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Application of Xylanolytic Fungi Inoculum of *Aspergillus Tubingensis* R. Mossery in Bamboo (*Bambusa* Sp.) Litter Composting

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Abstract. Bamboo is a plant that is easily found in various regions in Indonesia. Bamboo leaves are abundant and usually difficult to decompose naturally, so they are usually only burned. In fact, bamboo leaves can be a good source of organic material if processed properly. One way that can be used to overcome these problems is composting. The purpose of this study was to determine the effect of *Aspergillus tubingensis* (xylanolytic Fungi) inoculum with corn medium on the bamboo litter composting process. This research was conducted in a Completely Randomized Design (CRD) with 4 treatments consisting of Control (bamboo litter only), T1 (bamboo litter + 1% inoculum), T2 (bamboo litter + 1.5% inoculum), and T3 (bamboo litter + 2% inoculum) with 3 replications in each treatment. Chemical analysis is carried out at the 4th, 8th, and 12th weeks of composting. The result indicates that application of xylanolytic fungi inoculum of *A. tubingensis* gives dynamic results to C, N, P, and C / N ratio of bamboo litter compost during weeks 4, 8 and 12.

Keyword: *Aspergillus tubingensis*, xylanolytic, inoculum, bamboo, composting

1. Introduction

Bamboo is one of the plants is easily found in Indonesia. There are around 10% of the world's bamboo species spread in Indonesia ranging from lowlands to mountains with altitudes between 0 – 2000 meters above sea level [21]. Carbohydrates are the main component of bamboo, which consists of lignocellulose in the form of lignin, cellulose, and hemicellulose in the form of xylan. The Composition of the three ingredients is more than 90%, with 50 – 70% holocellulose, 30% pentose, and 20 – 25% lignin [12].

Bamboo plants produce litter in the process of metabolism. Litter produced in the form of leaves and bamboo branches that fall on the ground, both intact and partially weathered [6]. Bamboo litter has a slow decomposition time due to the high carbohydrates contained in it. One alternative way that can be done to overcome this case is through the composting process. Composts is the results of fermentation of organic materials such as leaf litter or grass that occurs consistently with the final result in the form of humus [16]. Composting can be done with the help of activators such as microbes in a wet environment with warm temperatures and within a certain period of time. Activators play a role in accelerating the process of decomposition of organic matter.



Xylanolytic fungi are one of the xylanase-producing fungi that can be used as activators in composting. Xylanolytic fungi include *Aspergillus niger*, *Aspergillus tubingensis*, and *Aspergillus awamori* [7]. *Aspergillus tubingensis* is one of the xylanolytic fungi that has the highest xylanase enzyme activity, indicated by clear zone around the colony on solid media [9]. The xylanolytic enzymes produced function as xylan hydrolysis, so the compounds break down into simpler organic elements. Some organic elements produced are used by the fungus in the process takes place faster with quality results.

2. Method

This research was conducted in August to December 2019 in the Laboratory of Microbiology, Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung. The composting application is carried out at the Green House Laboratory of Botany, Department of Biology, Faculty of Mathematics and Natural Sciences, University of Lampung. Compost analysis was conducted at the Soil Science Laboratory, Department of Agrotechnology, Faculty of Agriculture, University of Lampung. This study uses a Completely Randomized Design (CRD) with 4 treatments, and 3 replications in each treatment. Inoculum production was carried out using corn as a growth medium for *Aspergillus tubingensis* isolate incubated for 14 days at 37°C.

The inoculum which had been calculated was then applied to litter composting by the composting method based on the modification of the Merisca [13] method, which is as follows:

K (Control) : 1 kg of bamboo litter + 500 g manure cattle

A (Treatment 1): 1 kg of bamboo litter + 500 g manure cattle + 1 % inoculum (15 g)

B (Treatment 2): 1 kg of bamboo litter + 500 g manure cattle + 1.5 % inoculum (22.5 g)

C (Treatment 3): 1 kg of bamboo litter + 500 g manure cattle + 2 % inoculum (30 g)

The isolates used came from collection microbiology laboratory of our college. The *Aspergillus tubingensis* isolate need to be rejuvenated before it was applied to the inoculum. This was done to obtain isolates of sufficient age. Compost quality testing is carried out at weeks 4, 8, and 12, by analyzing the levels of C, N, P, and the ratio C/N in compost. The parameters measured in this study were the levels of C, N, P, and the C/N ratio. The data obtained were analyzed descriptively and presented in tables and graphs.

