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Effect of Palm Oil Mill Effluent (Pome) Concentration and Soil Type on the Growth of Oil Palm (*Elaeis guinensis* Jacq) in Pre-Nursery

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ABSTRACT: The place of research was carried out at Educational and Research Garden of the STIPER Agricultural Institute which is located in Maguwoharjo Village, Depok District, Sleman Regency, Yogyakarta, Indonesia. The research location is located 118 meters above sea level. This research was conducted between March to June 2024. Two components make up the factorial experiment used in the Complete Randomized Design (CRD). The soil type had three levels: A1 = latosol soil, A2 = regusol soil, and A3 = grumusol soil, was the first factor. Palm Oil Mill Effluent (POME) concentration was the second factor. It was consisted into four levels: X1 was the control (NPK fertilizer), X2 was 150 ml per polybag, X3 was 300 ml per polybag, and X4 was 450 ml per polybag. So there were 12 treatment combinations (3 x 4 = 12) with 4 repetitions, so all the experiment 48 plants. *Analysis of variance* (ANOVA) was applied at the significant level of 5% to check the observation data. Duncan's Multiple Range Test (DMRT) was then used at a noticeable 5% level if there was significant difference. The weight parameters of fresh roots and the amount of chlorophyll in the leaves are influenced by the interaction of the soil and POME concentration. The composition, regusol soil and POME 450 ml/polybag provide an optimal combination of treatments. The type of soil has an impact on the weight of fresh and dry crowns, the number of leaves, the chlorophyll content in the leaves, the volume of roots, and the height of the plant. The best type of soil is regusol soil. Plant height, root volume, fresh and dry crown weight, and leaf chlorophyll content are all affected by POME concentration. The concentration of POME 450 ml/polybag showed the best results

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KEYWORDS: *pre nursery*, POME, soil type

INTRODUCTION

Over the past few decades, Indonesia has become the largest producer of palm oil in the world. There are 26 provinces that have oil palm plantations out of 33 provinces in Indonesia. The dominance of palm oil in human production and consumption, this revolution led to a significant shift in the global vegetable oil trade. The Indonesian Palm Oil Entrepreneurs Association (GAPKI, 2024) announced that over the past few decades, Indonesia has emerged as the world's leading palm oil producer. In 2024, Indonesia produced more than 46.3 million tons of palm oil.

Crude *palm oil* (CPO) production in Indonesia reached 4,523,000 tons in October 2023, up 9.2% from 4,143,000 tons in September 2023. But today, because so many palm oil plants are more than 25 years old, palm oil production is declining. To bypass this and increase oil palm crop production again, replanting is required. For replanting activities, nurseries (*pre nursery* and *main nursery) are needed*. In order to produce healthy and robust seeds, the purpose of the nursery is to do so.

The availability of fertile soil is currently very limited, so the selection of suitable soil types for nursery must also be done. In conventional plantations, the soil used for nursery is the top soil of the mineral soil type. Top soil is a topsoil with a more excellent content of organic C- because it has a lot of humus, or organic matter (Roni and Witariadi, 2015).

One of the factors that can hinder nursery is the lack of nutrients. Plant growth is supported by sufficient nutrients, therefore fertilizer is very important for plants. Fertilizers are divided into 2 categories, namely organic and inorganic fertilizers.

Liquid waste from palm oil mill stores large amounts of dissolved solids, including those derived from lignocellulose materials containing oil from palm fruit defined as *Palm Oil Mill Effluent* (POME). Because it contains carbon dioxide and organic compounds, POME has the potential to be used as an organic fertilizer (Princess *et al*., 2023).

One of the organic fertilizers rich in nutrients needed by plants, such as N, P, K, Mg, and Ca, is called Palm Oil Mill Efficient (POME). In addition to being a valuable organic fertilizer that improves the physical, chemical, and biological quality of the soil, POME can be utilized as a source of nutrients for oil palm and add moisture to the soil (Perdian, 2021).

