

The Growth of Oil Palm Seedlings using a Combination Medium of Organic Oil Palm Empty Fruit Bunch and NPK Fertilizer at Main Nursery

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ABSTRACT

Oil palm (*Elaeis guineensis* Jacq.) holds a very strategic role in the Indonesia economy. Plants that have reached the economical age of 25 years need to be replanted using qualified oil palm seedling. The qualified seedling is obtained through proper fertilization. The combination of NPK fertilizer and organic material of oil palm empty fruit bunches (OPEFB) which has been given a cellulolytic bacterial consortium can provide sufficient nutrients for the growth of oil palm seedlings. The study aimed to determine the effect of giving a combination of OPEFB organic material, cellulolytic bacterial consortium, and NPK fertilizer on the growth of oil palm seedling (*Elaeis guineensis* Jacq.) at main nursery. This experiment used a single factor experiment arranged in a Completely Randomized Design (CRD). The treatments were a 100% NPK, a OPEFB compost, a 50% NPK + OPEFB compost, a 50% NPK + OPEFB + Cellulolytic bacterial consortium, and a OPEFB + cellulolytic bacterial consortium. The results showed that the application of inorganic fertilizers combined with organic fertilizers (a OPEFB compost and a OPEFB + cellulolytic bacterial consortium) had a good effect on each parameter. Giving organic fertilizer without inorganic fertilizer had not affected plant growth on all parameters. Application of a OPEFB compost and a OPEFB + cellulolytic bacterial consortium can reduce the use of inorganic fertilizers by 50%.

Keywords: NPK, Oil palm, OPEFB compost

ABSTRAK

Kelapa sawit (*Elaeis guineensis* Jacq.) memegang peranan yang sangat strategis dalam perekonomian Indonesia). Tanaman yang telah mencapai umur ekonomis yaitu 25 tahun perlu dilakukan peremajaan (*replanting*) dengan menggunakan bibit kelapa sawit yang berkualitas. Bibit yang berkualitas diperoleh melalui pemupukan yang tepat. Kombinasi pupuk NPK dan bahan organik TKKS yang telah diberi konsorsium mikroba selulolitik dapat memberikan unsur hara yang cukup untuk pertumbuhan bibit kelapa sawit. Tujuan penelitian untuk mengetahui pengaruh pemberian kombinasi bahan organik TKKS, konsorsium mikroba selulolitik dan pupuk NPK terhadap pertumbuhan bibit kelapa sawit di pembibitan utama. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan 5 perlakuan. Perlakuan pertama 100% NPK, perlakuan ke dua kompos TKKS, perlakuan ke tiga 50% NPK + kompos TKKS, perlakuan ke empat 50% NPK + TKKS + konsorsium mikroba, perlakuan ke lima TKKS + konsorsium mikroba selulolitik. Hasil penelitian menunjukkan bahwa pemberian pupuk anorganik yang dikombinasikan dengan pupuk organik (kompos TKKS maupun TKKS + konsorsium mikroba selulolitik) memberikan pengaruh yang baik pada setiap parameter. Pemberian pupuk organik tanpa pupuk anorganik tidak dapat memberikan pertumbuhan tanaman pada semua parameter. Aplikasi kompos TKKS maupun TKKS + konsorsium mikroba selulolitik mampu mengurangi penggunaan pupuk anorganik hingga 50%.

Kata Kunci: Kelapa sawit, kompos TKKS, NPK

INTRODUCTION

Palm oil (*Elaeis guineensis* Jacq.) play a very strategic role in the Indonesian economy, namely as a producer of edible oil, industry, and biofuels (biodiesel). Palm oil production in Indonesia comes from palm fruit grown in several regions in Indonesia, one of which is Riau Province. Statistics of Riau Province (2018) showed that in 2017 the area of oil palm plantations reached 2,776,500 ha, of the total land area that most of them have undergone a phase of less yield because plants have reached the economic age of 25 years. Therefore, oil palm plants need to be replanting.

According to the Plantation Fund Management Agency (2018), the government will begin replanting smallholder oil palm plantations covering 25,423 hectares for Riau Province in 2018. The replanting activities require quality oil palm seeds to be used instead of plants that are no longer productive. Quality is the main factor affecting plant productivity. This is in line with that stated by Pahan (2010) that the actual investment for commercial plantations is in the plant material to be planted in the form of seeds because it is a source of profit for the company. Jannah *et al.* (2012) added that nurseries are the first step in preparing good quality seedling because it will determine the productivity and longevity of plant production. Things that must be considered in the process of oil palm nurseries are fertilization.

