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Application of Empty Palm Fruit Bunch Compost on Red Yellow Podsolic Soil for the Growth of Oil Palm Seedlings (Elaeis quineensis Jacq)

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Abstract
If red yellow podsolid (RYP)soil is to be used for oil palm seedling growth, technological input is needed, including empty palm fruit bunch (EFB) compost fertilizer. The study aims to determine the effect of providing empty palm fruit bunch compost on the growth of oil palm seedlings in the main nursery on red yellow podsolid soil planting media. This study was conducted in Jambi Indonesia. The design used was a Completely Randomized Design with one factor, namely the provision of EFB compost with a comparison of % volume with the treatment level K0 = 0% EFB compost and 100% RYP soil, K1 = 10% EFB compost and 90% RYP soil, K2 = 20% EFB compost and 80% RYP soil, K3 = 30% EFB compost and 70% RYP soil, K4 = 40% EFB compost and 60% RYP soil, K5 = 50% EFB compost and 50% RYP soil. Observations; seedling height, stem diameter, dry weight of the crown, dry weight of the roots. Data were analyzed statistically using analysis of variance, and DNMRT test at the α level of 5%. The application of EFB compost to red yellow podsolid soil with various treatments has a significant effect on seedling height, stem diameter, dry weight of the crown and dry weight of the roots of oil palm seedlings. Empty palm fruit bunch compost fertilizer with a treatment of 50% red yellow podsolid soil and 50% empty palm fruit bunch compost showed the best effect.

Keywords: Empty Palm Fruit Bunches Compost, Red yellow podsolid soil, Oil Palm Seedlings

1. Introduction

Indonesia is known as an agricultural country because of the large area of agricultural and plantation land. Palm oil is one of the prima donnas of Indonesian plantation products that has high export opportunities and non-oil and gas foreign exchange sources, and it is not surprising that palm oil is widely in demand, planted, or cultivated by the Indonesian people. The islands of Sumatra and Kalimantan are the largest palm oil producing areas each year with an average production of around 53,500 million tons. In this case, Indonesia is able to contribute around 85% to meeting the world's palm oil needs. So it is undeniable that the amount of palm oil waste as agricultural waste is also very large. Palm oil waste or what is often referred to as empty oil palm bunches which comes from industry or agriculture. Empty Oil Palm Bunches are organic waste in the form of lignocellulose which contains many carbon elements in the form of hemicellulose and cellulose carbohydrates, and lignin around 25.83%.

The processing of palm fruit in palm oil mills leaves waste which is the remaining processing. Waste generated from FFB processing in palm oil mills includes solid waste and liquid waste. In addition to the fruit, there are several parts of the oil palm that can be utilized as by-products that are no less profitable. These by-products include the utilization of empty bunches from palm fruit processing. Empty Palm Fruit Bunch (EFB) waste has great potential to be a material for making compost that can be used to add nutrition and produce nutrients so that it can be beneficial for soil fertility (Setyamidjaja, 1991) [8]. Some of the advantages of using EFB compost include: improving the structure of clayey soil to be light, helping the solubility of nutrients needed for plant growth, being homogeneous and reducing the risk of being a carrier of plant pests, being a fertilizer that is not easily washed away by water that seeps into the soil, can be applied in any season. EFB compost contains 16.84% organic C, 1.56% Nitrogen, 10.79% C/N ratio, 1.25% phosphorus, 0.94% potassium (Santi et. al, 2018) [7].

One aspect that needs attention in supporting the oil palm plantation development program is the provision of healthy seeds, with superior potential and on time. To get good seeds, it is necessary to create conditions that support growth and cultivation, such as the availability of both macro and micro nutrients. Fertilization in oil palm nurseries usually uses inorganic fertilizers which are quite expensive. In addition, excessive use of these fertilizers tends to cause a decrease in soil biological fertility, nutrient poisoning in plants and ultimately seedling growth will be hampered (Lingga, 2013) [5]. Organic fertilizers are fertilizers that come from the remains of living things, both animals and plants that undergo a decomposition process. This fertilizer is cheaper and can be produced independently and is environmentally friendly. However, its weakness is that it is slowly absorbed by plants. Organic fertilizers can improve the physical, chemical and biological properties of the soil. One type of organic fertilizer is empty oil palm bunch compost.

The results of the study by Setiawan *et al*. (2007) [9], showed that the provision of EFB with a composition of 15% EFB + 80% ultisol subsoil soil is the optimal composition for all parameters, namely shoot height, number of leaves, shoot diameter, root volume, soil pH, and plant dry weight. The results of the study by Wahyuni *et al*. (2021) [10] The provision of 40% EFB biochar + 60% ultisol soil increased the height and circumference of the stem, number of leaves, seedlings, and leaf chlorophyll content of oil palm seedlings. The application of EFB compost in the nursery had a significantly better effect on seedling growth compared to the standard treatment (without EFB compost). The results of the study by Heriyanto *et al*. (2015) [4] found that the provision of 75% EFB compost + 25% topsoil showed a significant effect on increasing the maximum height of seedlings, stem diameter, and dry weight of agarwood plants. The results of the study by Rahmawan *et al*. (2015) [6] explained that the provision of solid palm oil mill waste on red-yellow podsolid soil with a ratio of 1: 1 was the best result for the growth of cocoa seedlings.

