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The effect different times of fermentation oil palm empty fruit bunches and composition of planting media on the growth of amaranth

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Abstract

Oil palm empty fruit bunches (OPEFB) are underutilized waste. The combination of OPEFB fermentation and eggshell powder as a planting medium, aims to determine the effect of the combination of treatment differences in OPEFB fermentation time and composition of growing media on the growth of amaranth (*Amaranthus tricolor*). This study consisted of 6 treatment combinations, 4 replications, completely randomized factorial design method, with the parameters of plant height (cm), number of leaves (strands), and total fresh weight (grams). Data were collected at the age of 7, 14 and 21 DAP. Analysis of variance and the smallest significant difference test (BNT) level 5% were used. The results of the analysis showed that the composition of the growing media had a significant effect (Fcount > Ftable), From the results of the study, it was found that the most optimal treatment for the composition of the growing media was W2K3 treatment with a composition of 3 kg of soil, 20 grams of eggshell powder, and 200 grams of OPEFB fermentation for 21 days. The interaction factor of these two factors had a significant effect (Fcount > Ftable) on plant height 21 DAP (4.697 > 3.55).

Keywords: Amaranth (*Amaranthus tricolor*), Fermentation Time, Oil Palm Empty Bunches, Planting Media Composition.

Introduction

Data compiled from the Central Statistics Agency for North Kalimantan[1], it is noted that Bulungan Regency has oil palm plantations with an area of 58,290 hectares. The total area of 3,179 hectares of the total area is an oil palm plantation managed by PT. Sustainable Palm Oil Image. These plantations almost dominate most of the area in North Tanjung Palas District, Bulungan Regency. In addition, the oil palm plantation area is adjacent to residential areas. The lack of shelter and proper use of palm oil production results in waste in the form of empty palm oil bunches that are piled up in the plantation area. The smell of waste is a little disturbing for residents around the area.

Oil palm empty fruit bunches (OPEFB) are one of the main solid wastes in large quantities[2], as a result of processing palm oil. Oil palm empty fruit bunches (OPEFB) are part of the oil palm plant where fresh oil palm fruits are attached, their shape resembles clumped fibers. This OPEFB is no longer used after the process of separating the palm fruits from the bunch. However, this OPEFB can used as compost or planting media which is expected to improve the physical, biological and chemical properties of the soil[3].

Empty oil palm fruit bunches in the form of solid waste from the palm oil processing industry have the opportunity to be used as organic fertilizer or compost[4]. Through a series of studies, it can be seen that the nutritional content of empty oil palm fruit bunches includes 35% Carbon, 2.34% Nitrogen, C/N 15, Phosphate 0.31%, Potassium 5.53%, Calcium 1.46%, Magnesium 0.96%, and Water 52%[5].

EFB that has undergone decomposition is useful as a planting medium. OPEFB contains many nutrients[6] including N, P, K and Mg which play a role in plant growth and development, and is able to improve soil physical properties. Artificial decomposition through OPEFB fermentation with the help of microorganisms. In addition to increasing the organic elements of fermentation, it can also increase the acidity of OPEFB, so it is necessary to add dolomite lime to the growing media which functions to increase pH, increase the Ca and Mg nutrients needed by plants[7].

Eggshell waste can be used as a substitute for dolomite lime which is useful for increasing soil pH[8], thus helping to reduce acidity from OPEFB fermentation. In addition, eggshell powder also accelerates fermentation and the content of calcium compounds plays a role in stimulating the formation of root hairs and stimulating plant stems.

Addition powder shell egg on media plant help provide nutrients for plants to grow and develop. The composition of the growing media that has been adjusted can be applied to be used as a growing medium for various plants, especially vegetables. Vegetables are one of the main commodities that people need, so it is necessary to increase the production and quality of these vegetables. According to the Bulungan Regency Central Statistics Agency, seasonal fruit and vegetable production in Bulungan Regency in 2019 has doubled compared to 2018. Amarant has increased production from 21.64 quintals/hectare in 2018 to 68.10 quintals/hectare. hectares in 2019. It is proven that the people of Bulungan Regency have a high level of consumption in amarant, so it is necessary to increase amarant productivity to meet the needs of the community by using the right composition of planting media.

