OBAFEMI AWOLOWO UNIVERSITY

EFFECT OF DIFFERENT ACTIVATORS ON THE COMPOSTING OF THRESHED PALM FRUIT BUNCHES

BY

TIMOTHY OKWUDILI CHUKWUDI

B. Sc. (Hons) MICROBIOLOGY ANAMBRA STATE UNIVERSITY, ULI

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POSTGRADUATE THESIS

AUTHOR: TIMOTHY OKWUDILI CHUKWUDI

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________________________ ________________________

Prof. Olu. Odeyemi Date

(Supervisor)

________________________ ________________________

Prof. G. O. Babalola Date

(Head, Department of Microbiology)

DEDICATION

This work is dedicated with profound gratitude to my beloved brother,

Mr Marcus Chukwudi, and my cousin, Mr Williams Onyia.

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Timothy Chukwudi.

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ABSTRACT

This study was undertaken to investigate the composting characteristics of threshed palm fruit bunch with different concentrations of poultry droppings, cow dung and *Gliricidia sepium* (Jacq.) as activators with the aim of generating quality soil conditioner.

Seven treatment piles of threshed palm fruit bunch comprising of threshed palm fruit bunch mixed with poultry dropping (1:1) (TPFB-P1), threshed palm fruit bunch mixed with poultry droppings (2:1) (TPFB-P2), threshed palm fruit bunch mixed with poultry dropping and *Gliricidia sepium* (2:1:1) (TPFB-PG), threshed palm fruit bunch mixed with cow dung (1:1) (TPFB-C1), threshed palm fruit bunch mixed with cow dung (2:1) (TPFB-C2), threshed palm fruit bunch mixed with cow dung and *Gliricidia sepium* (2:1:1) (TPFB-CG), and threshed palm fruit bunch alone (TPFB-CON), were set up for this study. During composting, several parameters including total bacteria and fungi count, the physicochemical properties [pH, temperature and elemental (N, P, K, Mg, Mn, Cu)], maturity and phytotoxicity index of each composting pile were measured using standard procedures.

The bacterial populations of the treatment piles were between 5 x 10^4 cfu/g and 2 x 10^8 cfu/g while the fungi populations were between 5 x 10^3 cfu/g and 9 x 10^6 cfu/g. There was diversity in occurrence of microbial populations of the various piles. TPFB-P1 attained the highest bacteria counts (2 x 10^8 cfu/g) jointly followed by TPFB-C1, TPFB-PG and TPFB-CG with bacterial counts of 1 x 10^8 cfu/g. TPFB-C1 attained the highest fungi count of 9 x 10^6 cfu/g. The control pile attained the least bacterial (2 x 10^7 cfu/g) and fungal counts (5 x 10^5 cfu/g). The temperature regime of all the composting piles ranged between 27 °C and 43 °C. TPFB-PG attained the highest temperature (43 °C). Maximum temperatures of 41 °C, 39 °C, 38 °C, 37 °C, 35 °C and 35 °C were attained by TPFB-CG, TPFB-P1, TPFB-C1, TPFB-P2, TPFB-C2 and TPFB-CON respectively. All the treatment piles showed an alkaline pH range

of 7.62 and 8.26 after composting. There was significance decrease of C/N ratio at the end of composting in all the composting piles with the lowest C/N ratio of 11.1 being observed in TPFB-P1 followed by TPFB-PG with C/N ratio of 13.6, while the highest C/N ratio of 28.9 was observed in TPFB-CON. TPFB-C1, TPFB-CG, TPFB-P2 and TPFB-C2 had C/N ratios of 13.8, 14.5, 14.6 and 19.8 respectively. The cured composts contained considerable varying amounts of elemental nutrients and very low levels of heavy metals. The phytotoxic evaluation of the various composts measured as germination index (GI) showed that all the composting piles have GI value greater than 60% which was indicative of their being none phytotoxic and suitable as soil conditioners. Except for TPFB-CON with CO_2 evolution of 39.6, the respiration test of the composts had CO_2 evolution that ranged between 17.4 and 32.1. All the generated composts significantly increased the growth of maize plant agronomically.

