RESPONSE OF FROM OIL PALM EMPTY FRUITS AND EM-4 COMPOSTING ON TOP SOIL MEDIA TO VEGETATIVE GROWTH OF COCOA (*Theobroma cacao* L.)

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Abstract. This research has been carried out at the UISU Agricultural Experimental Field, which is located at Gedung Johor Jln Karyawisata Medan, with height the place ± 25 masl. This research was started from February to April 2016. This study used a factorial randomized block design (RBD) with two factors. The treatments are: Factors for giving palm oil empty fruit bunch compost with various comparisons, namely : K_0 = 0 Control, K_1 = Topsoil : OPEB Compost (2 : 1), K_2 = Topsoil : OPEB Compost (2 : 2) , K_3 = Topsoil : OPEB Compost (2 : 3). EM-4 administration factor namely : M_0 = 0 Control , M_1 = 5 ml/l water, M_2 = 10 ml/l water. Observed parameters is plant height, stem diameter, number of leaves, wet weight and heavy dry plants. Results study show that the application of Oil Palm Empty Fruit Bunches had no significant effect on all observed parameters. Application of EM-4. solution no significant effect on plant height, stem diameter , number of leaves, wet weight and heavy dry plants. Application oil Palm Bunch Empty (OPEB) compost and EM-4 and the combination of the two treatments had no significant effect on all observed parameters.

Keywords : OPEB Compost, EM-4, Cocoa

INTRODUCTION

The development of cocoa *(Theobroma cacao* L. *)* can be seen in terms of the area planted and its contribution to the state as an export commodity. Until 2006, the area of cocoa plantations in Indonesia was 1.19 million ha, with a composition of 92.8% being smallholder plantations with an average area expansion growth of 7.4% per year. The expansion of this area aims to utilize natural resources, meet consumption and earn foreign exchange for exports, as well as increase the income of cocoa bean producers. Only 70% of the area is a productive plant because in general cocoa plants in Indonesia are over 25 years old. Indonesia actually has the potential to become a major producer of world cocoa if the main problems faced by cocoa plantations can be addressed and managed properly (Siregar *et al.* 2010).

Nurseries are a series of activities to obtain good cocoa seeds for planting in the field. Good seeds require sufficient nutrients and are available during growth. One of the efforts that need to be done is to fertilize and provide organic matter. The fertilizer given can be in the form of organic fertilizer or inorganic fertilizer into the nursery media. Propagation of cocoa can be done by vegetative and generative ways. Until now, cacao propagation is mostly done in a generative way because it can produce large amounts of seeds. The generative propagation of cocoa is more profitable in maintaining seedlings, as well as stronger roots (Maryani, 2011).

Plant material is one of the most important factors that determine the success of cocoa cultivation. The genetic interaction of superior planting material with an optimal environment will result in optimal plant growth as well. In Indonesia, the majority of planting material developed on

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smallholder plantations is very diverse and the source is unclear. This is the cause of the failure of cocoa cultivation. To overcome this problem, many recommended varieties or clones have been developed , such as the Lindak cocoa type (Fahmi, 2009).

Incomplete macronutrients and micronutrients can cause obstacles to plant growth and development and have a direct effect on plant productivity. The incompleteness of one or more of the macro and micro nutrients can be overcome by balanced fertilization and the addition of organic matter (Sutedjo, 2008).

Oil Palm Empty Bunches (OPEB) can be used as a source of organic fertilizer that contains nutrients needed by soil and plants. The role of oil palm empty fruit bunch compost on the soil is to bind the soil grains into larger grains and crumbs so that the soil becomes more friable so that root growth and development will be optimal. While its role in plants is to stimulate growth and root development to grow optimally (Yani, 2010).

Oil palm empty fruit bunch compost contains nutrients needed by soil and plants (Yani, 2010). Nutrient content of Empty Oil Palm Fruit Bunches (OPEB) compost is 45-50%, Ash 12.60%, N 2-3%, C 35.10%, P 0.2-0.4%, K 4-6%, Ca 1-2%, and Mg 0.8-1.0%. In addition, empty fruit bunches compost also has a high potassium content, so it can enrich the nutrients in the soil and also improve the physical, chemical and biological properties of the soil (Anonymous, 2009).

