DOI :https://doi.org/ 10.36378/juatika.v6i1.3259
JUATIKA
JURNAL AGRONOMI TANAMAN TROPIKA
VOL. 6 NO. 1 January 2024
eissn 2656-1727
pissn 2684-785X
Hal : 181 – 189

Optimizing The Growth of Palm Palm Seedlings by Providing Several Types of Market Waste Fertilizer and Planting Media

Hasrul Habib Sinuraya*, Enny Rahayu,
Umi Kusumastuti *
Institut Pertanian Yogyakarta
Jl. Nangka II, Krodan, Maguwoharjo, Kec. Depok, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55281
*E-mail: habibsinuraya4@gmail.com

ABSTRACT

Oil palm is a plant that holds a significant position in the agricultural and horticultural industries. The objective of this study was to examine the correlation between the composition of the planting medium and the utilization of commercial fertilizer waste on the growth of oil palm in nurseries. Additionally, the study aimed to determine the impact of different waste fertilizers on the market and the composition of the growing media for oil palm trees in the nursery. The research was conducted at the Education and Research Garden (KP2) in Wedomartani Village, Depok District, Sleman Regency, Special Region of Yogyakarta. The research site is at an altitude of 118 meters above sea level, and the study was conducted from March to June 2023. A factorial randomized design (CRD), consisting of two factors, was employed for this study. The first factor involved market waste, which was categorized into three levels: fish waste (70g), vegetable waste (70g), and fruit fertilizer (70g). The second factor focused on the composition of the planting media, which also had three levels: latosol 100g: beach sand 1900g, latosol 150g: beach sand 1850g, and latosol 200g: beach sand 1800g. The study included five repetitions, resulting in a total of 45 plants. The research data were analyzed using analysis of variance (ANOVA) at a significance level of 5%. The study's results revealed an interaction between the combination of market waste fertilizer and the composition of the oil palm planting media in the pre-nursery stage. Significant interactions and effects were observed between the combinations of fertilizer market waste and the composition of the growing media on leaf area and soil pH. Furthermore, the market waste fertilizer significantly impacted the number of leaves, stem diameter, shoot fresh weight, shoot dry weight, plant fresh weight, and plant dry weight. Additionally, the composition of the media had a significant influence on stem diameter and soil pH.

Keywords: market waste, planting media, and oil palm seeds

1. INTRODUCTION

Oil palm holds a significant role in agriculture overall and specifically in cultivation. Due to its abundant oil or fat production, oil palm stands out as the most economically valuable plant per hectare worldwide (Habibi Nasution et al., 2014).

The current oil palm plantation area in Indonesia has reached 10.95 million hectares, resulting in a production of 29.5 million tons of crude palm oil (CPO). The palm oil industry holds a significant position in the country's economy, with a commodity value of USD 17 billion, accounting for approximately 14% of total non-oil and gas trade. Besides its contribution to foreign trade, palm oil also plays a crucial role in local business and development, as the establishment of oil palm plantations has had a remarkable impact. Regarding productivity, oil palm plants surpass other vegetable oil-producing plants, with an average oil production of 4-5 tons per hectare on a commercial scale. This level of production exceeds that of rapeseed (2 tons/ha) and soybeans (0.5 tons/ha), which are the two main vegetable oil-producing plants (Suprianto et al., 2015).

High-quality seeds are the primary determinant of plant productivity in oil palm plantations. Additionally, the investment made in the plant material, specifically the seedlings, plays a crucial role in the profitability of commercial plantations in the future. Palm oil is a vital commodity for Indonesia, and its cultivation is rapidly expanding. Oil palm nurseries are typically categorized into Pre-Nursery and Main Nursery. In the Pre-Nursery stage, oil palm sprouts are planted in small polybags and nurtured in the soil until they reach three months of age (Nasution et al., 2014).

Fertilization is one method employed to enhance the quality of seeds in pre-nurseries. Oil palm seeds possess a limited supply of nutrients that can sustain seedling growth for three weeks. Therefore, subsequent nutrient requirements must be fulfilled through fertilization, ensuring the necessary nutrients are provided to support the growth of oil palm seedlings. It is crucial to pay attention to the proper application of fertilizer. Nitrogen-based fertilizers are essential at the initial stages of seedling growth. Nitrogen serves the purpose of stimulating overall plant development, including leaves. It stems from a fundamental component of proteins and nucleic acids that play significant roles within the plant(Prasetio, 2020).