Based on the description above, it can be seen that OPEFB is still a waste that has not been used properly[9]. The application of OPEFB fermentation aims to increase organic compounds as a support for planting media, especially the growth of amarant plants as a vegetable commodity in Bulungan Regency. So there is a need for research on the effect of differences in fermentation time of empty fruit bunches of oil palm and composition of planting media on the growth of amaranth (*Amaranthus tricolor*) plants.

Materials and Methods

This type of research is an experimental research type, with a factorial Completely Randomized Design (CRD) method. There are 2 variables in the study, namely the independent variable and the dependent variable. The independent variable consists of different factors of EFB fermentation time (W) and planting media composition factor (K). The W factor consists of 2 levels, namely fermentation for 14 days (W1) and fermentation for 21 days (W2). The K factor consisted of 3 levels, namely K1 (control 3 kg of soil), K2 (3 kg of soil, 150 g of fermented EFB, 15 g of eggshell powder), and K3 (3 kg of soil, 200 g of fermented EFB, 20 g of eggshell powder). While the dependent variable was the growth of amarant (*Amaranthus tricolor*) which was influenced by independent variables, including plant height (14 DAP and 21 DAP), number of leaves (7 DAP and 21 DAP), and total fresh weight (21 DAP).

The population in this study was the entire population of amarant (*Amaranthus tricolor*), while the research sample was amarant (*Amaranthus tricolor*) which had been given a combination of treatments. The sampling technique in this research is simple random sampling (simple random sample). In this study, there were 6 treatment combinations including control and 4 replications, with a total of 144 plants and a total sample of 72 plants. The data obtained were analyzed using two-way analysis of variance (two way of Anova) with a level of 5%, then further tests were carried out, namely the smallest significant difference test (BNT) with a level of 5%.

The research was carried out in March 2021 – May 2021, on the Plantation Land of Panca Agung Village, North Tanjung Palas District, Bulungan Regency, North Kalimantan. The tools used in the research include stationery, pestle, basin, hoe, paint bucket, measuring cup, scissors, handspray, mortar, cellphone camera, machete, stirrer, polybag, soil tester, scales, and digital scales. While the materials used in the research include water, seeds of amarant (*Amaranthus tricolor*), bioactivator em4, eggshell powder, palm sugar, plastic cover, manure, soil, and empty fruit bunches of oil palm.

The experiment was initiated by fermenting OPEFB for 14 and 21 days in 2 different buckets, by mixing 3 kg of OPEFB pieces (+ 5 cm), 100 g of eggshell powder, and molasses (a mixture of 500 ml of palm sugar solution and 6 ml of Bioactivator EM4) to make one. Close the bucket tightly with a plastic cover. Moisture, pH, and OPEFB characteristics were measured once every 7 days using a soil tester. The composition of the growing media consisted of soil, EFB fermentation, and eggshell powder with a predetermined dose. The mixture of planting media is put into a polybag according to the dose on the label. Seeds of amaranth (*Amaranthus tricolor*) aged 14 DAP were transferred to the polybag. Around the research site, protective nets and plastic covers are used to avoid livestock and animals.

Results

Plant Height (cm)

Based on the analysis, a bar chart is presented showing the average height of amaranth (*Amaranthus tricolor*) aged 14 DAP and 21 DAP as shown in Figure 1.

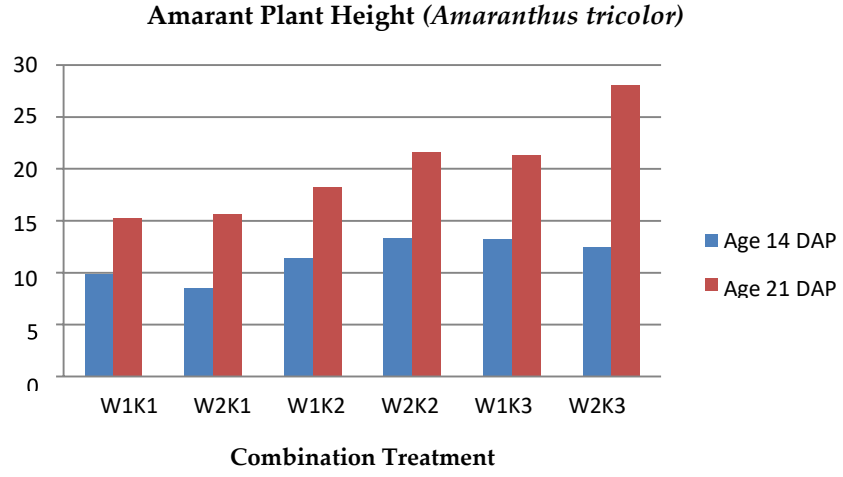

Figure 1. The diagram of average height of amarant plants (*Amaranthus tricolor*)