According to Kiswondo (2011), fertilization as a part of agricultural intensification is an effort aimed at increasing the supply of plant nutrients to increase production and quality of crop yields. One effort to provide nutrients for oil palm plants can be done by adding organic matter directly to the planting media. Organic materials that can be used to oil plantation are oil palm empty fruit bunches (OPEFB) (Sari *et al.* 2015; Sembiring *et al.* 2015; Yi *et al.* 2019), and palm fronds (Ariyanti *et al.* 2017; Ariyanti *et al.* 2019). Based on Al-Khoiri (2013) research, giving OPEFB to haplik podsolic soil type, plintik podsolic, district kambisol and district gleysol under oil palm stands can improve soil physical properties i.e. decrease bulk density and particle density, and increase total pore space, permeability, infiltration rate and water content at a depth of 0 cm-20 cm. Also, the addition of 1 kg of oil palm empty fruit bunches and/or 1 kg of crude palm oil ash per seedling in a recommended $\frac{1}{2}$ dose treatment results in optimum growth of oil palm seedlings and can replace the use of inorganic fertilizer $\frac{1}{2}$ dose recommendation (Jesus 2012).

The addition of organic matter from the OPEFB is also expected to maintain soil moisture because it functions as a mulch. Based on the results of the Situmorang *et al.* (2015), the giving of OPEFB organic mulch increased the total pore space, water content, pH, organic C, total N, and K which were significantly different in oil palm plantations. The spread of the OPEFB mulch was also able to suppress weed growth.

Provision of nutrients through the addition of OPEFB organic matter directly if there are microorganisms that decompose the organic matter into compost OPEFB. Microorganisms that can accelerate the process of decomposition of OPEFB one of them is cellulolytic bacterial. Saraswati *et al.* (2010) stated that cellulase enzymes produced by cellulolytic bacterial were able to accelerate the decomposition process of organic matter containing cellulose. Therefore, cellulolytic bacterial can decompose the cellulose contained in the OPEFB. This can support a sustainable system for managing oil palm plantations through the use of biofertilizers (Bakeri *et al.* 2019).

Based on the research of Hapsoh *et al.* (2016), they obtained six potential cellulolytic bacterial isolates consisting of two bacterial isolates from rice straw (*Bacillus cereus* JP6 and *Bacillus cereus* JP7), two bacterial isolates from oil palm empty fruit bunches (*Proteus mirabilis* OPEFB3 and *Proteus mirabilis* OPEFB7), and two isolates the origin of acacia litter (*Providencia vermicola* SA1 and *Bacillus cereus* SA6). The six cellulolytic bacterial isolates from several different sources are expected to work synergistically so that it has the potential to accelerate the composting process.

Palm oil seeds require a lot of nutrients such as nitrogen (N), phosphorus (P), and potassium (K) which are not enough just to give organic fertilizer but need to be combined with inorganic fertilizers. According to Sari *et al.* (2015), the combination of NPK fertilizer and organic fertilizer from empty bunches was able to increase seedling height, the number of oil palm seedlings, and stem diameter. One of the inorganic fertilizers that has a good influence on plant growth is NPK fertilizer (16:16:16). The results of other studies conducted by Adnan *et al.* (2015), showed that the addition of NPK fertilizer (16:16:16) can increase plant height, stem diameter and dry weight of oil palm plants at the age of 3 months. Sijabat and Wawan (2017) reported that giving OPEFB compost 100 g 10 kg⁻¹ media with NPK fertilizer (16:16:16) 10 g 10 kg⁻¹ media was a combination of treatments that resulted in the highest growth of 6 months old palm oil seedlings in ultisol soil media.

Based on the above explanation, the study aimed to determine the effect of giving a combination of OPEFB organic material, cellulolytic bacterial consortium, and NPK fertilizer against the growth of oil palm seedling (*Elaeis guineensis* Jacq.) at main nursery.

MATERIALS AND METHODS

Study Site

This experiment was conducted at the University of Riau Experimental Field, 12.5 KM Bina Widya Campus Simpang Baru, Tampan District, Pekanbaru.