One effort to increase soil maturity is through processing, one of which is using natural compost.

Composting is the biological decomposition and stability of organic material under certain temperature conditions resulting from heat due to the activity of microorganisms that multiply in it with results that are stable enough to be stored and used in the soil without harming the environment. The use of organic fertilizer derived from waste can save the use of chemical fertilizers by 25-40% (Supraptiningsih, 2010).

One possibility that can be seen from natural waste is its ability to make liquid fertilizer because natural waste itself contains nitrogen (N), phosphorus (P), potassium (K), nutrients, calcium (Ca).), iron. (Fe), sodium. (Na), Magnesium (Mg), and so on. Fruit mash benefits soil fertility, so it is very good for use as natural compost and environmental organisms. Natural compost can be an alternative to free plants from negative impacts, especially the buildup of compounds that people have used to process plants (Nur Muhammad, 2019).

Plant waste is easily decomposable due to its high water content. However, it also contains synthetic nutrients, minerals, and protein. The compost

derived from plant waste offers additional advantages as it decomposes easily in the soil. Moreover, plant waste contains essential ingredients such as fiber, phosphorus, iron, potassium, calcium, and other nutrients that aid in the growth and development of plants (Ajeng et al., 2021). According to research conducted by Markus Tambunan et al. in 2015, the combination of market waste compost and NPKMg fertilizer is believed to enhance the fertility of the planting medium. This combination increases the availability of nutrients that plants can readily absorb. Additionally, market waste compost helps retain soil nutrients due to its high ion exchange capacity, while NPKMg fertilizer further boosts the nutrient content in the soil. With an ample supply of nutrients, plant photosynthesis is optimized, leading to the distribution of photosynthetic products throughout the plant and supporting overall plant growth.

In this research, market waste fertilizer (fish, vegetables, and fruit) was used at a dose of 70 g and a combination of latosol and beach sand planting media, which is expected to support the growth of oil palm plants in the pre-nursery.

Soil obstruction is one of the variables that determines the level of disintegration. The higher the impurity disintegration record value (K), the lower the impurity opposition, the weaker the impurity for disintegration. Latosol soil is covered by kaolimit soil, especially mud with moderate flexibility and versatility, permeable to marginally permeable surfaces so that the limit of seepage and air circulation is very large without hindering the breathing of the roots, the ability to hold and store air is very large.

Latosol soil has very low shear strength, bearing limits, and compressive strength. The soil transportation limit value must be seen from the California Variable of Bearing (CBR) value. Sea sand is a low-yielding soil. The low efficiency of seaside sand is caused by limiting elements, for example, low water holding and holding capacity, high permeability and permeability, very low natural richness and materials, low usage proficiency, and little water (Panggabean et al., 2021).

The findings from the analysis conducted by Manu Rochmiyati and Wirianata in 2017 indicate that applying organic materials in different amounts to coastal sand soil consistently impacts the growth of oil palm seedlings. Specifically, providing a 20% dosage of organic fertilizer positively influences seedling growth. However, increasing the dosage to 25%, 33.3%, or 50% does not enhance further growth. This suggests that a 20% dosage of organic fertilizer adequately meets the nutrient requirements of the oil palm seedling medium. Moreover, adding organic material at a 20% dosage improves the aggregation of loose beach sand soil, ensuring proper aeration, drainage, and root respiration. Additionally, it enhances the soil's ability to retain and supply water to the seedlings. Consequently, the provision of organic materials increases nutrient availability and enhances beach sand soil's physical and chemical properties.

It is anticipated that utilizing a 70 g quantity of fertilizer derived from market waste and latosol media will yield favorable outcomes in enhancing the physical and chemical characteristics of beach sand soil. By effectively combining these two treatments, promoting the development of oil palm seedlings in the pre-nursery stage becomes feasible.

2. MATERIAL AND METHODS

The objective of this study is to determine if there is a correlation between market waste fertilizer and the composition of the planting media in the pre-nursery stage and to assess the impact of these factors on the growth of oil palm seedlings.