The data were analyzed using analysis of variance. Based on analysis of variance, the composition of the growing media had a significant effect (fcount > ftable) on the height of amaranth (*Amaranthus tricolor*) aged 14 DAP and 21 DAP. While the fermentation time factor and the interaction between the two factors had no significant effect (fcount < ftable) on amarant (*Amaranthus tricolor*) aged

14 DAP, but had a significant effect on amarant (*Amaranthus tricolor*) aged 21 DAP. So that the 5% level BNT test was carried out as shown in **Table 1**.

Table 1. Average plant height of amarant (*Amaranthus tricoloror*) with Treatment Factor

Treatment		Time Observation	
		14 DAP	**21 DAP**
Time Fermentation	**W1**	11.50	18.30[a]
	W2	11.43	21.70[a]
Composition of Planting Media	**K1**	9.2[a]	15.40[a]
	K2	12.35[b]	20.00[b]
	K3	12.85[b]	24.70[c]
Average		11.47	20.01

Note: Numbers followed by letters indicate the results of the 5% level BNT test.

Number of Leaves (strands)

Based on the analysis, a bar chart is presented showing the average number of leaves of amarant (*Amaranthus tricolor*) aged 7 DAP and 21 DAP as shown in **Figure 2**. The data were analyzed using analysis of variance. Based on analysis of variance, the composition of the growing media had a significant effect on the number of leaves of amarant (*Amaranthus tricolor*) plants aged 7 DAP and 21 DAP. While the fermentation time factor and the interaction between the two factors did not significantly affect the number of leaves of amaranth (*Amaranthus tricolor*). So that the 5% level BNT test is carried out as shown in **Table 2**.

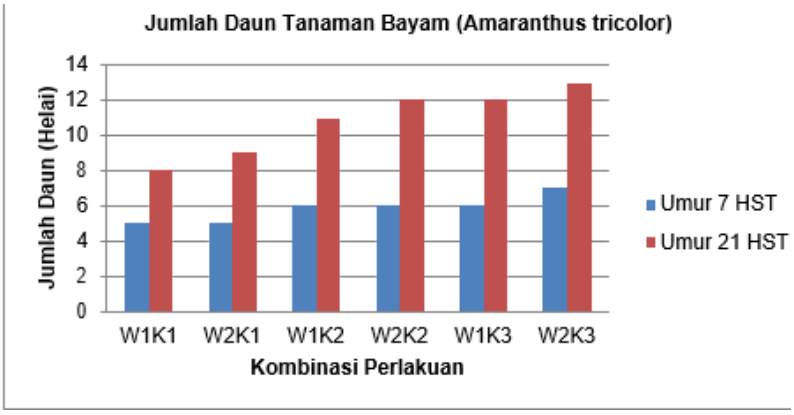

Figure 2. Diagram of average leaf number of amarant plants (*Amaranthus tricolor*)

Table 2. Average leaf number of amarant (*Amaranthus tricoloror*) with treatment factor

Treatment		Time Observation	
		7 DAP	21 DAP
Time Fermentation	**W1**	6	10
	W2	6	11
Composition of Planting Media	**K1**	5[a]	8[a]
	K2	6[a]	11[b]
	K3	7[b]	12[b]
Average		6	11

Note: Numbers followed by letters indicate the results of the 5% level BNT test.

Total Fresh Weight (gram)

Based on the analysis, a bar chart is presented showing the average total fresh weight of amarant (*Amaranthus tricolor*) at 21 DAP as shown in **Figure 3**.

