Research article

Effect of Rhizobacteria and Palm Mill Byproducts on the Growth of Oil Palm Seedlings in a Pre-Nursery

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Abstract.
Plant growth-promoting rhizobacteria (PGPR) is a type of microbe that can boost root development and plant growth by interacting with plant roots. The goal of this study was to examine how oil palm mill byproducts and PGPR can affect oil palm seedling growth in a pre-nursery. The study was conducted using a completely randomized design with factorial treatments. The empty oil palm bunches (EFB) were divided into three levels: soil:compost EFB (1:1), soil:ash EFB (1:1), and a control soil. The second variable was the PGPR dose, which was divided into three levels: chemical fertilizer (control), 20 ml, and 30 ml. Each treatment combination was repeated five times. The research findings were analyzed using analysis of variance to determine the true difference between the treatments tested using Duncan's multiple range test at 5%. There was no interaction between the administration of EFB and the dose of PGPR in the growth of pre-nursery oil palm seedlings, according to the findings. Oil palm seedlings grew well in EFB compost in a pre-nursery setting. In pre-nursery palm head seedlings, PGPR application at a dose of 20 ml was able to provide good growth.

Keywords: Pre-nursery, Empty Fruit Bunch, Organic Fertilizer, PGPR

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1. Introduction

Palm Oil (*Elaeis guineensis* Jacq.) is one type of plant from the family Arecaceae that produces edible vegetable oil (*Edible oil*) and the latestbiodicells and renewable biodicells, [1]. Currently, palm oil is in high demand to be managed and grown. The appeal of palm oil cultivation is still a mainstay of vegetable oil sources and agro-industrial materials in the Indonesian economy. palm oil commodities play a strategic role because this commodity has a bright prospect as a source of foreign exchange,[2].

Oil palm plantations in Indonesia every year have increased, the area of Indonesian oil palm plantations in 2017 was 12.38 million ha, in 2018 the area of Indonesian oil palm plantations was 14.32 million ha, and in 2020 the area of Indonesian oil palm plantations was 14.60 million ha.,[2]. The addition of Indonesia's oil palm plantation area significantly also increases its tonnage and production. Increased production has a big impact on processing in MCC. The processing in the MCC will also produce waste, both solid waste, and liquid waste.

One that can be processed from palm oil side products waste is empty bunches of palm oil, empty bunches of palm oil is a solid waste that can be applied as a soil cover. Empty bunches of palm (EFB) It can also be used as an organic fertilizer that is beneficial for the growth of palm oil seeds. Empty Fruit Bunch main ingredients are cellulose and lignin. Cellulose in empty bunches of palm oil reached 44.2 %, while the lignin content reached 20,4 %,[3].

Empty Fruit Bunch can be used then it must be done composting process. After all, if not done composting process then what happens is Empty Fruit Bunch can not be accepted by plants, because the C / N contained in the Empty Fruit Bunch is 17,93 mg/l, this can decrease the availability of N elements in the soil because element N mobilized in the process of organic material remodeling by soil microbes. Efforts to reduce C/N levels can be done by composting until the C/N level is close to the soil C/N level. The high-quality composting process with C/N content of about 15%,[4]; [5]. The content of Empty Fruit Bunches is quite complete, ranging from macro nutrients and micronutrients that are very important in providing influence on plant growth, namely: 42.8% C, 2.9% K2O, 0.8% N, 0.22% P2O5.0.30% MgO, 23 ppm Cu, and 51 ppm Zn. Empty Fruit Bunch which is organic has an element content of 1.5%N, 0.5% P, 7.3% K, and 0.9% Mg has a considerable potential to be used as a substitute for fertilizer by applying byproducts on the ground around the goal of oil palm plants. While Abu Janjang empty palm oil has a content of about 61% K_2O, 45% P_2O_5, 16% CaO, and 15 % MgO,[6].

The growth of palm oil seedlings can be increased by providing rhizobacteria (PGPR) that encourage plant growth through development activities at the root. PGPR has a direct effect on its ability to provide and facilitate or mobilize nutrient absorption processes in the soil as well as synthesize and alter concentrations of various growth boosters such as phytohormones. PGPR is influential in suppressing pathogenic activity by producing various compounds or metabolites such as siderophores and antibiotics, it is an indirect influence related to pgpr's ability to suppress pathogenic activity.

In a study that has been conducted on other growth (tomatoes)given PGPR with a concentration of 12.5 ml /plant, with the concentration can increase the height of plants significantly, it is because the application of PGPR has an influence on the absorption and utilization of N nutrients needed in the vegetative phase. PGPR serves in increasing the absorption and utilization of N nutrients by plants. Nutrient N absorbed plant roots are useful in increasing plant height and spurring growth.the higher theconcentration of PGPR provided, the more directly proportional to plant growth. Based on this, research is needed to find out its effect on the growth of palm oil seeds in pre-nursery,[7];[8].