RESEARCH METHODS

The research has been carried out at Research & Educational Garden of the STIPER Agricultural Institute, Kalikuning, Wedomartani Village, Depok District, Sleman Regency, Yogyakarta, Indonesia. The research carried out from March 2024 to June 2024. Measuring instruments, shovels, polybags, knives, ovens, and digital scales were some of the equipment used in this research. Meanwhile, the materials used in this study were planting media, POME, bamboo, paranet, oil palm sprouts (*Elaeis guinensis*).

The research design used a Complete Randomized Design (CRD} with 2 factors. The first factor was the treatment of POME dose application with four levels, namely control (0 ml), 150 ml/polybag (3x administration of 50 ml each), 300 ml/polybag (3x administration of 100 ml each), and 450 ml/polybag (3x administration of 150 ml each). The second factor consisted of different types of soils, including grumusol, regosol, and latosol. With four treatment combinations obtained 4 x 3 = 12 treatment combination with 4 replication. Therefore the total number of seedlings planted in this study was 48 plants. *Analysis of variance* (ANOVA) are used to examine the observation data. If significant effect was found, *the Duncan's Multiple Range Test* (DMRT) was performed at a significant level of 5%.

RESULTS AND DISCUSSION

The results of the ANOVA showed that there was a significant interaction between soil type and POME concentration on root dry weight and leaf chlorophyll levels. This shows that the two components can work together to provide good dry-weight parameters of roots and chlorophyll for the growth of oil palm seedlings in *pre-nursery*.

Table 1. Effect of soil type and POME on dry weight of roots and chlorophyll.

Growing media	POME	Observation parameters	
		Root dry weight (g)	Chlorophyll (nm)
Latosol soil	Control	0.27ab	50.52cde
	150 ml/polybag	0.23ab	49.35de
	300 ml/polybag	0.14c	42.65f
	450 ml/polybag	0.25ab	56.25b
Regosol soil	Control	0.16c	54bc
	150 ml/polybag	0.20ab	60.275a
	300 ml/polybag	0.20ab	54.05bc
	450 ml/polybag	0.45a	64.27a
Grumusol soil	Control	0.16c	51.5cd
	150 ml/polybag	0.18c	46.725e
	300 ml/polybag	0.21ab	50.35cde
	450 ml/polybag	0.31ab	61.37a

Remarks: The average number followed by the same letter in the column shows no significant difference based on DMRT at the 5% level.

Table 1 The results of the analysis of variance showed the interaction of dry weight of the roots, with the best treatment being regusol soil at POME 450 ml / polybag. Because POME can bind water and soil aggregates well and increases the availability of high organic matter and nitrogen content, it is suspected that regusol soil added with 450 ml of POME can increase the availability of N nutrients, P, K, Ca, and Mg, thus encouraging vegetative growth of plants (pre-production) (Herman, 2019). Regusol soil contains enough aeration to encourage root growth and functions as a nutrient transport agent in POME, meeting the nutritional needs of plants, so that it becomes a nutrient transport agent in POME, so the nutrient needs of plants are met. The results are in agreement with Genesis *et al.(* 2020). At the same time, the lowest significant treatment was 300 ml latosol soil/polybag, control regusol soil, control grumusol soil, 150 ml grumusol soil / polybag and latosol soil 300 ml / polybag. It is suspected that latosol soils, grumusol, and regusol soils have a low cation exchange capacity if they are not by the right dose, so they cannot hold many

positive ions such as K, Ca, and Mg and have poor acid-base properties, and can interfere with plant growth. Low pH levels can cause nutrients in POME to not be absorbed by plants (Wafa, 2023).