3. Results and Discussion

3.1 Compost Carbon (C) Content

Compost C level in the 4th, 8th, and 12th weeks tends to increase, with the highest increase occurring in the 12th week (Figure 1). High levels of C can be caused due to microorganism activity that are not optimal, and the presence of microorganisms that experience a phase of death. The carbon available in compost piles cannot be completely degraded by microorganisms and is still bound to others [11].

Increased levels of C in this study indicate that the decomposition process is ongoing and has not found an optimal point. The results of the analysis indicate that there are still fluctuations in the decomposition process. However, C levels of compost has fulfilled the SNI standard SNI. 19-7030-2004, which is around 9,8 – 32% [3].

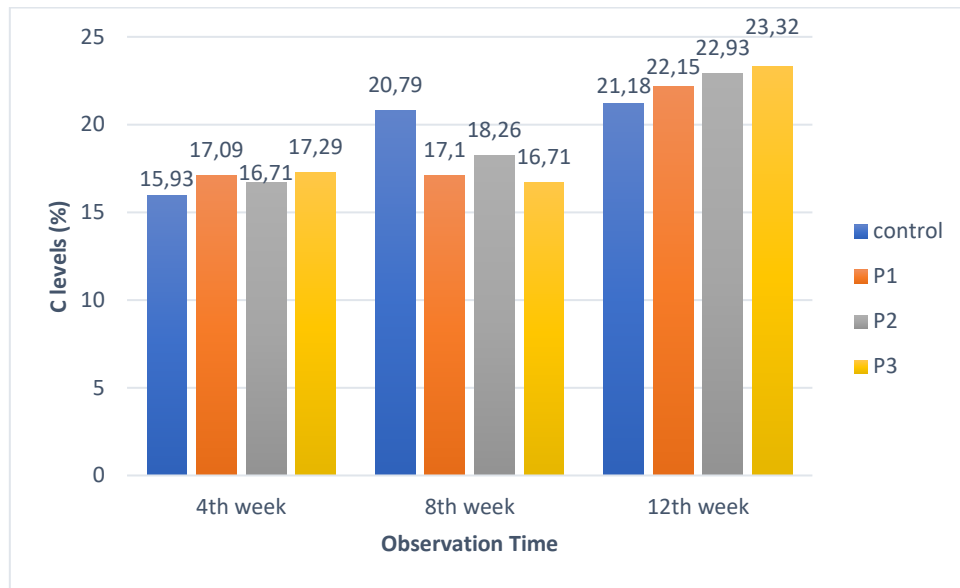


Figure 1. C Levels of Bamboo Leaf Compost at 4th week, 8th week, and 12th week

3.2 Compost Nitrogen (N) Levels

Nitrogen (N) is one of the important elements needed in the composting process as a raw material for protein synthesis. The higher the level of N in compost, the faster the organic material decomposes because the microorganisms that decompose compost material require nitrogen in its metabolic process [17]. Total N levels that are too low can result in reduced activity of microorganisms in compost. Total N levels affect the C/N ratio of compost produce, it can be used as an indicator to determine the feasibility of compost [10].