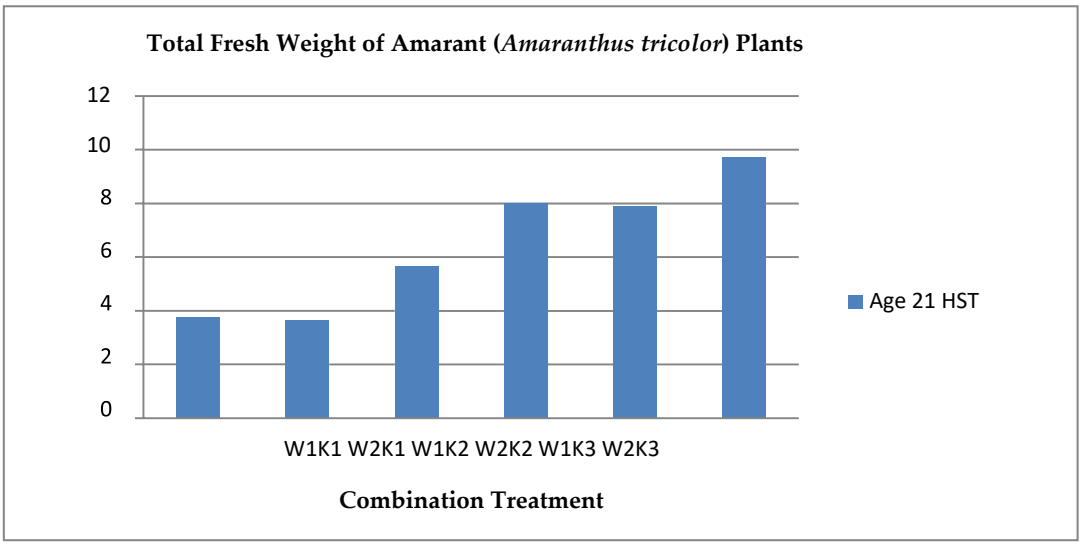

Figure 3. Diagram of average of average fresh weight of amarant plants (*Amaranthus tricolor*)

The data were analyzed using analysis of variance. Based on analysis of variance, the fermentation time factor and the composition of the growing media significantly affected the total fresh weight of amaranth (*Amaranthus tricolor*), but the interaction between the two factors had no significant effect. So that the 5% level BNT test is carried out as shown in table 3.

Table 3. Average Fresh Weight (grams) of Spinach (*Amaranthus tricolor*) with Treatment Factors

Treatment		Time Observation
		21 DAP
Time Fermentation	W1	5.80[a]
	W2	7.13[a]
Composition of Planting Media	K1	3.75[a]
	K2	6.85[b]
	K3	8.80[b]
Average		6.47

Note: Numbers followed by letters indicate the results of the 5% level BNT test

Discussion

Plant Height (cm)

Based on the BNT test at 5% level, the composition factor of the planting media with the highest value at the age of 14 DAP was found in the K3 treatment (12.85 cm) which was not significantly different from the K2 (12.35 cm) treatment. Meanwhile, at the age of 21 DAP treatment K3 (24.7 cm) had the highest value and significantly different from treatment K2 (20 cm). In the OPEFB fermentation time factor, the highest value was found in W2 treatment both at the age of 14 DAP (11.43 cm) and 21 DAP (21.7 cm), but it was not significantly different from W1 treatment. It can be concluded that the

combination of W2K3 treatment has the most effect on the height of amarant (*Amaranthus tricolor*).

The longer the OPEFB fermentation time and the more dosages of the composition of the growing media, the more nutrients available in the growing media to support the growth of amarant plants. This is in accordance with Warsito's statement[10], that the fermentation process of oil palm empty fruit bunches (OPEFB) will increase phosphorus and nitrogen compounds. The availability of nitrogen compounds helps cell activity, especially stem height, while phosphorus also helps cell division in plants[11] so that the plant stems will grow taller.

In addition to these two compounds, there are potassium compounds in OPEFB which help stimulate cells in the apical meristem so that plant shoot growth will take place properly. This is in accordance with Azlansyah's statement[12], that potassium compounds act as carbohydrate synthesisers for plants as a stimulant for apical meristems (shoots) and help absorb water by roots. Calcium compounds in egg shells also help strengthen cell walls[13] so that plant stems can grow strong. This is in accordance with the statement by Ernawati[14], that calcium has a function in plants to support and strengthen growth[15], especially cell walls in these plants.