The combination of the application of various soil types and POME concentration, there was a significant interaction on the parameters of oil palm chlorophyll. The combination of regusol soil and POME 450 ml/polybag gives the best results. It is suspected that the application of POME added to the regusol soil can increase the chlorophyll of plants. According to Marlina *et al*., (2018) that the population of POME-fed soil microorganisms increases, thereby increasing the availability of nutrients N, P, and K. This contributes to increasing plant chlorophyll, which is very important in photosynthesis. The type of soil also affects the chlorophyll of the plant. The research conducted shows that the nutrient uptake of N, P, and oil palm plant growth. A suitable soil pH can also increase plant chlorophyll, as a suitable pH can affect the activity of microbes that play a role in the photosynthesis process (Ramadan *et al.*, 2021). At the same time, the lowest significant treatment is POME 300 ml / polybag in latosol soil. It is suspected that latosol soil added with POME 300 ml/polybag has very low levels of organic matter so that it inhibits plant growth and photosynthesis. In addition, the pH of highly acidic latosol soil makes the activity of microorganisms decompose organic components and the absorption of plant nutrient components inhibited. A very acidic pH can also inhibit the photosynthesis process, so a neutral pH to a little alkaline is needed for it to occur (Saragi *et al*., 2023).

The nutrient components N, P, K and Mg come from a combination of POME treatment in latosol, regusol and grumusol soils. The nutrients in the soil can continue to increase and can increase the effectiveness of fertilization because of the soil cation exchange capacity (Haryati, 2014). In order for seedlings to grow, organic fertilizers must be available. Oil palm seedlings will slow down their growth if fertilizers are not applied precisely, as both will have detrimental effects. Organic fertilizers can improve the soil's physical, chemical, and biological fertility. This can increase the capacity of the soil to hold water, ensure sufficient aeration and drainage, increase soil circulation, and increase the activity of soil microorganisms in breaking down nutrients needed by plants (Saputra *et al.*, 2017). Palm oil waste is rich in nutrients and has potential agronomic value and can be used as raw materials for composting and can recycle nutrients. The Effect of palm oil waste compost on seed growth and nutrient absorption is that it can improve the physiology of oil palm seedlings by applying organic fertilizers. This is largely due to changes in the physical and chemical properties of the planting medium (Rosenani *et al*., 2016).

Table 2. The effect of soil type on the growth of pre-nursery oil palm seedlings.

Observation parameters	type of soil		
	Latosol soil	Regusol soil	Grumusol soil
Plant height (cm)	21.07b	23.08a	22.16ab
Number of leaves (pieces)	3.37a	3.18a	3.37a
Leaf area (cm2)	140.05a	139.94a	132.14a
Fresh weight of crown (g)	3.06c	4.33a	3.61b
Crown dry weight (g)	0.54b	0.66a	0.69a
Root fresh weight (g)	1.06c	1.56a	1.28ab
Root dry weight (g)	0.22a	0.25a	0.21a
Root length (cm)	22.6a	23.91a	22.84a
Root volume (ml)	2.28b	1.75a	1.71a
Chlorophyll (nm)	49.69a	58.15	52.49a

Remarks: The average value accompanied by the same letter in the column shows no significant difference based on DMRT at the 5% level.

