

# The Utilization of Coffee Husk Waste as a Eucalyptus Plantation Media for the Post-Mining Reclamation

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**Abstract**— The Eucalyptus plant (*Melaleuca cajuputi*) is useful as a producer of essential oils and is able to live in extreme areas such as post-mining land. PT Bukit Asam Tbk (PTBA) has produced this plant in large quantities to meet the needs of seeds to be planted in the reclamation area of a former mine by providing bocation fertilizer. The purpose of this study is to find the composition of a mixture of top soil and coffee husk waste for the growth of the seedlings. Based on the result of data analyzed based on Analysis of Varians (ANOVA), it is known that the research's results have a real influence so the BNT test was included for the further research.

**Keywords**— Coffee fruit skin, eucalyptus, , planting media.

## I. INTRODUCTION

PT Bukit Asam Tbk, hereinafter abbreviated as PTBA is one of the State-Owned Enterprises under Indonesia Mining Industry Holding (MIND ID) which operates in the coal mining sector, uses an open pit mining system as its production activities. The operational areas of PT Bukit Asam Tbk located in Tanjung Enim, Lawang Kidul Sub-district, Muara Enim Regency, South Sumatera with 3 IUP areas. The IUP areas are Tambang Air Laya (TAL) IUP, MTB IUP, and Banko Barat IUP.

An open pit mining's system can cause an environment change. According to a chemical matter, environmental changes have a direct impact to groundwater and surface water. The environmental changes also causing a physical change in morphology and topography. Besides the chemical and physical impact, the environmental changes can cause micro climate changes because of the change in wind velocity, flora and fauna's disruption, also resulting denuded land opening that reduce soil's productivities. (Listiyani, 2017)

When carrying out revegetation activities through planting and maintaining plants, it is necessary to make sure that the seeds are in a prime conditions to ensure that the reclamation plants can live and grow well according to the planned targets. To meet the nutrient requirements needed by plants, during sowing, the planting medium must be made with topsoil's soil and organic materials such as compost fertilizers or rice husks. However, the production of Kayu putih seedlings has begun to be hampered by a shortage of organic material, especially composite fertilizer.

Muara Enim Regency is one of the largest coffee producing areas in Indonesia. Since this area is a coffee-producing region, a lot of coffee skin waste is produced. Until now, this material has not been utilized optimally by the farmers even though it has a great deal of potential as a raw

material for organic fertilizer. With this large quantity and potential, coffee husk waste is predicted to be able to substitute the rice husks or other organic raw materials to become compost or planting media used for plant nurseries.

From the explanation above, this study will examine the effect of giving coffee fruit skin into planting media on the growth rate of Eucalyptus seedling in PT Bukit Asam Tbk Nursery.

## II. METHOD

### A. Place and Time

The research was carried out at Nursery location of PT Bukit Asam Tbk Tanjung Enim Mining Unit from September to October 2023.

### B. Tools and Materials

The tools used in the research are a stationary, tallysheet, camera, ruler, drill, small shovel, and a pair of scales. As the materials, this research used eucalyptus plant seedling seeds, water, polybags, soil, coffee fruit skin, and labels.

### C. Research's Plan

The treatment that studied was a total planting media composition of 6.25 kg. This research was planned in a Rancangan Acak Kelompok (RAK) with 5 treatments and 5 repetitions so there were 25 experimental units. The research plan is presented below.

K2U1	P2U1	K1U1	P3U1	P1U1
K1U2	K2U2	P2U2	P1U2	P3U2
P1U3	P3U3	K2U3	P2U3	K1U3
P2U4	P1U4	P3U4	K1U4	K2U4
P3U5	K1U5	P1U5	K2U5	P2U5

### D. Work Procedure

The work procedures that will be carried out in this research are described in the following explanation.

#### 1. Seedling Preparation

The eucalyptus seedlings used in the research have a ±3 cm height that come from seeds sown in the nursery. Eucalyptus seeds come from the environmental work unit of PT Bukit Asam Tbk in the nursery section.

#### 2. Planting Media Preparation

The planting media used in the research are coffee fruit skin and soil with a composition according to the treatment method.

3. Coffee Husk Addition

Coffee husk waste were added to the soil according to the dosage for each treatment.