Preparation of Oil Palm Seeds to be Used in the Field Experiments

The oil palm seedling used came from a 3-month-old Dura x Pisifera crossing originating from Medan Marihat PPKS. The seedling used has good growth and are free from pests and diseases. The oil palm seedlings are selected whose growth is the same as the plant height of ± 25 cm. The planting medium used for oil palm nursery is topsoil, Inceptisol soil. The soil comes from the University of Riau's Faculty of Agriculture experimental garden with a depth of up to 20 cm. The soil taken is then dried, then the soil is sieved using a 25 mesh sized sieve. The soil is weighed 10 kg each and then put in a polybag measuring 30 cm \times 35 cm.

Composting Processes

The cellulolytic microbes prepared as treatment were two bacterial isolates from oil palm empty fruit bunches *Proteus mirabilis* OPEFB3 and *Proteus mirabilis* OPEFB7, two isolates of *Bacillus cereus* JP6 genus and *Bacillus cereus* JP7, and two acacia litter isolates genus *Providencia vermicola* SA1 and *Bacillus cereus* SA6 (Hapsoh *et al.* 2016). OPEFB compost starts with making cellulolytic bacterial decomposer starter was carried out by growing the six cellulolytic bacterial isolates on OPEFB media (0.02% $MgSO_4 \cdot 7H_2O$; 0.03% NH_4NO_3 ; 0.05% K_2HPO_4 ; 0.1% KH_2PO_4 ; 0.002% $FeSO_4 \cdot 7H_2O$; 0.004% $CaCl_2 \cdot 2H_2O$; 0.2% yeast extract, 1% OPEFB).

The six cellulolytic bacterial isolates were grown in 10 ml Nutrient Broth (1% of OPEFB media) and incubated for one day at room temperature 20-25°C. After that, the inoculant was grown in 100 ml OPEFB media and incubated for

3 days at the same temperature. As many as 20 ml of the bacterial suspension was transferred into the beaker glass, then added 20 g of granulated sugar and 980 ml of rice washing water so that the solution volume reached 1 L. Then the decomposer starter was left for 3 hours (Kurniawan *et al.* 2014a). Composting was done 1 month before the research begins. In composting, a ratio of decomposer starter with OPEFB was 1:2 (1 L starter: 2 kg OPEFB), while the indirect application (OPEFB + cellulolytic bacterial consortium treatment), the ratio of decomposer starter with OPEFB was 1:1 (100 ml: 100 g OPEFB).

Method of Fertilizer Treatment

The treatment method in this research consisted of 3 methods application, namely inorganic fertilizer, compost, and OPEFB + cellulolytic bacterial application. Application NPK fertilizer is carried out using NPK compound fertilizer (16:16:16). NPK fertilizer was given based on the dose level, namely 50% NPK as much as 10 g polybag⁻¹ and 100% NPK as much as 20 g polybag⁻¹. This activity was carried out in two stages which were one week before planting and one month after planting. In the application compost and OPEFB + cellulolytic bacterial, the amount of compost and raw OPEFB gave 100 g polybag⁻¹ each.

Data Analysis

The experiment was design in a Completely Random Design (CRD) with a single factor experiment to test the 5 treatments, namely M_1 : 100% NPK, M_2 : OPEFB compost, M_3 : 50% NPK + OPEFB compost, M_4 : 50% NPK + OPEFB + cellulolytic bacterial consortium, and M_5 : OPEFB + cellulolytic bacterial consortium. The data obtained were tested by simple statistics and continued with the Duncan Multiple Range Test (DMRT) with a 5% test. The observations in this research consisted of plant height, number of leaves, total leaf area, stem diameter, root to shoot ratio, and plant dry weight.

RESULTS AND DISCUSSION

Increase in Plant Height of Oil Palm Seedling

The results of the analysis of variance showed that NPK fertilizer and TKKS compost significantly affected plant height after two months and three

Table 1. Plant height (cm) of oil palm seedling in each treatment tested during three months of planting.