So that the development and increasing area of land then many oil palm seeds are needed with a very large amount and must be quality,[9]. Currently in accelerating the growth of nurseries many use chemical fertilizers because the use of chemical fertilizers is considered easy to obtain and gives faster results to growth,[10]. But the price of chemical fertilizers is relatively expensive and as a result of excessive administration of chemical fertilizers resulting in soil conditions both physically, biologically and chemically the soil becomes very bad, the use of chemical fertilizers result in the physical properties of the soil becomes very dense and also many soil organisms die. Based on various sources and reference bases that using fertilizers / organic materials is greater to have a good impact in improving the soil,both physical, chemical, and soil biology,[11].

So the alternative is done by composting Empty Fruit Bunch, ash Empty Fruit Bunch, and other ways is by giving PGPR. Microorganisms in it can improve the productivity and health of plants known as rhizobacteria that encourage plant growth,[12]; Organic matter provides nutrients for plants and also provides nutrients for the soil, with the provision of organic empty fruit bunch (EFB) is able to increase soil fertility so that it has a real impact on plant growth,[13].

2. Methodology

Research Methods

The method used in this study is experimental with Complete Randomized Design (CRD) using a factorial pattern consisting of two factors.

The first factor is PKS solid waste consisting of 3 levels, namely:

P1: Soil

P2: Soil: compost Empty Fruit Bunch 1:1

P3: Soil: Empty Fruit Bunch Ash 1:1

The second factor is the administration of PGPR dose consists of 3 levels, namely:

D0 : 0 ml + chemical fertilizer (NPK and urea) as control

D1 : 20 ml/seed

D2 : 30 ml/seed

From both treatments obtained 9 combinations of treatments and each treatment is done 5 replays. The number of seeds needed for the experiment is (3 x 3) x 5 = 45 seedlings and embroidered seeds as many as 15 seeds of palm oil as much as the total seeds needed 60 seeds of oil palm. Data analysis used is fingerprint at a real level of 5%. If there is a noticeable difference between further tested treatments using DMRT (Duncan Multiple Range Test) at a real level of 5%.

2.1. Research Location

This research was conducted in Kalikuning Tempelsari village, Maguwoharjo, Depok District, Sleman Regency, Province of Daerah Istimewa Yogyakarta (DIY). This research was conducted from May to February 2021.

2.2. Tools and Materials

The tools used are a hoe, polybag (20cm x 20 cm), sipping, ruler, oven, analytical scales, drill, bucket, measuring cup, paranet, plastic, meter, bamboo, stationery. The materials used are Empty Fruit Bunch compost, Empty Fruit Bunch ash, PGPR NPK and urea fertilizer, palm oil sprouts (DxP) Tenera varieties with the name simalungun seeds obtained from Pusat Penelitian Kelapa Sawit (PPKS) Medan.

2.3. Observation Parameters

Plant height (cm), Number of leaves (strands), stem diameter (cm), fresh root weight (g), fresh weight of header (g), dry weight of roots (g), dry weight of header (g), root volume (ml).

3. Results and Discussions

Observation and measurement of parameters were carried out for approximately 13 weeks with the initial observations made in the 4th week of HST. Data retrieval is done with fingerprint *analysis (analysis of variance)*and tested with DMRT with a level of 5%. The results of the analysis are presented and discussed in the image below.

The results of the diversity fingerprint analysis that has been conducted show that there is a real interaction with the provision of Empty Fruit Bunches and Blank Fruit Bunch bunches on all parameters of growth of palm seedlings in pre-nursery, except

TABLE 1: The influence of Empty Fruit Bunch and Empty Fruit Bunch ash as a planting medium on the growth of Oil Palm seedlings in pre-*nursery*.

Parameters		Land only	Soil: Compost Empty Fruit Bunch	Soil: Compost Empty Fruit Bunch Ash
Plant height (cm)		24.03 ab	25.63 a	22.16 c
Number of leaves (strands)		4.26 b	4.93 a	4.26 b
Rod diameter (cm)		0.97 a	1.02 a	0,86 a
Fresh weight heading (g)		6.04 b	7.66 a	4.08 c
Fresh weight heading (g)		2.19 ab	2.64 a	1.87 b
Header dry weight (g)		1.43 b	1.81 a	0.93 c
Dry weight of roots (g)		0.50 a	0.54 a	0.37 b
Root volume (ml)		1.50 b	2.30 a	1.31 b

the stem diameter parameters. It is possible that the provision of nutrients derived from Empty Fruit Bunch and Empty Fruit Bunch Ash correlates to PGPR added in palm oil nursery media.

Table 1 shows that the treatment of Empty Fruit Bunch as a planting medium with composting composition: soil exerts a real influence on all parameters observed except the diameter parameters of the stem. The provision of compost Empty Fruit Bunch makes a good enough input as soil aggregate strengthening material, improve soil chemical properties and physical properties of soil, such as improving soil ability to absorb water, improve soil aggregates, pores, and soil aerase so that the diffusion of O_2 into the soil increases,[14].