4. Plantation

Eucalyptus (*Melaleuca cajuputi*) seedlings are ready to be transplanted, characterized by a seedling height of ± 3 cm and are ± 2 weeks old. Eucalyptus (*Melaleuca cajuputi*) seedlings are ready to be transplanted when they reach a 3 cm height and are 2 weeks old. The activity of weaning eucalyptus seedlings is carried out when it has reached a size of ± 3 cm.

5. Plant Care and Maintenance

The plant care and maintenance activities that have been carried out in this research are watering and weeds cleaning. Plants are watered when there is a little or no rain in the morning or evening. Cleaning the weeds around plants or planting media where weeds grow is done manually.

6. Observation

The activity begins by observing the physical and chemical properties of the initial soil as well as the pH scale, temperature, and nutrient content. Then proceed with observing the growth in height and increase in the number of leaves of eucalyptus plants for 4 weeks or 28 days.

7. Variables

This research will observe 3 (three) variables, namely: 1) Plant height from the root collar to the tip of the plant, 2) Number of new leaves; and 3) Physical and chemical properties of the soil.

III. RESULT AND DISCUSSION

A. The Analysis of Chemical and Physical Properties of Soil

According to soil’s physical and chemical properties on the Table 1, the analysis show the results in the form of a soil texture with the criteria for a sandy clay texture class, where the percentage of sand is 56.4%, 18% for dust, and 25.6% clay. Soil texture is one of the factors that influence a soil’s fertility.

TABLE I. Initial soil chemical and physical properties

No	Soil Properties	Unit	Analysis Result	Criteria
1	Soil Fractions			
	Sand	%	56,4	
	Dust	%	18	
	Clay	%	25,6	
2	Texture Class	-	-	Sandy clay
3	Temperature	°C	29°C	Fine
4	pH	-	4,83	Acidic
5	N-total	%	0,10	Very low
6	P-exist (P <sub>2</sub> O <sub>5</sub> )	mg kg <sup>-1</sup>	11,6	High
7	K-exist (K <sub>2</sub> O)	cmol kg <sup>-1</sup>	0,13	Very low
8	Mn	mg kg <sup>-1</sup>	12	Low

B. Plant’s Height

Eucalyptus plant height measurements were carried out once a week, starting from the beginning of planting until the 4th week after planted. There were 25 experimental units from 5 treatments and 5 repetitions. This research uses data on changes in plant height or delta data from the beginning of

planting until the 4th week after planting activities. The research used data on the changes of plant’s height or delta data from the start of planting until the 4th week after planting activity. The data tested is not absolute data, as the purpose is to figure out whether there was a significant increase in the plant height. Height is the vertical growth of plants which varies each day. The treatment with the highest plant growth is P2, where Eucalyptus plants grew around 17,02 cm in 4 (four) weeks.

From the results of Table 4.4 in the attachment, it is known that the value of  $F > F(\alpha; k-1; k(n-1))$ . This shows that H0 is rejected, which means there is a real influence from providing coffee husk waste as a growing medium for eucalyptus plants. The results of this research are in accordance with research by Hartati et.al., (2019) which states that the use of coffee husk waste at different doses has an effect on the height of *Vigna sinensis* L. plants, compared to media without coffee husk compost (control). This is proven by the results of the analysis or F test on the height of the *Vigna sinensis* L. plant at the age of 2 weeks after being given coffee husk compost, showing a F value of  $8.13 > F$  Table (4.07), while at the age of the plant 4 weeks after giving the husk compost. coffee showed an F count value of  $7.99 > F$  Table (4.07) and the 6th week after giving coffee husk compost showed an Fcount of  $14.34 > F$  Table (4.07).

TABLE II. The effect of treatment to the plant’s height

Treatment	Plant’s height (cm)
Control	10,10
P1	15,10
P2	17,02
P3	8,74
P4	6,42

To determine the influence of adding coffee husk waste as a growth medium for eucalyptus plants, the Beda Nyata Terkecil (BNT test) was performed. The results of the BNT test can be seen in table 4.5 in the attachment, The results reveal that the BNT test value from one treatment to the next is quite different. It can also be seen that P2 is the most optimal treatment, this is because the test value in treatment 3 shows the highest value.

