic matter, vitamins, hormones, and plant enzymes which are not supplied by chemical fertilizers and also acts as buffer to changes in soil pH. Composting phenomena could also kill pathogenic organisms, weeds and other unwanted seeds when temperatures are reached over 60 °C. Mature compost quickly comes into equilibrium with the soil. It has the ability to be blended or mixed with different materials which increases the nutrient content of the compost fertilizer (García-de-la-Fuente et al., 2011; Nawar, 2008).

1.2 Problem statement

Palm oil is one of the two most important vegetable oils in the world's oil and fats market. Oil palm is the most productive oil producing plant in the world, with one hectare of oil palm producing between 10 and 35 tones of fresh fruit bunch (FFB) per year and the processing of the oil releases some 2.5 tones (of effluents

into the water) for each ton of oil processed. The palm has a life of over 200 years, however the economic life is 20-25 years (nursery 11-15 months, first harvest is 32-38 months from planting and peak yield is 5-10 years from planting) (Igwe and Onyegbado, 2007).

Malaysia is the major palm oil producer in the world. This industry generates many types of biomass such as the mesocarp fiber, shell, empty fruit bunch (EFB), oil palm frond (OPF) and oil palm bark (OPB). The application of those biomasses for value-added purposes such as composting needs to be explored and investigated (Singh et al., 2010).

1.3 Objectives

This study is conducted to justify the following objectives:

- To study the effect of cow dung (CD) and poultry litter (PL) on composting process of Palm oil bio waste (POBW)
- To evaluate the effect of temperature, moisture, pH, EC, carbon and nitrogen on composting of POBW and the various mixture
- To determine the required time for mature composting of POBW and the various mixture

1.4 Scope of study

It is expected that through composting process this research should be revealed low cost compost from waste material. By studying different waste materials in

different mix combination and conditions, a good understanding will be developed on the reuse potential of those wastes as a composting raw material.

Variety of wastes including, paper mill sludge and hardwood sawdust, soil, poultry litter, cattle manure and vegetable waste, olive mill wastewater sludge and agricultural wastes has been applied on composting process. These materials are rich in nutrients and are a good source of compost. They would also provide a wide variety of microorganisms that would aid in the biodegradation of organic matter. In this study cow dung and poultry litter used as additional substrates to provide adequate nutrients and microorganisms in composting process. Furthermore these manures are low cost, easy available and also this is the way to manage and recycling the manures in farms.

1.5 Organization of Thesis

This thesis is contained five chapters, references and some appendices. The Chapter One highlights briefly the introduction of the research, the problem statement, objectives and the scope of the study. Literature Review which is mentioned as Chapter Two includes an overview of the reported results related to this study and the main basic knowledge about this research such as composting, methods of analyzing composts etc. Chapter Three is named Materials and Methods, includes descriptions on the materials, experimental procedures and instrumental analyses used in this study. This chapter is presented in great detail and arranged in such a way that other researchers will be able to repeat the experimental works based on the sufficient details. Discussions on the results generated in this project are covered in Chapter Four. This chapter is sectionalized into different parts to fully

cover the objectives of this study. In Chapter Five which is named as Conclusions and Recommendations, covers the overall conclusions based on results and findings made in the present study. Recommendations for future research based on the understanding and knowledge generated in the present study are also given in this chapter.