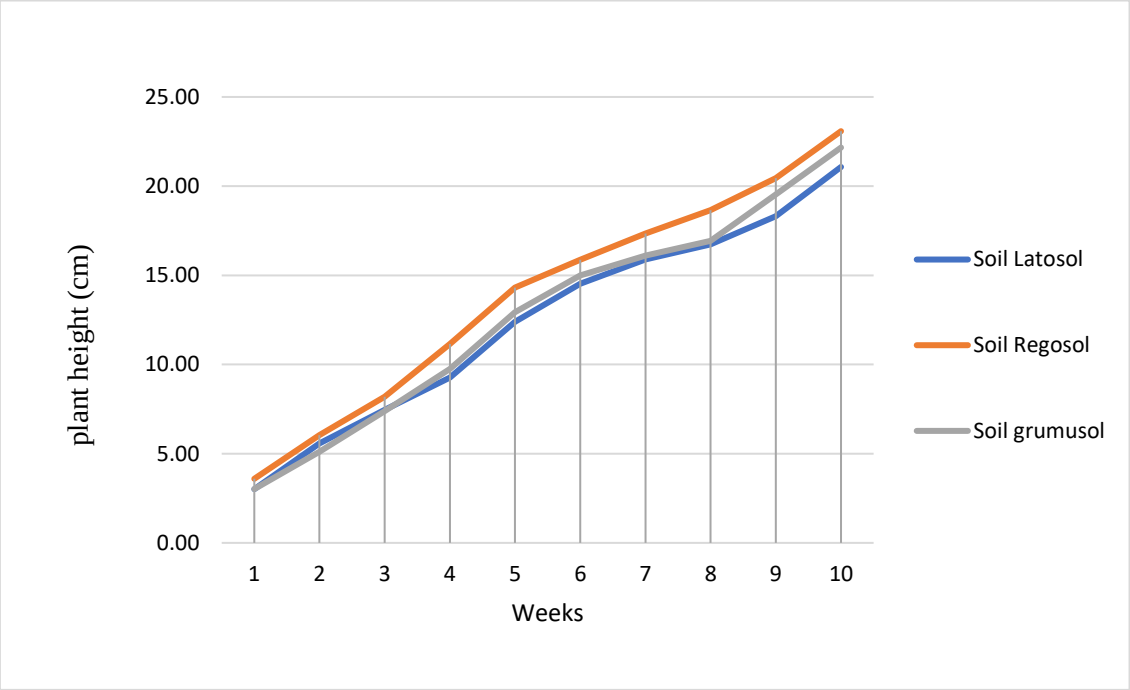

Figure 1. High development of pre-nursery oil palm seedlings in the application of various soil types

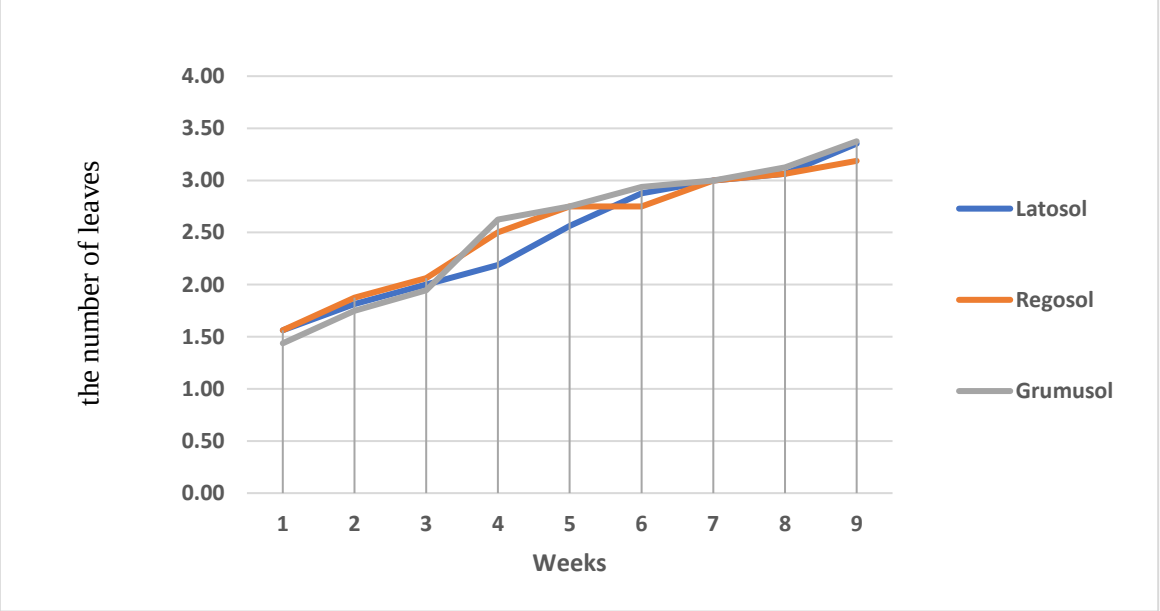

Figure 2. Development of the number of leaves of pre-nursery oil palm seedlings in the application of various soil types

Figure 1 and 2 are representing the growth of plant height (cm) and number of leaves every week on various soil types.

Table 2 shows that plant height, fresh weight of crown, dry weight of crown, fresh weight of roots, and volume of roots are affected by the treatment of various types of soil. In the five parameters above, the best type of regusol soil. Regusol soil has good aeration to support respiration, this supports plants to get the oxygen they need for growth (Igun *et al*., 2023).

