International Journal of Multi Discipline Science (IJ-MDS)
Vol. 3 No. 2 (2020)
e-ISSN: 2615-1707. Page: 39-43

The Utilization of Effective Microorganism 4 (EM4) on Growth of Oil Palm Seedling in Pre Nursery

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Keywords:
Microorganisme, Morphology, Pre Nursery

ABSTRACT
A planting medium that rich in nutrients is needed for oil palm, especially in the nursery phase. This study aimed to determine the effect of various doses of EM4 and to get the best dose of EM4 on the growth of oil palm seedlings in the pre-nursery. The research method used was a non-factorial completely randomized design with 4 treatments, namely 0 ml EM4 (A1), 4 ml EM4 (A2), 8 ml EM4 (A3), and 12 ml EM4 (A4). Each treatment was repeated 6 times so that there were 24 experimental units. The data obtained were analyzed for variance at the 5% level, if the effect was real, it was followed by the least significant difference (LSD) test. Based on the results of the study, it could be concluded that application of various EM4 doses had a significant effect on plant height (4-12 MST), the number of leaves (4-8 MST), trunk girth (4-12 MST), and shoot wet weight but did not significantly affect the number of leaves (12 MST), the volume of roots, length of roots, root wet weight and shoot dry weight, dry weight root, the best dose was shown at a dose of 12 ml EM4.

INTRODUCTION

The nursery phase is important in determining the quality and quantity of oil palm production at maturity. According to Parnata (2010), the problem that is often faced during oil palm nurseries is the ability of the soil to provide nutrients continuously for the growth and development of oil palm. One way to increase soil fertility is by utilizing fermented microorganisms which have a role in providing organic matter, fertilizing plant material, and making soil healthy. EM4 is a type of fermented microorganism that is easily found in the market at an affordable price.

According to Higa and Parr (1997), EM4 consists of a mixed culture of beneficial and naturally living microorganisms and can be applied as an inoculum to increase the diversity of soil and plant microorganisms. The composition of EM4 includes about 80 genera of microorganisms consisting of 5 main groups, namely phosphate solubilizing bacteria, *Lactobacillus*, Yeast, *Actinomycetes*, and photosynthetic bacteria. In addition, EM4 contains nutrients such as Ca, Mg, Fe, Al, Zn, Cu, Mn, and Na (Subali and Ellianawati, 2010). EM4 can increase soil microbes, improve soil health and quality. Higa (1998) stated that soil microorganisms are beneficial for plant growth and yield by increasing

chemical transformation during the decomposition process, breaking down polysaccharides into carbon and water, and stimulating the weathering of plant debris into smaller particles. Research on the use of EM4 to increase the growth of various types of plants has been widely reported, such as the results of research by Prabowo, Dewi, and Susilarto (2018) which showed that the EM4 dose with an application time of 15 days was the best combination of treatment for plant height, plant biomass and root length of chili plants. cayenne. In addition, Ali, Utami, and Komala (2018) reported that good compost is a sample with the addition of EM4 30 mL and 15 ml sugar solution with a C/N ratio of 17.08 in making compost from industrial crumb rubber waste. The purpose of this study was to determine the effect of various EM4 doses and to obtain the best EM4 dose on the growth of oil palm seedlings in the pre-nursery.

METHOD

This research was implemented at the Citra Widya Edukasi Palm Oil Polytechnic Experimental Garden from September to November 2020. The materials used are oil palm seeds, polybags, EM4. While the tools used are measuring cups, rulers, calipers, digital scales, ovens, and stationery. The design used was a non-factorial completely randomized design with 4 treatments, namely 0 ml EM4 (A1), 4 ml EM4 (A2), 8 ml EM4 (A3), and 12 ml EM4 (A4). Each treatment was repeated 6 times so that there were 24 experimental units. The data obtained were analyzed for variance at the α 5% level, if there was a real effect, it was followed by the Least Significant Difference (LSD) test.

The experimental procedure began with planting oil palm sprouts and then continued with the application of treatment according to the predetermined dose. Observation of parameters was carried out starting from 4 weeks after planting (MST) to 12 WAP of seedlings on parameters of plant height, trunk girth, and the number of leaves. The parameters of root volume, root length, root and shoot wet weight, root, and canopy dry weight, number, and density of stomata were carried out at the end of the study. Analysis of nutrient content in soil was carried out at the beginning and end of the study, while analysis of nutrient content in plants was carried out at the end of the study.