Number of Leaves (strands)

Based on the BNT test at 5% level, the composition of the growing media factor on the number of leaves of amarant (*Amaranthus tricolor*) at the age of 7 DAP with the highest value was found in the K3 treatment (7 strands) which was significantly different from the K2 treatment (6 strands), as well as at the age of 21. The highest HST value was found in the K3 treatment (12 strands) which was not significantly different from the K2 treatment (11 strands). The fermentation time factor and the interaction factor had no significant effect on the number of leaves of the amarant plant (*Amaranthus tricolor*), but when analyzed the fermentation time factor with the highest value was found in the W2 treatment (11 strands) at the age of 21 DAP. Meanwhile, based on the average analysis, the W2K3 combination treatment had the highest average number of leaves, with 7 leaves at 7 DAP and 13 at 21 DAP.

K3 treatment with a media composition of 3 kg of soil, 20 g of eggshell powder, and 200 g of OPEFB fermentation, had a higher dose than the K1 and K2 treatments. It is suspected that the more the media dose, the more nutrients contained in the planting medium to support the growth of amarant (*Amaranthus tricolor*) plants. According to Atmaja[16], that through a series of studies it can be seen that the nutritional content of empty oil palm fruit bunches includes 35% Carbon, 2.34% Nitrogen, C/N 15, Phosphate 0.31%, Potassium 5.53%, Calcium 1 .46%, Magnesium 0.96%, and Water 52%. Nitrogen compounds help in the vegetative growth of plants[17], one of which is an increase in the number of leaves, as well as phosphate compounds (phosphorus) which stimulate cell division for the formation of leaf primodials.

The content of calcium compounds in eggshell powder helps support the growth of plant cell walls, so that the leaves on amarant plants (*Amaranthus tricolor*) can grow well and do not fall off easily. This is in accordance with Hasmeda's statement[18] that vegetables have a strong and crunchy structure, because calcium plays a role in strengthening cell walls, Calcium also plays a role in accelerating leaf growth[19].

Total Fresh Weight (grams)

Based on the 5% level BNT test on the total fresh weight of amarant (*Amaranthus tricolor*), the fermentation time factor with the highest value was found in the W2 treatment (7.13 grams) which was not significantly different from the W1 treatment (5.8 grams). While the composition factor of the planting media with the highest value was found in the K3 treatment (8.8 grams) which was not significantly different from the K2 treatment (6.85 grams). So that the longer the fermentation time and the more doses of planting media, the more influential it will be on the total fresh weight of amarant (*Amaranthus tricolor*) plants.

The compounds contained in OPEFB will increase during the fermentation process and become a source of nutrients to support the morphological growth of amarant. The growth of plant stem height and increased number of leaves will cause an increase in the total fresh weight of the plant. Phosphorus and nitrogen compounds that support plant and leaf height growth[20] continue to increase during the fermentation process in accordance with Warsito's statement[10], that the fermentation process of oil palm empty fruit bunches (OPEFB) will increase phosphorus and nitrogen compounds.

In addition, the more dosages of the composition of the planting media, the higher the nutrient content of the growing media. Such as magnesium compounds found in OPEFB can stimulate and help the photosynthesis process properly, so that the supply of oxygen, water, and nutrients can be delivered properly to all plant tissues. Plants will thrive. This is in accordance with Azlansyah's statement[12] that magnesium compounds in OPEFB are responsible for the photosynthesis process, if plants lack these compounds, their growth will be hampered.

The process of photosynthesis is closely related to calcium compounds contained in eggshell powder, which helps stimulate the growth of root hairs to absorb nutrients and water as material for plants to carry out photosynthesis. This is in accordance with the statement of Azlansyah[12], that calcium compounds help strengthen stems[20] and stimulate the growth of root hairs in plants.

Conclusions

Based on the research that the difference in OPEFB fermentation time has a significant effect (Fcount > Ftable) on the growth of amarant (*Amaranthus tricolor*) plants which include plant height at 21 DAP and total fresh weight at 21 DAP. However, it had no significant effect (Fcount < Ftable) on plant height at 14 DAP, and number of leaves at 7 and 21 DAP. Meanwhile, the composition of the growing media had a significant effect (Fcount > Ftable) on the growth of amaranth (*Amaranthus tricolor*) which included all parameters of plant height, number of leaves, and total fresh weight. There is an optimal dosage of the composition of the growing media for the growth of amarant (*Amaranthus tricolor*) plants, namely the combination of W2K3 treatment consisting of 3 kg of soil, 20 grams of eggshell powder, and 200 grams of OPEFB fermentation for 21 days.

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Conflicts of Interest

There are not potential conflicts of interest.

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