Treatment	1 month after planting	2 months after planting	3 months after planting
M ₁ : 100% NPK	3.497 a	10.830 a	17.162 a
M ₂ : OPEFB compost	1.080 a	4.077 b	8.910 b
M ₃ : 50 % NPK + OPEFB compost	3.500 a	10.497 a	17.662 a
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	2.790 a	8.580 a	17.330 a
M ₅ : OPEFB + Cellulolytic bacterial consortium	0.580 a	3.412 b	9.745 b

Note: The numbers in the column are followed by different lowercase letters significant effect according to the DMRT advanced test at the level of 5%.

months after planting. The average increase in plant height after a DMRT further test at 5% is presented in Table 1.

Table 1 shows that the increase in plant height after 1 month of planting was not significantly different in all treatments. This was likely due to the nutrients supplied through each treatment have not shown a significant effect on plants. After 2 months of planting, M₁ treatment produced the highest plant height which was significantly different from the M₂ and M₅ but not significantly different from other treatments. It is suspected NPK fertilizer can provide nutrients quickly for plant growth. According to Ariyanti (2019), the availability of nitrogen nutrients in the soil can stimulate vegetative growth, namely an increase of stems and leaves and plant height. Kaya (2014) stated that inorganic fertilizer can provide nutrients quickly for plant growth and increase soil chemical fertility because inorganic fertilizers are hygroscopic, which can absorb or bind water molecules from free air so that they are easy to melt and can easily be absorbed by plant roots.

After 3 months of planting, the highest increase in plant height was produced by M₃ treatment. The treatment was significantly different from the M₂ and M₅ treatments but not significantly different from other treatments. This was likely due to the application of OPEFB compost fertilizer was slowly providing nutrients for plant growth. Sundram *et al.* (2019) said that nutrient content of organic fertilizers is for the most invariably low compared to inorganic fertilizers. Based on the results of the analysis that has been carried out nutrient content in OPEFB was N 1.52%, P 0.30%, and K 4.52%. The content of organic matter is thought to be insufficient for palm oil seedling, so it must be combined with inorganic fertilizer. This is in line with the research of Hasibuan *et al.* (2014) which stated that the provision of OPEFB compost without the addition of NPK tended to show a lower increase in plant height when compared with the combination of OPEFB and NPK

addition. Ariyanti *et al.* (2017) reported that the height of sugar palm plants not yet produced also experienced an increase due to the administration of 25-50% of organic fertilizer combined with 50-75% inorganic fertilizer.

Compost can also improve the structure of the planting medium to be better. According to Yan and Gong (2010), using organic fertilizer can improve soil organic content. Yeboah *et al.* (2009) stated that the combination of inorganic fertilizers with organic fertilizers generally increases growth because organic matter can improve soil conditions so that nutrients become more available to plants. Rosenani *et al.* (2016) added the addition of organic fertilizers (oil palm waste compost) to soil increased oil palm seedling growth up to 70% at prenursery. However, the use of only compost is not enough to meet the nutritional needs of plants, so it must be combined with inorganic fertilizers to produce better plant height growth. Yi *et al.* (2019) added that the application of inorganic fertilizers does not much improve the physicochemical properties of the soil when compared to the combination of both. This was what causes that the M₃ and M₄ treatments gave the effect of increasing the height of oil palm seeds better than M₁ M₂ and M₅ treatments. This is also supported by Sijabat and Wawan (2017), where the combination treatment of 100 g 10 kg⁻¹ media OPEFB compost + NPK 10 g 10 kg⁻¹ of media is the best compared to all treatments and produces the highest average plant height of 37.70 cm at age 3 month.

Increase in Number of Leaves (strands) of Oil Palm Seedling

Based on the results of the analysis of variance, the addition of some NPK, OPEFB and OPEFB compost treatments significantly affected the increase in the number of leaves. The average increase in the number of leaves after further DMRT testing at 5% is presented in Table 2.

Table 2. Increasing the number of leaves of oil palm seedlings (strands) in each treatment tested.

Treatment	Number of leaves opened perfectly at the beginning	Number of leaves opened perfectly at the end	Increase in the number of leaves opens perfectly
M ₁ : 100% NPK	6.3	10.475	4.165 ab
M ₂ : OPEFB compost	5.7	8.4	2.662 d
M ₃ : 50 % NPK + OPEFB compost	6.37	11.22	4.827 a
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	6.22	10.22	3.915 bc
M ₅ : OPEFB + cellulolytic bacterial consortium	6.05	9.22	3.162 cd

Note: The numbers in the column are followed by different lowercase letters significant effect according to the DMRT advanced test at the level of 5%.