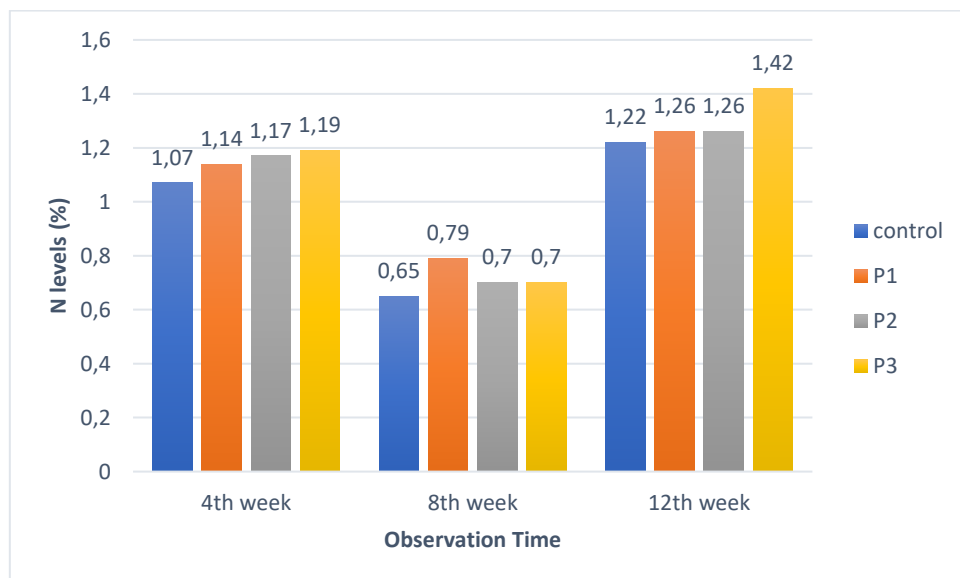


Figure 2. N Levels of Bamboo Leaf Compost at 4th week, 8th week, and 12th week

Total N levels in the 8th week decreased, and increased in the 12th week (Figure 2). This decreased is caused by the reaction of nitrogen with water to form NO₃⁻ and H⁺. NO₃⁻ compounds are very mobile, and very water-soluble, the NO₃⁻ reaction becoming N₂ and N₂O also causes the loss of N so that the water content can be reduced. Another function of compost reversal is to provide sufficient oxygen supply for microorganisms to break down protein into ammonia (NH₄⁺), and provide a good aeration process [19].

Increased levels of N in compost can be caused by the activity of microorganisms in the process of decomposition of compost material and produce ammonia and nitrogen [1]. This increase can also occur because the volatile solids or degraded organic material is greater than the volatilized NH [4]. According to [2], nitrogen levels initially decreased and then increased until the last week. Compost in this study was stated to have fulfilled the mature compost standard mentioned in SNI 19-7030-2004 which is > 0,4 %.

3.3 Compost Phosphorus (P) Levels

The results of the analysis of compost P levels at 8th week decreased, but increased again at week 12 (Figure 3). This decrease is caused by the activity of microorganisms that bind several types of nutrients in the body, one of which is phosphorus [14]. Phosphorus plays a role in the process of storing and transferring energy bonds in microorganisms. Fungi belonging to the genus *Aspergillus* has a high ability in dissolving P, so that it can be applied as a bio fertilizer [5].