In the 1980s, *Prof. Dr. Teruo Higa from the University of The Ryukus, Okinawa, Japan* has conducted research on a group of microorganisms that can effectively be useful in improving soil conditions, suppressing the growth of microbes that cause disease and improving the efficiency of using organic matter by plants. This group of microorganisms is called *Effective Microorganisms* which is abbreviated as EM. (Higa, 1980)

The EM technology that has become familiar with the community is *Effective Microorganisms-4* , commonly abbreviated as EM-4, is a mixed culture of several microorganisms that can be used as microbial inoculants that function as a biological control tool. These microorganisms function in the plant environment as a suppressor and control of the development of pests and diseases (Higa, 1980).

RESEARCH METHOD

This research has been carried out at the UISU Agricultural Experimental Field, which is located at Gedung Johor Jln Karyawisata Medan, with height the place ± 25 masl. This research was started from February to April 2016.

The material used is seed Cocoa clone UF 667, EPEFB compost, EM-4 , polybag 3 kg , bamboo , midrib coconut palm , Decis 2.5 EC and Dithan e M-45 80 WP. The tools used are hoes, machetes, gembor, meter and others.

This study used a factorial randomized block design (RBD) with two factors. The treatments are: Factors for giving OPEB Compost with various comparisons , namely : K_0 = 0 Control, K_1 = Topsoil : OPEB Compost (2 : 1), K_2 = Topsoil : OPEB Compost (2 : 2), K_3 = Topsoil : OPEB Compost (2 : 3). EM-4 administration factor namely : M_0 = 0 Control, M_1 = 5 ml/l water, M_2 = 10 ml/l water.

RESEARCH RESULT AND DISCUSSIONS

RESULTS

1. Plant Height (cm)

The results of the analysis showed that OPEB Compost and EM-4 as well as the interaction of the two treatment factors had no significant effect on the height of cacao seedlings at the age of 10 WAP.

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Table 1 . Average Cocoa Plant Height (cm) In Treatment of OPEB Compost and EM-4 On Age 10 WAP .

Treatment	EM-4			Average
	M_0	M_1	M_2	
OPEB Compost				
K_0	24,67	25,11	23,33	24.37
K_1	24.89	26,67	26,00	25.85
K_2	25,44	23,00	25.67	24.70
K_3	23,22	26,67	26,33	25.41
Average	24.56	25.36	25,33	

Description: Numbers that are not followed by letters showed no significant difference

In Table 1 it can be seen that the addition of OPEB compost did not significantly affect the height of the cocoa plant. However, there was a tendency for higher OPEB compost applications to be obtained in the Topsoil treatment: 2:1 OPEB Compost (K_1) which is 25.85 cm, Topsoil: 2:3 OPEB Compost (K_3) which is 25.41 cm, Topsoil: OPEB Compost 2:2 (K_2) is 24.70 cm, and 0 Control (K_0) is 24.37 cm. The treatment of giving EM -4 also did not significantly affect the increase in height of cocoa plants. Higher EM-4 application results were obtained in treatment M_1 (5 ml/l water) which was 25.36 cm, M_2 (10 ml/l water) was 25.33 cm, and M_0 (0 ml/l water) which is 24.56 cm. The interaction between the two treatments also did not significantly affect the growth of cocoa plant height, but there was a tendency for the interaction between the two treatments M_1 and K_1.

2. Rod Diameter

The results of the analysis showed that OPEB had no significant effect on stem diameter, while EM-4 and the interaction of the two treatment factors had no significant effect on stem diameter of cocoa plants at the age of 10 WAP.

Table 2. Average Stem Diameter of Cocoa Seeds (mm) On Treatment OPEB compost and EM-4 On Age 10 WAP .

Treatment	EM-4			Average
	M_0	M_1	M_2	
OPEB compost				
K_0	0.37	0.38	0.39	0.38
K_1	0.40	0.42	0.43	0.42
K_2	0.44	0.42	0.44	0.43
K_3	0.43	0.40	0.41	0.41
Average	0.41	0.41	0.42	

Description: Numbers that are not followed by letters showed no significant difference

In Table 2 it can be seen that the provision of OPEB had no significant effect on the stem diameter of the cocoa plant. Higher OPEB application results were obtained in the Topsoil treatment: 2:3 (K_3) OPEB Compost, 0.41 mm, Topsoil: 2:2 OPEB Compost ($K2_{)}$, 0.43 mm, Topsoil: 2:1 OPEB Compost. (K_1) is 0.42 mm, and 0 Control (K_0) is 0.38 mm. The EM-4 treatment also had no significant effect on the increase in stem diameter of cocoa plants. Higher EM-4 application results were obtained in treatment M_2 (10 ml/l water) ie 0.42 mm, M1 (5 ml/l water) ie 0.41 mm, M_0 (0 ml/l water) ie 0.41 mm. The interaction between the two treatments also had no significant effect on the

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increase in stem diameter of the cocoa plant, however there was a tendency for the interaction between the two treatments M2 and K2.