In conclusion, this study established that threshed palm fruit bunches could be converted into a very good organic fertilizer especially by composting them with the right proportions of poultry droppings, cow dung and *Gliricidia sepium*.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Instead of imitating nature's complex stability, industrial farmers use force, attempting to bend the naturally simplified ecosystem to their will. As a result, most agricultural districts are losing soil at a non-sustainable rate and produce food of lowered nutritional content, resulting in decreasing health of all life forms which depend on the products of farms. The high cost of synthetic fertilizers has greatly contributed to the recent global problems of food shortage most especially in the developing countries where most farmers could not afford the exorbitant prices of chemical fertilizers (Odeyemi, 1998). New technologies that can enhance the economic viabilreity of farming systems with little or no use of chemical fertilizers and pesticides are urgently needed and composts seem to be an important consideration to farmers especially in less developed countries.

Composting has been described as a viable means of transforming various organic wastes into products that can be used safely and beneficially as biofertilizers and soil conditioners (Odeyemi, 2011). Thus, composting offers several benefits such as enhancement of soil fertility and soil health which increase agricultural productivity, improve soil biodiversity and reduce ecological risks all of which provide a better environment. According to Atkinson *et al.,* (1997), composting can be used to stabilize many solid wastes and is, therefore, expected to increase substantially in many countries.

Composting may be applied to many waste products to release nutrients and render them safe to use (Jones and Martin, 2003). The end product of composting (compost) can be considered a soil conditioner that contributes to soil fertility, structure, porosity, organic matter, water-holding capacity, cation exchange capacity, and disease suppression, provided it is properly prepared (Sesay *et al.*, 1997; Zucconi *et al.*, 1981).

Recycling of organic wastes for agricultural purposes through appropriate biological treatments can produce valuable organic matter which can be of great interest to the farmers. Parr *et al.,* (1986) noted that when agricultural and municipal organic wastes are properly managed through composting, the end product (compost) has the capability of improving soil productivity which can lead to about 60 % food production increase worldwide. In fact, the end product of composting process has been shown to be the remarkably resistant and complex organic substance called humus (Keener *et al.,* 2000), which is largely responsible for the brown colour of the majority of soils in temperate regions

In Nigeria, the potentials for compost have been recognised long ago, but its exploitation has remained at rudimentary level, abandoned to peasant poor farmers and most of the potential biodegradable/compostable wastes are rather thrown away instead of converting them into valuable products (compost). Much of our wastes including food residues, municipal leaves, farm yard materials, agricultural wastes, human and livestock manure, form good materials for composting and consist of organic materials, all of which should be returned to the soil from which they originated.

One of the agricultural wastes commonly generated in Nigeria is the oil palm bunch refuse. Nigeria, as the third largest oil palm producing country after Malaysia and Indonesia, generates large amounts of wastes (threshed palm fruit bunches (TPFB), fibres/nuts, palm oil mill effluent (POME), trunk/fronds) during palm oil processing. Of all the aforementioned wastes, TPFB, the ligno-cellulose fibrous medium left after bunch stripping (removal of palm fruits), remains the most abundant of all these wastes (Baharuddin *et al*., 2009). While few of these wastes are used for heating, large amount are heaped in the open, where they not only constitute an eye sore but serve as a breeding ground for many dangerous insects, reptiles and rodents.

According to Saletes *et al*; (2004), a mill with a capacity of 60 tonnes fresh fruit bunches (FFB) per hour will thus produce almost 83, 000 tonnes of TPFB per year. Thus, in many oil palm plantations, producers have access to a plentiful supply of this waste material that can be converted into a valuable soil conditioner. In fact, the oil palm waste, which has been estimated from this industry at about seven million metric tonnes annually, is yet to be harnessed for the production of organic manures and agricultural development generally.

There is, therefore, a need to develop effective composting system to produce high quality soil conditioners from this waste product in order to ensure that the agronomic value of TPFB is put to the optimum and profitable use.

1.2 Aim and objectives

The aim of this work was to investigate the decomposition characteristics of oil palm bunch using poultry droppings, cow dung and *Gliricidia sepium* as activators. The specific objectives of this research, therefore, are to:

(a) determine the best concentration of activator among cow dung, poultry droppings and *Gliricidia sepium* for effective composting of threshed palm bunches;

(b) Isolate and identify the bacteria and fungi associated with the composting;

(c) determine the physico-chemical parameters, phytotoxicity and maturity of the end products of the composting mixes; and

(d) carry out the agronomic evaluation of the matured compost in the greenhouse.