POME can activate biochemical activity in soil, including microbes that release the phosphatase enzyme, by acting as an energy source for microorganisms. This enzyme promotes plant growth by converting the P element into an accessible form. By applying POME as an organic fertilizer, plants can increase the availability of the P component and inhibit the ability of the Fe component and the Al component to bind the P element (Ramadan *et al.*, 2021). The availability of nutrients is essential for growth. POME contains nutrients such as calcium, potassium, and nitrogen that help in cell elongation and division, promote the growth of new cells, and thicken cell walls.

In table 2, the treatment of different soil types on the parameters of plant height, fresh weight of crown, dry weight of crown, fresh weight of roots and volume of roots. In the five parameters above, the latosol soil type obtained the lowest growth. It is thought that regarding nutrient content, redder latosol soils usually have a lower content. Generally, the nutrient content in this soil is low

to moderate. Latosol soil has a poor drainage rate and is difficult to absorb water so that infiltration and percolation of water in this soil can take place from a bit fast to slow (Igun *et al., 2023)*. Latosol soil is usually found in moist places and has high rainfall because it contains iron and aluminum, so it is less fertile and not good for plant establishments. The pH of latosol generally ranges from 4.5-6.5 which is somewhat acidic and insufficient for plant growth (Saragi *et al*., 2023). 100% POME is accepted as fertilizer. This can be caused by the rapid mineralization of chemical fertilizers and the availability of plant nutrients for plants. The addition of organic amendment materials such as POME has made a significant contribution to the improvement of soil organic matter. POME will help improve the organic matter content and soil color. The addition of POME has also been reacted as a *buffering agent* to counter the addition of H+ in soil solutions (Hettiarchy. *et al*., 2020).

Table 3. Effect of POME on growth parameters of oil palm seedlings in *pre nursery*.

Observation parameters	POME			
	Control	150 ml/polybag	300 ml/polybag	450 ml/polybag
Plant height (cm)	18.56q	23.49p	22.40p	23.95p
Number of leaves (pieces)	3.33p	3.25p	3.33p	3.33p
Leaf area (cm2)	114.94q	147.29p	144.64p	142.63p
Fresh weight of crown (g)	3.20p	3.53p	3.14p	4.79p
Crown dry weight (g)	0.45r	0.62q	0.62q	0.82p
Root fresh weight (g)	0.98s	1.43pq	1.20qr	1.6p
Root dry weight (g)	0.20p	0.20p	0.18q	0.33p
Root length (cm)	26.31p	21.33p	21.88p	22.95p
Root volume (ml)	1.66q	1.79q	1.58q	2.62p
Chlorophyll (nm)	52.01q	52.12q	49.02r	60.63p

Remarks: The average number followed by the same letter in the column shows no difference based on DMRT at the 5% level.