Table 2 shows that the M₃ treatment was the highest of the number of leaves, however it was not significantly different from the M₁ treatment, but significantly different from other treatments. It was suspected that if only NPK fertilizer is given, it will dissolve quickly so that NPK fertilizer will slowly contribute fewer nutrients to plants. According to Sutedjo (2008) that inorganic fertilizers dissolve easily in water because they are hygroscopic so that inorganic fertilizer application to the soil can increase the availability of nutrients quickly for plants. If the plant is only given NPK fertilizer, it will slowly reduce the quality of the soil and will invite negative effects on the soil includes changes in the physical, chemical, and biological properties within the soil (Sundram 2019). That is why the highest amount of open leaves was found in M₃ treatment compared with M₁ treatment. This is supported by Astralya (2009) which states that the use of compost is very supportive of improving soil quality both physically, biologically, and chemically so that nutrients can be available. Anwar (2009) added that organic fertilizer such as OPEFB compost has the effect of increasing soil pore space for the better and providing nutrient intake in soil fauna so that nutrients are available for plant growth. Organic matter content in the soil can increase the effectiveness of inorganic fertilization because it can bind nutrients and increase

the amount of negative charge so that the soil cation exchange capacity is high (Herviyanti *et al.* 2012).

The combination of compost and inorganic fertilizer will provide sufficient macro and micronutrients in the formation of leaves. Nutrients needed for leaf formation are elements N and P. Lakitan (2007) stated that plants that do not get additional Nitrogen will grow stunted and the leaves that are formed are also smaller, thinner, and the numbers will be smaller, while plants that get additional nitrogen nutrients will form more leaves and width. Nutrient N in OPEFB compost generally ranged from 1.34-2.03%. In the analysis of the OPEFB compost fertilizer, nitrogen content reached 1.52%. Nengsih (2015) added that the treatment of soil planting media + OPEFB compost (1: 2) had a significantly different effect from the treatment of soil + OPEFB compost (1: 1) on the number of oil palm seedling fronds. Besides, Sembiring *et al.* (2015) stated that the combination of 50 g humic⁻¹ acid polybag and 75 g polybag⁻¹ compost OPEFB gave the highest increase in plant height, number of leaves, stem diameter, root to shoot ratio, and dry weight compared to other treatment combinations.

Total Leaf Area (cm²) of Oil Palm Seedlings

The results of the analysis of variance on the observation of the total leaf area of oil palm seedlings

Table 3. Total leaf area of oil palm seedlings (cm²) in each treatment tested.

Treatment	Total leaf area (cm ²)
M ₁ : 100% NPK	173.18 b
M ₂ : OPEFB compost	78.56 c
M ₃ : 50 % NPK + OPEFB compost	185.04 ab
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	196.90 a
M ₅ : OPEFB + cellulolytic bacterial consortium	79.91 c

Note: The numbers in the column are followed by different lowercase letters significant effect according to the DMRT advanced test at the level of 5%.

Table 4. Increase in stem diameter of palm oil (cm) in each treatment tested.

Treatment	Stem Diameters at the beginning	Stem Diameters at the end	Increase in Stem Diameters
M ₁ : 100% NPK	1.06	3.22	2.160 a
M ₂ : OPEFB compost	1.2	2.34	1.145 b
M ₃ : 50 % NPK + OPEFB compost	0.8	3.24	2.200 a
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	1.05	3.1	2.050 a
M ₅ : OPEFB + cellulolytic bacterial consortium	1.25	2.4	1.152 b

showed that the treatment of NPK, OPEFB, and OPEFB compost gave a significant effect on the total leaf area. DMRT follow-up test results at the 5% level are presented in Table 3.