The land available for oil palm plantations in Sumatra is generally red yellow podzolic soil (RYP). Naturally, RYP soil has less favorable chemical and physical properties. These properties include acid soil reaction, Cation Exchange Capacity and low nutrient content, especially N, P, K, and low organic matter content (Aditya *et al*., 2018) [1]. The level of fertility decline in RYP soil is quite high, therefore soil nutrient requirements need to be considered. This needs to be considered because the level of soil nutrients will greatly affect oil palm seedlings in the main nursery. One way that can be done to increase the fertility of RYP soil for oil palm seedlings in the main nursery is by fertilizing (Lingga, 2013) [5]. This study aims to determine the effect of providing empty palm fruit bunch compost on the growth of oil palm seedlings in the main nursery on red yellow podzolic soil planting media.

2. Materials and Methods

This research was conducted in Jambi City. The materials and tools used in this study were 3-month-old oil palm seedlings, water, red-yellow podzolic soil (RYP), empty oil palm bunch compost, 40 x 50 cm polybags, machetes, hoes, buckets, soil sieves, meters, analytical scales, calipers, electric ovens, bamboo, stakes, and deaf tools. The design used in this study used a Completely Randomized Design (CRD) with one factor, namely the provision of empty palm fruit bunch (EFB) compost with a comparison of % volume with the treatment level K0 = 0% EFB compost and 100% PMK Soil, K1 = 10% EFB compost and 90% RYP Soil, K2 = 20% EFB compost and 80% RYP Soil, K3 = 30% EFB compost and 70% RYP Soil, K4 = 40% EFB compost and 60% RYP Soil, K5 = 50% EFB compost and 50% RYP Soil. Each experimental unit consisted of 3 plants, each treatment was repeated 4 times so that the oil palm seedlings needed in this experiment amounted to 96 plants. Each experimental unit contained 1 sample plant, so that there were 24 sample plants. Observations; seedling height, stem diameter, dry weight of the crown, dry weight of the roots. The data needed to support the results of this study include soil chemical analysis, namely: total N, available P, available K, organic C and pH. The data were analyzed statistically using variance analysis, if the variance analysis shows a significant effect, it is continued with the DNMRT test at the α level of 5%.

3. Results and Discussion

The results of the data analysis of observations of the growth of oil palm seedlings given EFB compost in RYP soil in oil palm nurseries are shown in Table 1 below::

Table 1: Growth of oil palm seedlings after giving EFB compost in the main nursery at the age of 14 weeks after planting

Treatment EFB Compost	Seedling Height (cm)	Stem Diameter (mm)	Crown Dry Weight (g)	Root Dry Weight (g)
K5	58.25 a	21.30 a	25.53 a	10.52 a
K4	53.93 b	18.73 b	19.98 b	8.83 b
K3	51.18 b	18.08 b	19.38 b	8.66 b
K2	43.85 c	16.35 c	14.59 c	7.13 c
K1	42.15 d	13.35 d	11.93 d	6.03 d
K0	37.88 e	11.95 e	9.27 e	4.92 e

Description: Numbers followed by the same lower case letter are not significantly different in the DNMRT follow-up test at the 5% level.

Based on the results of the analysis of variance on seedling height, stem diameter, dry weight of the crown and dry weight of plant roots, it shows that the provision of EFB compost in the planting medium of oil palm seedlings has a significant effect. Furthermore, for the DNMRT test at the 5% level for each treatment can be seen in Table 1.

Based on Table 1, it can be seen that the highest seedling height, stem diameter, dry weight of the crown, dry weight of plant roots were obtained in the treatment of providing EFB compost with RYP soil with a ratio of 50%: 50% (K5), namely each seedling height 58.25 cm, stem diameter 21.30 mm, dry weight of the crown 25.53g, dry weight of the root 10.52g these results are significantly different when compared to other treatments. The lowest results in seedling height, stem diameter, dry weight of the crown and dry weight of plant roots were obtained in the treatment without giving empty oil palm bunch compost with PMK soil with a ratio of 0%: 100% (K0) namely for seedling height 37.88 cm, stem diameter 11.95 mm, dry weight of the crown 9.27 g, and dry weight of the root 4.92 g.