The research occurred at the Education and Research Garden (KP2) in Wedomartani Village, Depok District, Sleman Regency, Yogyakarta Special

Region. The research site is at an elevation of 118 meters above sea level. The study was conducted from March to June 2023.

This study employs an experimental approach utilizing a completely random factorial design (CRD) with two factors. The first factor involves market waste fertilizer, which is categorized into three levels: fish waste fertilizer 70 (g), vegetable waste fertilizer 70 (g), and fruit fertilizer 70 (g). The second factor pertains to the composition of the planting medium, which consists of three levels: latosol 100 (g): beach sand soil 1900 (g), latosol 150 (g): beach sand 1850 (g), and latosol 200 (g): sand coast 1800 (g).

Consequently, there are a total of 9 combinations, each repeated 5 times, resulting in the requirement of 45 seeds. The collected data was subjected to Analysis of Variance (ANOVA) at a significance level of 5% for further analysis.

The stages in carrying out the research are shown in the diagram.

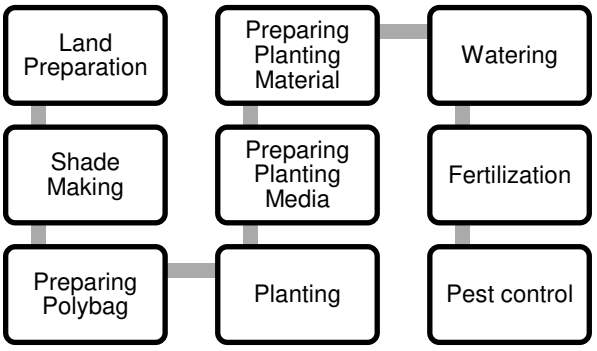

Figure 1. Research Stage

3. RESULT AND DISCUSSION

The results of testing variations in oil palm leaf area show a real interaction between the application of market waste organic fertilizer and the composition of the planting media per leaf area. The results of the analysis can be seen in Table 1.

Table 1. The results of the planting media per leaf area (cm)

Market Waste	Planting Media Composition Latosol (g) : Beach sand (g)			Mean
	100 : 1900	150 : 1850	200 : 1800	
Fish waste	153.71 b	144,87 b	152.27 b	150.28
Vegetable waste	180.58 a	148,31 b	145,01 b	157,96
Fruit waste	130.41 b	136,13 b	144,12 b	136,89
Mean	154,90	143.10	147,13	(+)

Note : Numbers followed by the same letter in the same column or row are not significantly different based on the DMRT level of 5%.

(+) : There is real interaction

The table above shows that the combination of treatments occurred on latosol soil 100 (g): beach sand soil 1900 (g), and vegetable market waste fertilizer. And latosol 100 (g): beach sand 1900 (g) with vegetable waste fertilizer had a better influence on leaf area than other treatments.

The results of this research show that there is a better influence and interaction with the combination of vegetable waste fertilizer 70 (g) and latosol 100 (g): beach sand 1900 (g) with a total leaf area of 180.58 (cm2), compared to the research results (Markus Tambunan et al., 2015) which shows that there is an interaction and influence on the application of market waste fertilizer and NPKMg fertilizer with the best total leaf area of 135.49 (cm^2).

The results of testing variations in oil palm soil pH showed a significant interaction between the application of commercial waste compost and the composition of the planting media on soil pH. The results of the analysis can be seen in Table 2.

Table 2. The results of the oil palm soil pH

Market Waste	Planting Media Composition Latosol (g) : Beach sand (g)			Mean
	100 : 1900	150 : 1850	200 : 1800	
Fish waste	5.40 e	6.10 cd	5.90 d	5.80
Vegetable waste	6.50 bc	5.40 e	6.90 ab	6.26
Fruit waste	6.00 cd	6.00 cd	7.30 a	6.40
Mean	5.96	5.83	6.66	(+)

Note: Numbers followed by the same letter in the same column or row are not significantly different based on the DMRT level of 5%.
(+) : There is real interaction

The table above shows that the combination of treatments occurred on latosol soil 200 (g), beach sand 1800 (g), and fruit market waste fertilizer. Also, the combination of fruit waste fertilizer with latosol 200 (g): beach sand 1800 (g) has a better effect on soil pH than other treatments. It has the same results as the composition of the planting media latosol 200 (g): beach sand 1800 (g). Meanwhile, the combination of planting media latosol 150 (g): beach sand 1850 (g) and latosol 100 (g): beach sand 1900 (g) had the lowest effect in each treatment.