Table 3 shows that the M₄ treatment resulted in the widest leaf area was not significantly different from M₃ treatment and was significantly different from other M₃ treatments. This is suspected due to the provision of organic matter OPEFB which was added to the cellulolytic bacterial consortium which slowly decomposes and provides nutrients needed in plant growth. Also, the stocked organic matter of OPEFB can create good pore space, maintain soil moisture, and suppress weed growth. According to Widodo and Kusuma (2018), the addition of organic matter to the soil will increase water content due to increased soil pore so that the power to hold water increases. Besides, Hapsoh *et al.* (2019) stated that the provision of bacterial consortium applied through biofertilizers would support plant growth for the better. Three cellulolytic bacterial used in this study were *Bacillus cereus*. These bacteria are included in the PGPR bacterial group. This bacterium can produce phytohormone Indole Acetic Acid (IAA) (Gholami *et al.* 2009). This is thought to be one of the factors causing the area of palm oil leaves in the M₄ treatment to be better than the other treatments.

According to Ariyanti (2019), the leaf area describes the extent of the surface that plays a role in capturing the sun's rays needed for photosynthesis. Broader leaves tend to capture more sunlight so that they will contribute more to the photosynthates produced for the growth of other plant organs. The leaf area is strongly influenced by the N element. Lakitan (2007) added that nitrogen nutrients affect the formation of new cells, phosphorus plays a role in activating enzymes in the process of photosynthesis. Kiba *et al.* (2011) said that there is an interaction between phytohormones with nutrients N which ultimately affects the growth and development of plants.

Increase in Stem Diameters of Oil Palm Seedlings

The results of the analysis of variance showed that the treatment of NPK fertilizer, OPEFB compost, and OPEFB compost significantly affected the increase in stem diameter. The average increase in stem diameter after a DNMRT further test at 5% is presented in Table 4.

Table 4 shows that the M₃ treatment resulted in an increase in stem diameters was not significantly different from M₁ and M₄ treatments and was significantly different from M₂ and M₅ treatments. It was likely that the combination of inorganic and organic fertilizers given can equalize the growth of plants that are given nutrients through inorganic fertilizers. Yi *et al.* (2019) said that the use of organic fertilizers either alone or in combination with inorganic fertilizers will increase the nutrient content of the soil, improving the health of soils, and can reduce the use of inorganic fertilizers. Kurniawan (2012) reported that OPEFB compost in topsoil medium can improve soil structure, absorbency and save water better, and compost as an organic material can also provide nutrients for plants. The results of the study on the use of OPEFB compost increasing the stem diameter were also reported by Kusuma (2013) where the preparation of 20 Mg ha⁻¹ OPEFB compost was able to increase the diameter of the stem at the nursery stage. Adnan (2015) reported that there was an interaction between 50% NPK fertilizer and 36 g per polybag organic fertilizer on the stem diameter of palm oil seedlings in the nursery.

The increase in the diameter of plant stems is strongly influenced by the elemental content of potassium and phosphor (Setyamidjaja 2006). According to Maryani (2018) who stated that the potassium element plays an important role in increasing the diameter of plant stems, especially in its role as a network that connects roots and leaves in the process of nutrient absorption.

Table 5. Root to shoot ratio of oil palm seedlings (g) in each treatment tested.

Treatment	Root to shoot ratio
M ₁ : 100% NPK	2.025 bc
M ₂ : OPEFB compost	1.757 c
M ₃ : 50 % NPK + OPEFB compost	2.810 ab
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	3.045 a
M ₅ : OPEFB + Cellulolytic bacterial consortium	1.480 c

Note: The numbers in the column are followed by different lowercase letters significant effect according to the DMRT advanced test at the level of 5%.

Root to Shoot Ratio of Oil Palm Seedlings

The results of the analysis of variance on the observation of root to shoot ratio of oil palm seedlings showed that the addition of some NPK, OPEFB and OPEFB compost treatments significantly affected the root to shoot ratio. The average canopy ratio after further DNMRT tests at 5% is presented in Table 5.

Table 5 shown that M₄ treatment resulted in the best of root to shoot ratio was significantly different from other treatments and was not significantly different from M₃ treatment. It is suspected that the structure of the planting with a combination of inorganic fertilizer with OPEFB compost or OPEFB + cellulolytic bacterial consortium better than only given inorganic or organic fertilizer. Kurniawan *et al.* (2014b) said that OPEFB compost in topsoil medium can improve soil structure, absorbability and store water better, and compost as an organic material can also provide nutrients for plants. This is supported by the results of the Situmorang study (2015), that the addition of OPEFB organic mulch resulted in an increase in total pore space, water content, pH, C-organic, total N and K which were significantly different from oil palm plantations. Fauzi and Puspita (2017) reported that the addition of OPEFB compost at a dose of 750 g plant⁻¹ and P fertilizer 4.5 g plant⁻¹ increased root volume.