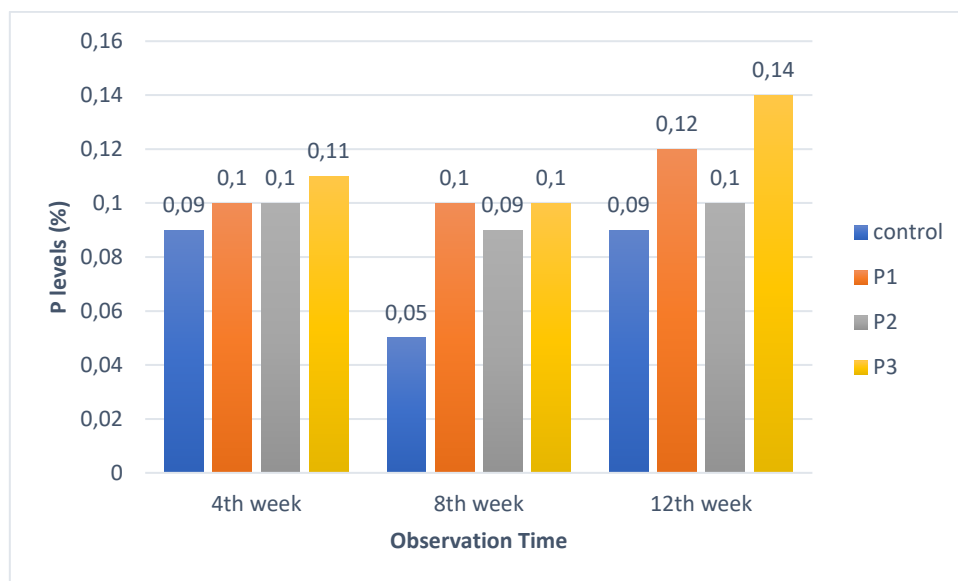


Figure 3. P Levels of Bamboo Leaf Compost at 4th week, 8th week, and 12th week

The nitrogen content in compost has an effect on the phosphorus content, the higher the nitrogen contained, the microorganisms that overhaul the phosphorus will increase so that there is an increase in the phosphorus content in compost [8]. Mature compost standard according to SNI 19-7030-2004 is >0,1 %. Compost with the addition of xylanolytic fungi inoculum *Aspergillus tubingensis* has P levels that already meet the standard of compost maturity compared to compost without the addition of inoculum. This is consistent with the statement of [15], that the addition of enrichment material to compost can increase the total P-content compared to unenriched compost.

3.4 Compost C/N Ratio

One of the chemical characteristics that can be used as parameters in the standard of compost maturation is the C/N ratio. Based on SNI 19-7030-2004, compost mature has a C/N ratio of 10 – 20%. The physical characteristics of mature compost are shown by the change in color to brown or blackish, smelly, and crumb-textured like soil [20]. Decrease in C/N ratio in compost occurs because of the lot of CO₂ release, whereas the release of N.

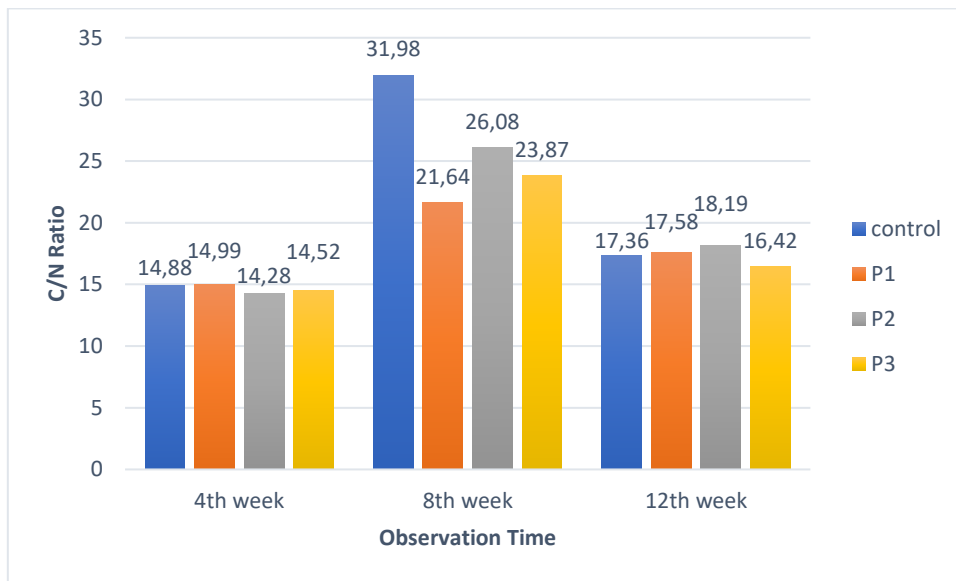


Figure 4. C/N Ratio of Bamboo Leaf Compost at 4th week, 8th week, and 12th week

Figure 4 shows that the compost C/N ratio increased at 8th weeks. This increase was caused by a decrease in compost N levels, and not followed by a decrease in C levels. According to [18], the longer the composting process is carried out, the smaller the C/N ratio. The results indicated that the C/N ratio had fulfilled SNI 19-7030-2004 which was 10 – 20%.

4. Conclusion

Aspergillus tubingensis xylanolytic fungi are able to grow well on corn media. The higher concentration of inoculum gives better results on N, P, and C/N ratio of bamboo leaf compost.

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