The variance analysis results show interaction and real influence from fruit waste fertilizer and latosol 200 (g): beach sand 1800 (g). This is different from research results (Markus Tambunan et al., 2015), which showed that applying market waste fertilizer and NPKMg fertilizer only had a real effect on soil pH but did not provide an interaction between the two treatments. However, it has equally good results with an average pH of 6.20, which is included in the neutral pH category.

Table 3. The effect of providing market waste compost fertilizer on the growth of oil palm seedlings in the pre-nursery

PARAMETER	MARKET WASTE FERTILIZER		
	FISH	VEGETABLES	FRUIT
Plant Height (cm)	19,80 p	21.86 p	21.66 p
Number of Leaves (pieces)	3.93 q	4,33 pq	4,73 p
Leaf Area (cm^2)	150.28	157,9	136,8
Bar Diameter (mm)	7,39 q	7,71 pq	8,49 p
Root Length (cm)	21.86 p	23.20 p	21.73 p
Header Wet Weight (g)	3.16 q	4,65 p	4,89 p
Header Dry Weight (g)	0.72 q	1.03 p	1.10 p
Root Wet Weight (g)	1.89 p	2.22 p	2.13 p
Root Dry Weight (g)	0.42 p	0.51 p	0.47 p
Plant Wet Weight (g)	16,33 p	20.22 p	21.17 p
Plant Dry Weight (g)	1.35 p	1.66 p	1.78 p
Soil pH	5,80	6,26	6,40

The analysis results show that using fertilizer from market waste significantly affects the number of leaves, stem diameter, fresh weight of shoots, dry weight of shoots, fresh weight of plants, and even plants.

The results of the analysis show that there are differences with the results of research (Manu Rochmiyati & Wirianata, 2017) which used organic manure, LCC compost, peat, and vermicompost, which shows that the application of organic fertilizer cannot have a real effect on the above parameters. This shows that applying fish, vegetable, and fruit market waste fertilizer at a dose of 70 (g) has a good influence on the growth of oil palm plants in the pre-nursery.

The research using market waste fertilizer treatment showed that in terms of plant height parameters, fish, vegetable, and fruit waste fertilizer gave equally good results in each treatment. The leaf number parameter indicates that the fruit and vegetable waste fertilizer application has the same good results and is better when compared to the effect provided by fish waste fertilizer. Fish waste fertilizer had the lowest influence on the growth of the number of leaves.

The stem diameter parameter indicates that the utilization of fruit waste fertilizer yields comparable outcomes to the utilization of vegetable waste fertilizer. Additionally, the application of fruit waste fertilizer demonstrates superior results compared to the application of fish waste fertilizer. In the meantime, vegetable waste fertilizer produces positive outcomes similar to fruit and fish waste fertilizer on the leaf area of oil palm plants during the pre-nursery stage.

Regarding the root length parameters, it is evident that the application of fish, vegetable, and fruit waste fertilizer all yield equally favorable results on the root length of oil palm plants in the pre-nursery stage.

When considering the wet crown weight and shoot dry weight parameters, it is observed that the application of vegetable and fruit waste fertilizer yields similar and superior results compared to the impact of fish waste fertilizer. Notably, fish waste fertilizer has the least influence on the growth of shoot fresh weight and shoot dry weight of oil palm plants in the pre-nursery stage.

The parameters of wet root weight and dry root weight show that applying fish, vegetable, and fruit waste fertilizer gives equally good results on the growth of root wet weight and root dry weight of oil palm plants in the pre-nursery.

The parameters of plant wet weight and plant dry weight also show that applying fish, vegetable, and fruit waste fertilizer gives equally good results on plant wet weight and dry weight of oil palm plants in pre-nursery.