3. Number of Plant Leaves

The results of the analysis showed that OPEB had no significant effect while EM-4 and the interaction of the two treatment factors had no significant effect on the number of leaves of cocoa plants at the age of 10 WAP.

Table 3 . Average Number of Cocoa Plant Leaves On Treatment of OPEB compost and EM-4 On Age 10 WAP .

Treatment	EM-4			Average
	M_0	M_1	M_2	
OPEB compost				
K_0	12,56	14,22	13,33	13,37
K_1	12,56	13,56	15,33	13,82
K_2	15,33	13,33	13,89	14,18
K_3	13,55	15,89	15,89	15,11
Average	13,50	14,25	14,61	

Description: Numbers that are not followed by letters showed no significant difference

In Table 3 it can be seen that the provision of OPEB Compost significant effect on the number of leaves of cocoa plants. Higher OPEB application results were obtained in the Topsoil treatment: 2:1 OPEB Compost (K_1) which was 13.82 leaves, Topsoil: OPEB compost 2:3 (K_3) ie 15.11 leaves, 0 Control (K_0) which is 13.37 leaves, and Topsoil: OPEB compost 2:2 (K_2) is 14.18 leaf blade. The EM-4 treatment also had no significant effect on the growth of the number of leaves of the cocoa plant. Higher EM-4 application results were obtained in the M2 treatment (10 ml/l water) which was $_{14.61}$ leaves, M_0 (0 ml/l water) is 13.50 leaves, and M_1 (5 ml/l water) which is 14.25 leaf blade. The interaction between the two treatments also had no significant effect on the growth of the number of leaves of the cocoa plant, but there was a tendency for the interaction between the two treatments M_2 and K_3.

4. Plant Wet Weight

The results of the analysis showed that OPEB had no significant effect on the wet weight of the plant, also the EM-4 treatment and the interaction of the two treatments had no significant effect on the wet weight of the cocoa plant .

Table 4. Average Wet Weight Seeds Cocoa (g) Pada Treatment OPEB Compost and EM-4.

Treatment	EM-4			Average
	M_0	M_1	M_2	
OPEB Compost				
K_0	22,67	23.67	24,33	23.56
K_1	24,33	25,00	25,33	24.89
K_2	26,00	24,67	24,00	24.89
K_3	24,67	25.67	26,33	25.56
Average	24.42	24.75	25.00	

Description: Numbers that are not followed by letters showed no significant difference

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In table 4 it can be seen that the administration of OPEB had no significant effect on the wet weight. Higher OPEB application results were obtained in the Topsoil treatment: 2:3 (K_3) OPEB Compost 25.56 g, Topsoil 2:2 OPEFB Compost (K_2) 24.89 g, Topsoil: 2:1 EPEFB Compost (K_1) is 24.89 g, and 0 Control (Ko) is 23.56 g . The EM-4 treatment also had no significant effect on the wet weight of cocoa plants. Higher EM-4 application results were obtained in treatment M2 (10 ml/l water) which was 25.00 g, M1 (5 ml/l water) was 24.75 g, and M0 (0 ml/l water).) which is 24.42 g. The interaction between the two treatments also had no significant effect on the wet weight of cocoa plants, but there was a tendency for the interaction between the two treatments M2 and K3.

5 . Heavy Dry Plants

The results of the analysis show that OPEB Compost has no effect real to heavy dry cocoa plant , too treatment EM-4 and interaction second treatment no take effect real to heavy dry cocoa plant .

Table 5. Average Dry Weight of Cocoa (g) On OPEB Compost Treatment and EM-4.

Treatment	EM-4			Average
	M_0	M_1	M2 _	
(TKKS)				
K_0	9.33	9.67	11.00	10.00
K_1	10.67	9.67	9.00	9.78
K2 _	10.00	9.33	9.67	9.67
K_3	10.33	11.33	12.67	11.44
Average	10.08	10.00	10.59	

Description: Numbers that are not followed by letters showed no significant difference

In table 5 it can be seen that the provision of OPEB had no significant effect on the dry weight of cocoa plants. Higher OPEB application results were obtained in the Topsoil treatment: 2:3 OPEB Compost (K_3) which was 11.44 g, 0 Control (K_0) was 10.00 g, Topsoil: 2:1 OPEB Compost (K_1) was 9.78 g, and Topsoil: OPEB compost 2:2 (K_2) which is 9.67 g. The EM-4 treatment also had no significant effect on the dry weight of cocoa plants. Higher EM-4 application results were obtained in treatment M_2 (10 ml/l water) which was 10.59 g, M_0 (0 ml/l water) was 10.08 g, and M_1 (5 ml/l water)) which is 10.00 g. The interaction between the two treatments also had no significant effect on the dry weight of cocoa plants. However, there was a tendency for the two treatments to interact with M2 and K3.