According to Lakitan (2011), significant results in the height growth of coffee seedlings can be supported by the availability of nutrients needed by the plants so that plant growth is not hampered and is maximized. It is also stated that the plants who receive the N nutrient according to their needs will grow tall and have wide leaves (Falahudin et al., 2016).

C. Number of Leaves

Eucalyptus plant height measurements were carried out once a week starting from the beginning of planting until the 4th week after planting. There were 25 experimental units from 5 treatments and 5 repetitions. This research uses data on changes in the number of plant’s leaves from the beginning of planting until the 4th week after they were planted. The data tested aims to determine whether there was an increase in the number of plant leaves observed through this study’s treatment. The treatment that had a highest influence was P2 where the number of leaves increased by around 19 over 4 (four) weeks.

One of the factors that influences the variation in the number of leaves on eucalyptus plants is the quality of the soil. Table III. in the attachment explained that the dose treatment has a significant effect on the number of leaves. This is shown by the results of  $F > F$  table. Therefore, the analysis of the effect of giving coffee skin waste needs to be continued using the Least Significant Difference test (BNT test).

TABLE III. The effect of treatment to the number of leaves

Treatment	Number of leaves
Control	13,40
P1	15,40
P2	19,00
P3	13,60
P4	8,40

The BNT test was carried out to determine the amount of influence of adding coffee husk waste as a growth medium for eucalyptus plants. The results of the BNT test in Table IV, where most of the treatments show significantly different results. It can also be seen that treatment 3 is the best treatment, given that the test value in treatment 3 is the highest of all.

*D. Chemical Properties of Soil (pH, temperature, and nutrient)*

The observations of soil pH values were carried out with composite soil samples from 5 treatments and 5 repetitions. The soil pH value was measured once, at the end of the observation period, in the fourth week. The comparison of soil pH values in the treatments is presented in table iv.

TABLE IV. pH value, Temperatures, and Nutrients

Treatments	pH	N-total (%)	P-exist (mg kg <sup>-1</sup> )	K-exist (cmol kg <sup>-1</sup> )	Mn (mg kg <sup>-1</sup> )	Temperature (°C)
K (100% soil)	4,9	0,11	13,97	0,18	14,4	30
P1 (25% coffee husk + 75% soil)	4,9	0,1	14,18	0,32	14	32
P2 (50% coffee husk + 50% soil)	5	0,14	14,2	0,53	8,5	33
P3 (75% coffee husk + 25% soil)	5	0,12	14,56	0,64	9,3	34
P4 (100% coffee husk)	5	0,18	14,71	0,72	7,8	33

The soil pH value (soil reaction) is the degree or level of acidity or alkalinity of the soil, which is measured on a pH scale ranging from 0 to 14. The availability of soil nutrients to meet plant demands is greatly influenced by pH. Soil pH can affect plant development indirectly by influencing nutrient availability and the activity of living organisms in the soil.

In conditions of high soil pH, macro nutrients are frequently found. On the contrary, the high soil acidity result in low macro nutrients, which can activate amphoteric metals such as Al, Fe and Mn which are toxic to plants (Risniah et al., 2013). The liming activities can be used as an alternative to increase the pH value of the soil so it can fulfill the plant's nutrient requirements. Because nutrient availability is closely related to the pH value of the soil. It is necessary to check the pH value of the soil to determine whether the soil pH is suitable for planting eucalyptus plants.

Coal mining activities have a serious impact on ecological sustainability. The process of stripping topsoil results in the loss of primary macronutrients needed by plants. In line with research by Ma et al., (2019) where the upper layer has a lot of materials as the main source of storage and exchange of nutrients, so it can influence plant growth through nutrient availability.

IV. CONCLUSIONS

Based on the results of research on the use of coffee husk waste as a growing medium for eucalyptus plants in the context of reclamation of post-mining land, there are 2 (two) conclusions, namely:

- 1) The composition of the media has a significant effect on plant height and number of leaves of eucalyptus (*Melaleuca cajuputi*) seedlings. The best composition for growing plant height and increasing the number of leaves is 1:1 (for soil and coffee skin).
- 2) The treatment has an effect on improving the physical and chemical properties of the soil which maintains and increases the soil porosity, pH value, also the availability of Nitrogen, Phosphorus, and Potassium elements in the planting medium.

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