SUCCESSION OF SOIL FAUNA DURING THE COMPOSTING PROCESS OF OIL PALM EMPTY FRUIT BUNCH

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Abstract

Succession of soil fauna during the composting the empty fruit bunches (EFB) of oil palm were studied. The research was conducted in a plastic house and the EFB taken from PTPN VII Rejosari. The fauna was enumerated by wet sieving methods. The results showed that The abundance of macro fauna, meso fauna, and micro fauna were changed over time during the composting process of EFB. Meso fauna was preferred and dominated to growth and decomposed EFB at the beginning of composting periods followed by meso fauna at the middle time, and micro fauna at the end of composting. The macro fauna abundance were dominated by beetles, caterpillars, diploda, coleoptera, and thysanoptera, while meso fauna were dominated by collembola, and acarina, and micro fauna were dominated by naked amoeba, flagellates, and ciliata

Keywords: *Macro fauna, meso fauna, micro fauna, succession, EFB.*

1. Introduction

The expansion of oil palm (*Elaeis guineensis* Jacq.) cultivation in Indonesia has been driven by strong world demand for food especially fats and oils. In the production of fats and oil, the plantations generate a large quantity of by-products, such as empty fruit bunches (EFB) and palm fronds. EFB is a suitable raw material for recycling because it is produced in large quantities in localized areas. These by-products are very difficult to decompose in natural condition although the EFB can be directly apply to soil for mulching or incorporating into soil (Lim and Rahman, 2002; Budianta et al., 2009). Composting EFB is a possible way to transform the bulky bunches into a valuable manageable product for use in the plantation because it would be able to provide some useful nutrients for growing plants or as market product.

Conventionally, composting is the aerobic process through which biodegradable organic materials undergo a partial mineralisation and profound transformations due to the metabolism of a complex microbial population. The result of such a process is a biologically stable and humified end product, the compost, which can be applied in agriculture. It has been thought that the micro organisms contributing to organic matter decomposition. Beside of micro organisms, soil fauna, that was classified into three group according to the body size, i.e. macro fauna (2.0 mm to 20 mm) which include termite, earthworms, ants, beetles, myriapods, and others macroarthropods, meso fauna (0.2 mm to 2 mm) including mainly microarthropods (collembolans and mites), and Enchytraeids, and micro fauna (body size less than 0.2 mm) with nematodes and protozoa (Lavelle and Spains, 2001; Coleman and Crossley, 2004) is responsible for decomposition, as well (Starbuck, 2006). The research on the composting of EFB has been conducted in many aspects (Thambirajah et al., 1995; Schuchardt et al., 2002; Lim and Rahman, 2002), however, monitoring of succession the soil faunal during the decomposition processes of composting of EFB is still limited and almost no information although the research on soil fauna from the viewpoint of soil ecology have been conducted by many authors (Huhta, 2007).

The purpose of the present study is to determine the abundance of soil faunal succession during the composting of EFB in a monitored process.

2. METHODS

2.1 Sample Preparation

Composting trials were conducted in Plastic House at Faculty of Agriculture, University of Lampung. EFB were taken from Rejosari (PTPN VII) Oil Palm Plantation. Before composting, EFB were chopped until 2–3 cm length and measured of water content. The chopped of EFB were entered into the composting funnel with the weight of 25 kg oven dry weight basis. Chicken manures and limes were added to each composting material as much as 2% of material weight and covered with black plastic. For maintaining the moistures at 75% of composting, thereafter container was watered every 7 days and mixed for maintaining from anaerobe condition. The compost trials were conducted in triplicates.

2.2 Soil Fauna Observations

Soil fauna successions were observed through fluctuating populations of fauna during the composting process of EFB. The abundance of soil fauna from compost samples were observed at the 2, 4, 6, 14, 21, 28, 35, 42, 49, 56, 63, 70, 77, and 84 days. The soil fauna from composting pile was sampled using a soils corer of 5,5 cm diameter and 8 cm height from three randomized point in three replications. Soil macro-, meso, and micro fauna in each sample were extracted by wet sieving methods and macro fauna was observed with bare-eyed where as meso- and micro fauna were observed in petri dishes, under stereo microscope with magnification of 20-40 times and collected animal stored with ethanol 70 for determined. Faunal abundance was expressed individuals per dm^3.

2.3 Temperature and Ratio C:N

The composting temperature was continuously monitored. Process temperature was determined every two days until six days and weekly after that by inserting the thermometer 25 cm deep into the pile or the composting EFB in the wooden box. Ratio C:N was measure every two weeks with Kjehdahl for total nitrogen and Walkley and Black Methods for C-total.