DISCUSSION

1. Response of OPEB Giving to Cacao Plant Growth

The results showed that the application of Oil Palm Empty Fruit Bunches had no significant effect on all observed parameters. The higher plant height parameters were found in treatment K1 (25.85 cm), followed by treatment K3 (25.41 cm), K2 (24.70 cm), K0 (24.37cm).

Oil Palm Empty Bunches (OPEB) can be used as a source of organic fertilizer that contains nutrients needed by soil and plants. The role of oil palm empty fruit bunch compost on the soil is to bind the soil grains into larger grains and crumbs so that the soil becomes more friable so that root growth and development will be optimal. While its role in plants is to stimulate growth and root development to grow optimally (Yani, 2010).

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It is suspected that the content of OPEB has low nutrients, causing a slow response to the growth of cocoa plants and causing insignificant yields on plant growth, also caused by climatic factors that are not suitable for cocoa plants.

2. Giving Response EM-4 on the Growth of K a k ao Plants

The results showed that the application of EM-4 solution no significant effect on plant height, stem diameter , number of leaves, wet weight and heavy dry plants . Better plant height was found in the treatment of M_1 (25.36 cm), followed by M_2 (25.33 cm), and M_0 (24.56 cm). Better stem diameter was found in M_2 treatment which was 0.42 mm followed by M_1 0.41 mm, and M_0 0.41 mm. The better number of leaves was found in the treatment of M_2 (14.61 leaves), followed by M_1 (14.25 leaves), and M_0 (13.50 leaves). Better wet plant weight was found in M_2 treatment which was 25.00 g followed by M_1 (24.75 g), and M_0 (24.42 g). Better dry plant weight was found in M_2 treatment which was 10.59 g followed by M_0 (10.08 g), and M_1 (10.00 g).

I know this that Product EM-4 Agriculture is a bacteria fermenting soil organic matter fertilizing plants and nourishing the soil. Made from natural selection of fermented and synthetic microorganisms in the soil packaged in a liquid medium (Wididana, 1999).

EM-4 application was carried out two weeks before the plants were transferred to large polybags. When applied by sprinkling on the ground using a measuring glass. The EM-4 contained in the package was mixed with 1 liter of water and brown sugar solution and then stored for 1 night in order to activate the microorganisms contained in the EM-4 solution after which it was applied to the planting medium according to the recommended dose.

The application of organic matter into the soil without the application of EM-4 Simultaneous agriculture will cause decay of organic matter which sometimes will produce inorganic elements so that it will produce heat and toxic gases that can interfere with plant growth (Wididana, 1999).

So one of the causes of the insignificant effect on the EM-4 treatment is because it is wrong to do the application which is not done at the same time but on the same day also due to weather factors.

3. Combination bunch Empty Coconut Palm oil and EM-4 To Growth Cocoa Plant

Combination second treatment no real effect to tall plant, stem diameter, and number of leaves. Second no treatment each other support in influence tall plant, stem diameter, and number of branches of the cocoa plant. The parameters of wet weight and dry weight of plants did not show a significant effect with the combination of the two treatments, this was because at that time both treatments had a slow response to the wet weight and dry weight of the plant.

In this study, what caused the combination of the two treatments to be unrealistic was suspected because the OPEB decomposer process with the help of EM-4 was slow to respond by cocoa plants, the decomposing bacteria in the EM-4 solution were thought to be inactive due to unfavorable environmental factors. OPEB that has been mixed well with the soil is not fermented by the bacteria present in the EM-4 solution.

CONCLUSION

The application of Oil Palm Empty Bunches coconut had no significant effect on all observed parameters. Application of EM-4. solution no significant effect on plant height, stem diameter , number of leaves, wet weight and heavy dry plants. Application Oil Palm Empty Bunch Coconut (OPEB) and EM-4 and the combination of the two treatments had no significant effect on all observed parameters.

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