RESULTS AND DISCUSSION

The EM4 treatment contains a soil fraction consisting of 8% sand fraction, 47% dust fraction, and 45% clay fraction so that was included Silty Clay (Eviati and Sulaeman, 2009). Soil pH was considered neutral with pH KCl was 5.5 and pH H_2O was 6.4 which was included in the moderately acid category (Eviati and Sulaeman, 2009). The suitable pH in the nursery media of oil palm seedling was 5.25 (Hidayat, Saleh, & Hermansyah, 2017). The C organic obtained by the growing media with EM4 treatment was quite low compared to terra pretta treatment which was 0.94%, while Nitrogen organic was 0.14%. Based on the assessment criteria of chemical soil, the results of the analysis of C organic soil were included in the very low category, as well as organic N (Eviati and Sulaeman, 2009). The C/N ratio in growing medium with EM4 treatment was included in the mature category with a value < 20. Based on Andriyanto, Budiari, and Subagyo (2019) research, EM4 application in the composting process can reduce the C/N ratio of Empty fruit bunch (Oil Palm EMP) compost. Toiby, Rahmadani, and Oksana (2015) research, application of EM4 in oil palm empty fruit bunch compost for ameliorant in plant media is recommended for A3B4 treatment (EM4 dose 20 ml/L and curing time of 10 weeks). The available P_2O_5 content was 18 ppm and K_2O was 130 ppm. The CEC content in EM4 treatment had a value of 14.61 cmolc/kg in the medium category (Eviati and Sulaeman, 2009). In their research, Ekawandani and Alvianingsih (2018) showed that compost-used EM4 activator contains P of 0.12%, K of 0.47% with a C/N ratio of 25.

The height of oil palm seedlings influenced plant height at 2 WAP, 4 WAP, and 10 WAP. EM4 implication had a better effect than without EM4 treatment. Treatment without EM4 had a different effect compared to EM4 4 ml and EM4 12 ml treatments, whereas treatment with EM4 8 ml had no significant effect. Commercial EM4 contained fermentation of bacteria which contribute to fertilizing

plants and soil health was very effective in increasing plant height when compared to without EM4. EM4 treatment also had an effect on the height of chili plants at the age of 45 DAS with the best doses being 5 ml and 10 ml (Syafruddin and Safrizal, 2013).

Table 1
Results of Preliminary Analysis of Planting Media with EM4 Applications

Parameter	EM4	Unit
Texture Pipet method		
Sand	8	%
Dust	47	%
Clay	45	%
pH		
H_2O	6.4	
KCl	5.5	
Organic matter		
C Walkey method	0.94	%
N Kjeldahl method	0.14	%
C/N ratio	7	
P_2O_5 available Olsen method	18	ppm
K_2O available Morgan method	130	ppm
CEC	14.61	cmolc/kg

Data Source: Soil Research Institute of Laboratory

EM4 application on parameters affected the number of leaves oil palm seedlings aged 2 WAP, 4 WAP. Meanwhile, the number of leaves at 10 MST did not affect. The treatment of EM4 gave the effect of the number of leaves more than without EM4.

EM4 treatment affected the trunk girth of oil palm seedlings at 2 WAP, 4 WAP, and 10 WAP. At the age of 2 MST oil palm seedlings, EM4 8 ml and 12 ml treatments had the same effect when compared to treatments without EM4 and EM4 4 ml. Oil palm seedlings at the age of 4 WAP have a larger trunk girth at 4 ml EM4 treatment. The trunk girth of oil palm seedlings at the age of 10 MST with EM4 treatment was higher than those without EM4. It was assumed that EM4 application can increase the trunk girth of different according to the age of oil palm seedlings. The 4 ml EM4 treatment stably starting from the age of 2 MST to 10 MST affected the trunk girth of the oil palm. Elpawati, Dara, and Dasumiati (2015) reported that the planting medium (M2) with compost and soil composition (1:2) and the addition of EM10 fertilizer at a concentration of 20 ml was able to increased trunk girth (2.29 mm), while at a concentration of 15 ml increased corncop production (1.66 fruit) of maize crop at harvest time.