According to Yan and Gong (2010), using organic fertilizer also improves soil organic content

with a larger yield trend along with a contribution to the carbon sequestration by favoring root development. Widodo and Kusuma (2018) added that the addition of compost can causes loose soil structure and increased soil pore which will later cause easy plant roots developing. The growth of root can be improved by improving soil structure by increasing organic matter in the soil, thereby increasing nutrient exchange capacity, providing better water retention in the soil, preventing soil acidity by supporting the soil, and reducing leaching of N and P lost through fixation (Sundram 2019).

Dry Weight Biomassa of Oil Palm Seedlings

The results of the analysis of variance on the observation of the total dry weight of biomass of oil palm seedlings showed that the addition of some NPK, OPEFB and OPEFB compost treatments significantly affected the dry weight of oil palm seedlings. Average seedling dry weight after DNMRT further testing at 5% is presented in Table 6.

Table 6 shows the M₁ treatment produces the highest dry weight of plant but not significantly different with M₃ and M₄ treatments. Mishra and Dash (2014) said that fertilizers with high nutrient content are given with small amounts into the soil generally soluble and available to the plant immediately, which creates a direct, fast improvement in plants. However, the M₃ and M₄ treatments produced a relatively high dry weight of the plants such as the M₁ treatment. This shows

Table 6. Dry weight biomass of oil palm seedlings (g) in each treatment tested.

Treatment	Dry weight biomass
M ₁ : 100% NPK	54.000 a
M ₂ : OPEFB compost	24.450 b
M ₃ : 50 % NPK + OPEFB compost	50.750 a
M ₄ : 50% NPK + OPEFB + cellulolytic bacterial consortium	43.075 a
M ₅ : OPEFB + cellulolytic bacterial consortium	25.400 b

Note: The numbers in the column are followed by different lowercase letters significant effect according to the DMRT advanced test at the level of 5%.

that the combination of organic and inorganic fertilizers will also increase plant dry weight.

This is thought to be the case for both OPEFB and OPEFB compost given a cellulolytic bacterial consortium that contributes nutrients to plants even though they are available slowly but eventually can be absorbed by the roots. The availability of nutrients supports increasing plant dry weight. Nutrients from OPEFB compost help the metabolic processes of plants that trigger plant organ formation. It can be seen from the increase in height, a diameter of the stem, and some leaves and total leaf area in the seeds of oil palm plants. This is supported by the results of a study by Fauzi and Puspita (2017) reported that interaction between OPEFB compost and P fertilizer gave a good influence on all parameters, namely plant height, leaf number, stem diameter, root volume, seed dry weight, root to shoot ratio, leaf area, and dry weight of oil palm seedlings aged 7 months. Sijabat and Wawan (2017) added that the addition of 100 g/10 kg OPEFB compost combination media with 10 g/10 kg NPK fertilizer media was the best combination of treatments to increase plant height, leaf number, stem diameter, root volume, plant dry weight and ratio root crown of oil palm seedlings aged 3-6 months in Ultisol soil media.

All parameters generated by the treatments of M_2 and M_5 were much lower because the plants experience nutrient deficiencies so that a combination of inorganic fertilizers is needed to provide better nutrients. According to Widodo and Kusuma (2018), compost does not affect the vegetative growth of plants but it significantly influences changes in physical characteristics such as increasing soil pores and reducing the weight of soil contents. Therefore, to increase the growth of oil palm seedling and improve soil health by combining fertilizers (inorganic, organic, and microbial-based products) (Sundram 2019).

CONCLUSIONS

It can be concluded that firstly, giving a combination of 50% NPK + OPEFB compost gives the best effect on the parameters of increasing the height of oil palm seedlings, stem diameter, number of leaves and dry weight of seedlings, while the combination of 50% NPK + OPEFB + cellulolytic bacterial consortium provides the best leaf area and root to shoot ratio. Secondly, the organic fertilizer without inorganic fertilizer cannot provide plant growth on all parameters. Finally, application of OPEFB organic fertilizer given a cellulolytic bacterial consortium able to reduce the use of inorganic fertilizers by up to 50%.

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