3. Results and Discussions

3.1 Macro Fauna

The macro fauna abundance were dominated by beetles, caterpillars, diploda, coleoptera, and thysanoptera. The abundance of soil macro fauna were changed during the composting periods (Figure 1). It was shown that macro fauna abundance maximum reached in the 21 days after composting process and declined after that time, then reached minimum number at 63 days and almost zero after that. In the initial of composting, raw material with high ratio C:N preferred by macro fauna, such as beetles, caterpillars, and larva of coleopteran. Macro fauna in the composting process have a role as regulators for microbial activity and as microbial feeders although their role dominated with physically activity (Brussaard, 1998).

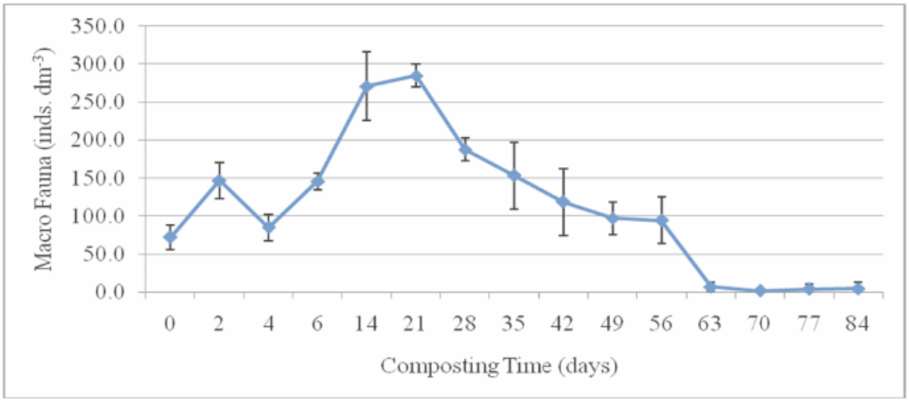

Figure 1. The fluctuation of soil macro fauna during the composting process of EFB.

3.2 Meso Fauna

The meso fauna abundance was dominated by collembola, and acarina. The abundance of soil meso fauna were changed during the composting periods (Figure 2). It was shown that meso fauna abundance reached maximum number in the 35 days after composting process and declined after that time, then reached a lower number at 49 days and almost zero number after that time. The abundance of meso fauna dominated in the composting process after the abundance of macro fauna depleting in concomitant with this time, texture of EFB were more broken than before.

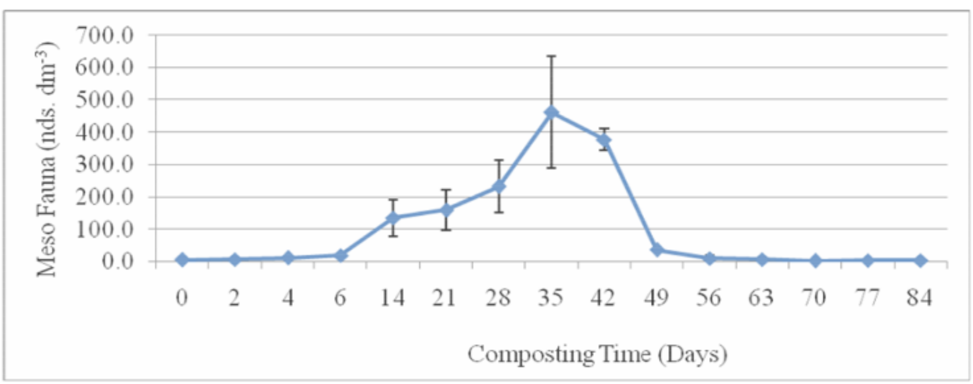

Figure 2. The fluctuation of soil meso fauna during the composting process of EFB.

3.3 Micro Fauna

The micro fauna abundance was dominated by naked amoeba, flagellates, and ciliate. The abundance of soil micro fauna was changed during the composting periods (Figure 3). It was shown that micro fauna abundance reached maximum number in the 42 days after composting process and declined after that time until lower in 56 days and increased at 63 days, then reached lower number at 70, 77, and 84 days. These micro fauna was dominated after macro- and meso fauna depleting in later decomposition.