The provision of empty fruit bunch compost also increases the biological activity of the soil such as encouraging the development of roots through the activity of microorganisms that occur in the root, this will certainly expand the range of roots in the absorption of water and nutrients so that the metabolism of plants will run well,[15]. Compost given to the soil will decompose to produce compounds and nutrients available to plants to increase the activity of organisms that indirectly improve the soil structure from solid to loose that makes it easier for roots to absorb nutrients,[6]. The provision of MCC solid waste can increase the capacity of cation exchange (KTK) so that soil that was previously low in organic matter content and solid soil becomes a medium of planting organic matter and high soil becomes loose, and organic matter can also store nutrients in the soil so that the nutrients stored will become particles that are easily absorbed by plants.

Planting media in the form of soil: Empty Fruit Bunch ash gives lower yields compared to the compost treatment of Empty Fruit Bunch allegedly due to the high K element contained in Empty Fruit Bunch ash which is high enough to cause inhibition of plant growth process due to the occurrence of N-K bonds that result in difficult absorption of nitrogen elements by plants. Empty Fruit Bunch also contains silica in its ash, this makes the texture of the soil if exposed to water continuously will be solid like cement and affect the roots that are difficult to penetrate the soil. In addition to the characteristics such as silica, and high K content, Empty Fruit Bunch ash applied is thought to be too much compared to the soil, this causes the dominance of Empty Fruit Bunch ash to the comparison with the soil. So to reduce it can be done by adding soil and organic soil material so that the composition of planting materials are balanced, the pH of empty janjang ash should also be considered, the pH contained in the ash of palm oil janjang reaches 13 which results in the growth of oil palm seedlings is inhibited and to neutralize the pH using dolomite so that the pH becomes neutral between 5.5- 7.0, [16];[17].

Table 2: Effect of PGPR Dose on the growth of oil palm seedlings in *pre-nursery*.

Parameter	**0 ml + Fertilizer (Control)**	**20 ml**	**30 ml**
Plant height (cm)	24.67 p	23.70 p	24.03 p
Number of leaves (strands)	4.40 p	5.20 p	4.48 p
Rod diameter (cm)	0.97 p	0.92 p	0.95 p
Fresh weight heading (g)	6.25 p	5.31 p	6.23 p
Fresh weight heading (g)	2.16 p	2.30 p	2.23 p
Header dry weight (g)	1.47 p	1.27 p	1.43 p
Dry weight of roots (g)	0.50 p	0.48 p	0.42 p
Root volume (ml)	1.62 p	1.76 p	1.73 p

Based on Table 2, the results of the analysis show that the administration of PGPR at various doses, both 20 ml and 30 ml, showed the same pre-seedling growth of oil palm seeds with chemical fertilizers. The provision of PGPR containing Rhizobacteria can encourage plant growth (a group of beneficial bacteria that actively colonizes the rhizosphere). PGPR is able to increase activity in the root area for the better, [18] In addition, the provision of PGPR is also beneficial for plant growth, both its influence directly and its influence indirectly. The direct influence felt in the provision of PGPR is its ability to provide and facilitate, and mobilize the process of absorption of various nutrients in the area of plant root range and able to adjust the concentration of various phytohormones that act as a growth booster, [12]. But in this study, PGPR that is expected to help the growth of oil palm seedlings is still not optimal, which may be caused by the duration of the fermentation process PGPR itself. In addition to PGPR fermentation, pgpr dose also affects the growth of palm oil seeds in pre-nursery. Pgpr provision in general has not been able to spur more maximal on the process of growth of palm oil seedlings in pre-nursery, but in fact, it has had a positive impact as a substitute for chemical fertilizers so that using PGPR can further minimize the use of chemicals and more environmentally friendly,[12].

The use of standard doses is possible not yet able to give maximum results, and to increase the maximum result is to increase the number of doses PGPR per seedling, so that it can be seen the real difference between seedlings without the administration of PGPR (replaced chemical fertilizer), administration of PGPR with a dose of 20 ml, and PGPR with a dose of 30 ml. analysis shows that PGPR dose 20 ml and 30 ml have given the same growth of oil palm seedlings with seeds without the administration of PGPR (replaced by chemical fertilizers), it is appropriate in table2 that shows the three treatment dose values show close to the same value, both the use of chemical fertilizers, PGPR dose 20 ml, and PGPR dose 30 ml. Overall the dosage used in this study provides results that can be compared with each other so that it can be used as a reference in the use of PGPR in oil palm *pre-nursery.*

4. Conclusion

Based on the analysis of research results and discussions, it can be concluded as follows: There is no interaction between PKS solid waste and PGPR dose to the growth of pre-*nursery* palm seedlings.

PGPR application with a dose of 20 ml can provide good growth in palm head seedlings in pre-*nursery* and be able to replace the role of chemical fertilizers

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