Table 2
The Influence of Various EM4 Dosage on Plant Height, Leaf Number, and Trunk Girth

Treatment	Plant Height (cm)			Leaf Number (sheet)			Trunk Girth (cm)		
	2 MST	4 MST	10 MST	2 MST	4 MST	10 MST	2 MST	4 MST	10 MST
0 ml EM4	5.75 b	9.30 b	18.75 b	1.33 b	1.67 b	3.83 a	4.83 c	8.67 ab	5.67 b
4 ml EM4	9.10 a	13.85 a	26.55 a	2.00 a	2.83 a	4.83 a	6.50 b	9.50 a	10.83 a
8 ml EM4	7.27 ab	10.42 ab	22.70 ab	2.00 a	2.50 a	4.83 a	8.17 a	8.00 b	10.00 a
12 ml EM4	9.15 a	13.67 a	25.70 a	1.83 a	2.33 a	5.00 a	7.00 ab	5.67 c	9.83 a
Average	**7.82**	**11.81**	**23.43**	**1.79**	**2.33**	**4.62**	**6.63**	**7.96**	**9.08**
CV	**28.02**	**25.15**	**20.81**	**18.37**	**21.43**	**17.09**	**16.25**	**15.43**	**24.74**

Note: Numbers followed by the same letter in the same column indicate results that are not significantly different based on LSD at $\alpha = 5\%$.

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EM4 treatment did not affect root length parameters and root volume of oil palm seedlings. It was assumed that there was no direct effect on the root area. The effect of EM4 was only concentrated on the plant canopy of the pre-nursery oil palm seedlings.

Table 3
The Influence of Various EM4 Dosage on Root Length and Root Volume

Treatment	Root Length (cm)	Root Volume (ml)
0 ml EM4	21.05 a	16.00 a
4 ml EM4	22.60 a	21.83 a
8 ml EM4	17.22 a	17.83 a
12 ml EM4	23.02 a	21.67 a
Average	**20.97**	**19.33**
CV	**35.76**	**40.41**

Note: Numbers followed by the same letter in the same column indicate results that are not significantly different based on LSD at α = 5%.

The EM4 treatment affected the wet weight of the canopy of the oil palm seedlings but did not affect the wet weight of roots. EM4 treatment had a higher canopy wet weight when compared to without EM4 application. It was assumed that the content of EM4 in the form of fermented bacteria can increase the plant biomass and the water content in the canopy of oil palm seed.

On the parameters of canopy dry weight and root dry weight, EM4 treatment had a nonsignificant effect. It was assumed that the water content derived from the wet weight evaporated in different amounts when it was the drying process. Research conducted by Prabowo, Dewi, and Susilarto (2018) showed that EM4 treatment at a dose of 5 ml, 5 ml, and 25 ml did not affect the biomass of *Capsicum fruscens* L.

Table 4
The Influence of Various EM4 Dosage on Wet and Dry Weight Canopy and Root

Treatment	Wet Weight (gram)		Dry Weight (gram)	
	Canopy	Root	Canopy	Root
0 ml EM4	1.36 b	0.80 a	1.06 a	0.375 a
4 ml EM4	5.36 a	1.79 a	1.52 a	0.583 a
8 ml EM4	4.97 a	1.21 a	1.45 a	0.465 a
12 ml EM4	5.35 a	1.60 a	1.49 a	0.577 a
Average	**4.26**	**1.35**	**1.38**	**0.500**
CV	**48.89**	**45.55**	**53.69**	**47.09**

Note: Numbers followed by the same letter in the same column indicate results that are not significantly different based on LSD at α = 5%.

CONCLUSIONS

Based on the results of the study, it can be concluded that application of various EM4 doses had a significant effect on plant height (4-12 MST), the number of leaves (4-8 MST), trunk girth (4-12 MST), and shoot wet weight but did not significantly affect the number of leaves (12 MST), the volume of roots, length of roots, root wet weight and shoot dry weight, dry weight root, the best dose was shown at a dose of 12 ml EM4.

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