Vegetable waste fertilizer has a total Nitrogen content of 3.06%, a total Phosphorus content of 3.18%, and a total Potassium content of 3.32% (Amalia Karyanto et al., 2022). And fruit waste fertilizer has a total Nitrogen content of 3.53%, a total Phosphorus content of 0.53%, and a total Potassium content of 4.44 (Surtinah, 2013). Meanwhile, fish waste fertilizer has a total Nitrogen content of 2.26%, a total Phosphorus content of 1.44%, and a total Potassium content of 0.95% (Muhammad & Pavi Harjo, 2017).

Nitrogen is a supplement that plants need for vegetative development and protein regulation. Assuming the plant lacks nitrogen, it will cause stunted development, limited root development, yellow leaves, and falling off. Higher convergence of nitrogen, phosphorus, and potassium fundamentally impacts the development of leaf number, stem size, new shoot weight, shoot dry weight, new plant weight, and plant dry weight.

Table 4. The influence of the composition of the planting medium on the growth of oil palm seedlings in the pre-nursery

PARAMETER	Planting Media Composition Latosol (g) : Beach sand (g)		
	100 : 1900	150: 1850	200: 1800
Plant Height (cm)	20.03 a	21.56, a	21.73 a
Number of Leaves (pieces)	4,00 a	4,40 a	4,60 a
Leaf Area (cm^2)	154,90	143.10	147,13
Bar Diameter (mm)	7,26 b	8,42 a	7,90 ab
Root Length (cm)	19,16 b	23.33 a	24,30 a
Header Wet Weight (g)	3.50 a	4,41 ab	4,78 b
Header Dry Weight (g)	0.85 a	0.89 a	1.11 a
Root Wet Weight (g)	1.87 a	2.21 a	2.16 a
Root Dry Weight (g)	0.41 a	0.52 a	0.47 a
Plant Wet Weight (g)	16,59 a	21.49 a	19,64 a
Plant Dry Weight (g)	1.35 a	1.83 ab	1.61 b
Soil pH	5,96	5,83	6,66

Figure 2. Comparison of treatment results on oil palm seedling

Observation results show that the composition of the planting medium has a real influence on stem diameter and root length.

The observation results are in accordance with the research results (Manu Rochmiyati & Wirianata, 2017), which state that the provision of organic material in planting media plays a role in the physical and biological properties of the soil, such as soil stabilization and aggregates. The ability of the soil to store and provide water for seedlings, as well as optimizing soil aeration, so that the soil is better at supplying available water for seedlings, more smoothly in assisting the root respiration process and able to expand the root development zone due to the soil being more loose and crumbly.

These observations indicate that the planting media treatment gave equally good results for plant height and number of leaves in each planting media composition.

The stem diameter parameter shows that the administration of latosol 150 (g): 1850 (g) beach sand has the same good results as latosol 200 (g) : 1800 (g) beach sand, and is better when compared with the composition of latosol 100 (g): beach sand 1900 (g).

The root length parameters indicated that the utilization of the latosol 150 (g): beach sand 1850 (g) composition yielded outcomes that were equally satisfactory or even superior when compared to the impact produced by the latosol 100 (g): beach sand 1900 (g) composition.

The shoot fresh weight, shoot dry weight, root fresh weight, root dry weight, plant fresh weight, and plant dry weight parameters demonstrate that the composition of the planting media delivered consistently positive results across all treatments.

The planting media analysis reveals that the composition of latosol and beach sand can mutually enhance each other's effects. By blending these two media, you can offer plants optimal nutrition and create a growth-promoting environment for oil palm seedlings. Additionally, the research findings demonstrate that the combination of latosol and beach sand results in a neutral soil pH. This neutral pH facilitates the easy dissolution of nutrients in water, enabling plants to absorb them efficiently.

4. CONCLUSION

The interactions between market fertilizer and the production media influence the growth of oil palm trees in nurseries. The presence of manure waste in the market significantly impacts various aspects of the trees' development, such as the number of leaves, stem width, weight of new shoots, dry weight of shoots, weight of new plants, and dry load of the trees. Interestingly, vegetable waste manure has been found to have a comparable or even superior effect on oil palm development compared to fish waste compost in nurseries.

Furthermore, the composition of the planting medium also plays a crucial role in the growth of oil palm seedlings. It affects the stem diameter and root length, and this effect remains consistent across different treatments in the Pre Nursery. Therefore, it is essential to consider the composition of the planting media when aiming for optimal growth and development of oil palm seedlings.

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