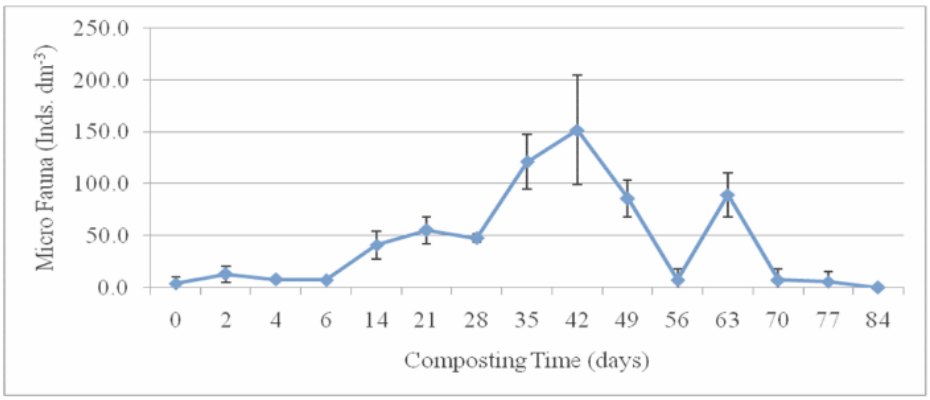

Figure 3. The fluctuation of soil micro fauna during the composting process of EFB.

3.4 Temperature

The heap temperature of during composting period is shown graphically through Figure 4.The highest temperature in the composting process of EFB was 42.67°C at 2 days after incubation and still more than 40°C until 7 days of composting. Temperature was start decreased on 15 days after incubation. The maximum temperature was only moderate value because of the observation in initial process was not every day or every hours. The other possibility was the height of compost pile was not enough for reaching maximum temperature. Normally, temperature in composting process grew up until 70°C (thermopillic stage) and gradually decrease in response to depleting food until it reached room temperature (Nakasaki et al., 2005; Schuchardt et al., 2002).

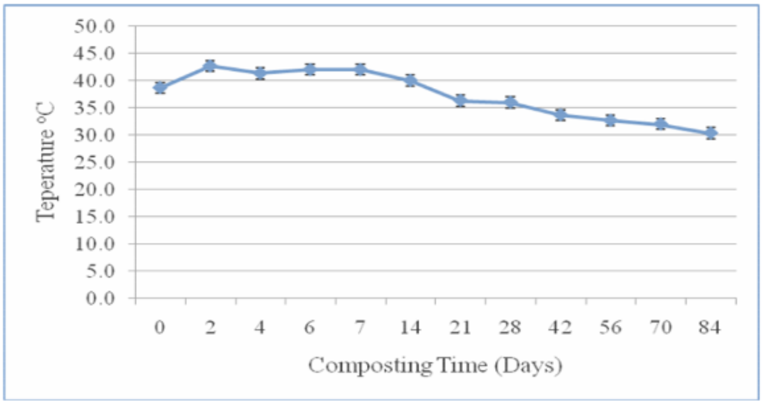

Figure 4. Temperature during composting of EFB

3.5 C:N Ratio

The fresh EFB had a higher initial starting C:N ratio (108.33) then significantly decreased to 45.67 after 84 days of composting. Figure 5 shows the C:N ratio during the composting process. The C:N ratio decreased slowly at the first 42 days and decreased fast after 42 days composting of the EFB material. This is evidence was caused by the fine material was occurred and then micro fauna have great preference to grow in this habitat as well in the fine material decomposition. In addition, the EFB material after 42 days decomposition was more easily to decompose by micro fauna in concomitant with micro flora.

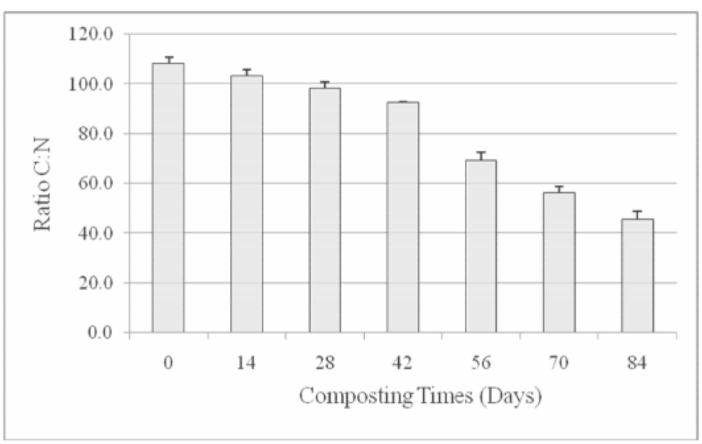

Figure 5. C/N ratio during composting of EFB

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4. Conclusion

The abundance of macro fauna, meso fauna, and micro fauna were changed over time during the composting process of EFB. Meso fauna was preferred and dominated to growth and decomposed EFB at the beginning of composting periods followed by meso fauna at the middle time, and micro fauna at the end of composting.

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