The results of the analysis of variance showed that the provision of EFB compost had a significant effect on seedling height, stem diameter, dry weight of the plant crown and dry weight of the roots of oil palm seedlings. The existence of this significant effect is closely related to the metabolic process in the plant body, because this process requires nutrients in sufficient quantities, the need for these nutrients is mostly contained in empty oil palm bunch fertilizer, both macro and micro. Based on the results of the Duncan test, it showed that the dose of EFB compost in the K5 treatment, namely 50% RYP soil compared to 50% EFB compost, could significantly increase plant height, stem diameter, dry weight of the crown and dry weight of plant roots compared to the K0 treatment or without EFB compost. The better growth of seedlings in the K5 treatment is closely related to the improvement of soil conditions and the availability of nutrients for oil palm seedlings.

The results of the RYP soil analysis after treatment showed that in the K5 treatment there was an increase in soil pH of 6.95, while in the untreated soil the pH was 5.52. An increase also occurred in the values of organic C, available P, total N, and available K in the soil after treatment. In the K5 treatment, organic C was 2.99, total N 0.291, available P 18.84 and K 0.49. While in the untreated soil, the availability of nutrients was shown in small amounts, where organic C was 0.97, total N 0.081, available P 1.21 and K 0.14. When the EFB compost fertilizer was mixed with the soil, there was a release of nutrients and a change in soil structure from solid to loose. Physically, the change in soil structure from solid to loose will cause changes in life in the soil and more microorganisms will live.

Increasing the pH in the soil will increase the availability of nutrients (K, Ca, Mg) which are obtained by increasing the dose of empty oil palm bunch compost. The increase in dry weight of oil palm plants in the K5 EFB compost treatment is due to the role of potassium in plant tissue. This is in accordance with Gardner's (1991) [3] statement that the absorption of potassium from the soil is stored in plant vacuoles which function to accelerate the growth of meristem tissue. Increasing the amount of potassium absorbed by plants will accelerate the division of meristem tissue cells continuously and produce new cells that form the plant body which in the end the branches also produce more. The provision of EFB compost given in sufficient quantities will improve PMK soil granulation so that it can improve aeration quality, improve soil drainage and increase the soil's ability to absorb water. This will lead to better root growth and development. This condition will greatly affect the increase in the absorption of nutrients and water which will ultimately have an impact on increasing the height and diameter of plant stems. One of the most important nutrients available in the provision of EFB compost is nitrogen. The function of N for plants is to stimulate overall plant growth and specifically on the stems, branches and leaves. Oil palm plants are plants that live in places that get full sunlight and have stomata on both surfaces, this indicates a high rate of photosynthesis. The process of photosynthesis itself requires nutrients in sufficient quantities so that it can increase vegetative growth. Elements that have a fairly dominant role in photosynthesis include the element N (Lingga, 2013) [5]. According to Gardner, et.al (1991) [3], photosynthate formed during the photosynthesis process is partly used for the formation of new cells in the meristem tip tissue. In addition, the results of protein synthesis are distributed to parts of the plant that are used in the formation of plant organs such as plant height. Thus, the photosynthate will be translocated to the meristematic base at the tip of the apex or root tip of cell division and cell enlargement in increasing the height and length of the roots. The occurrence of photosynthate and nutrients in sufficient quantities can increase vegetative plant growth such as leaf formation, increasing plant height and root formation. EFB compost fertilizer produces more nutrients, especially K. Gardner (1991) [3] stated that potassium plays an important role in photosynthesis because it directly increases growth and leaf area index and therefore also increases CO_2 assimilation and increases translocation of photosynthesis results out of the leaves. Translocation increases due to the formation of more ATP which is important for loading assimilation results into the phloem.

The dry weight of oil palm seedling crowns affects the nutrient content in plant tissue related to observations of seedling height and stem diameter where these parameters show significantly different effects. This shows that the composition of plant tissue nutrients is relatively different, so that the dry weight of oil palm seedling plants is significantly different. Nutrients absorbed by plants are part of all components of plant dry weight. Plants consist of liquid and dry materials. Dry materials consist of organic, inorganic and mineral elements. All of these elements are essential in building plant metabolic cell tissue. Deficiency of one of the above elements can inhibit the growth of oil palm plants.

In the K0 treatment, seedlings were not given EFB compost fertilizer which would give poor results. This can be seen from the growth in height, stem diameter and dry weight of root shoots and dry weight of roots showing poor growth due to lack of nutrients and dense soil conditions so that soil aeration is lacking.

4. Conclusion

The application of empty fruit bunch (EFB) compost on red-yellow podzolic (RYP) soil with various treatments gave a significant effect on seedling height, stem diameter, dry weight of the crown and dry weight of the roots of oil palm seedlings. The application of empty fruit bunch compost fertilizer with the treatment of 50% RYP soil and 50% empty fruit bunch compost showed the best effect on seedling height (58.25 cm), stem diameter (21.30 mm), dry weight of the crown (25.53 g) and dry weight of the roots (10.52 g).

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