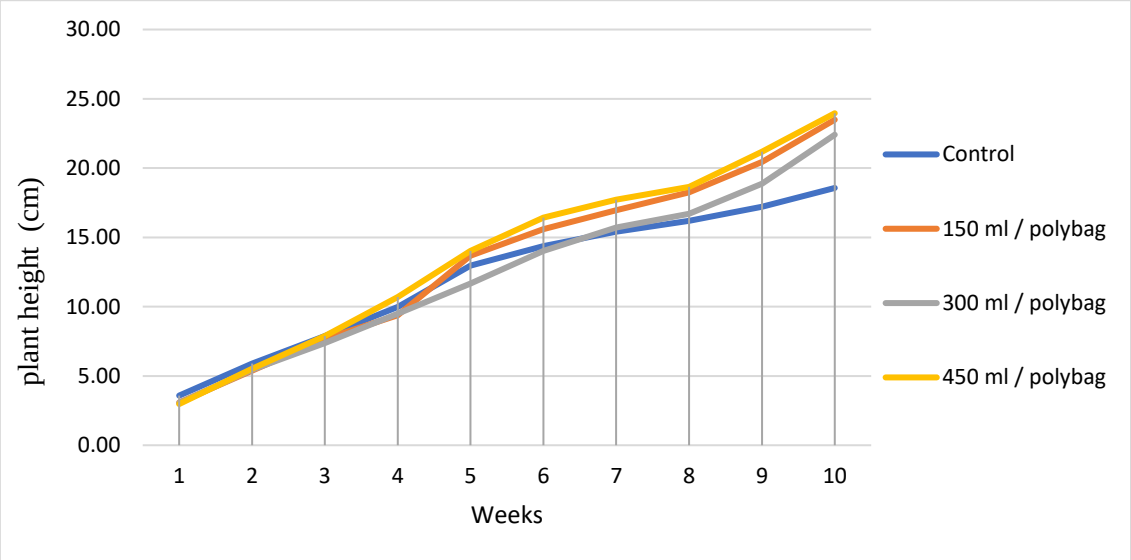

Figure 3. High growth of oil palm pre-nursery plants in POME application

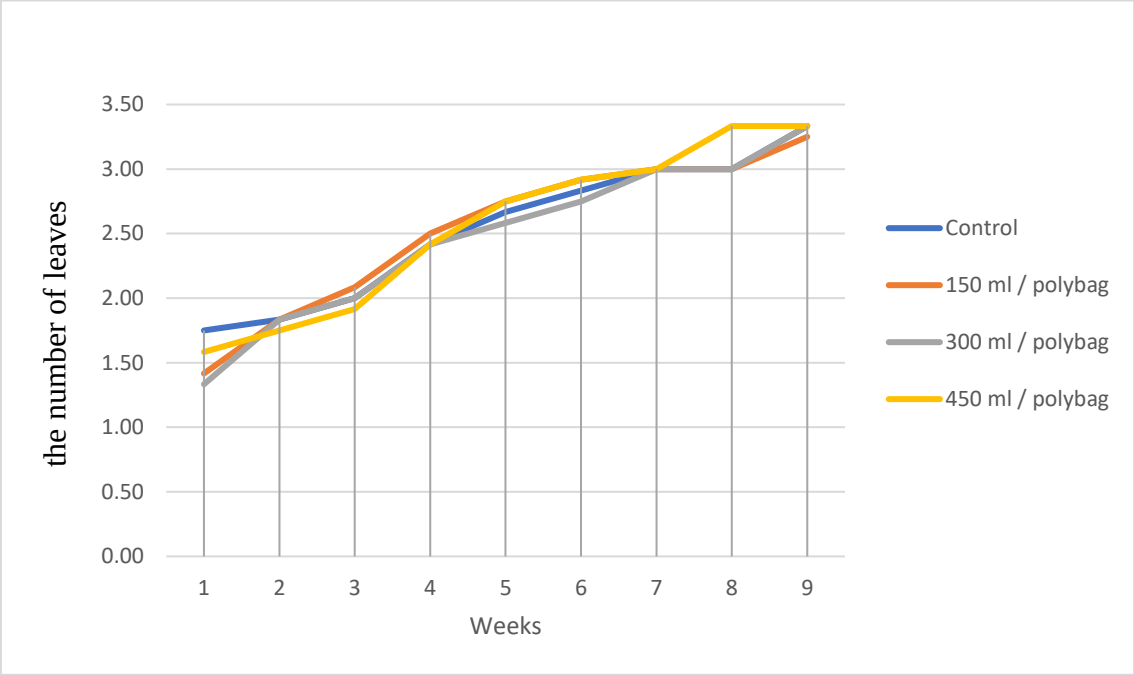

Figure 4. Growth in the number of leaves of oil palm seedlings pre-nursery in POME application.

Based on Table 3 Plant height, leaf area, crown dry weight, root fresh weight, and root volume are all affected by POME treatment. With using the five parameters mentioned above, POME 450 ml/polybag has the best care. The use of liquid waste to ensure the availability of nutrients such as N, P, K, and Mg can promote plant growth and have an impact on the quantity and area of leaves in oil palm seedlings (Saputra *et al*., 2022). POME can activate biochemical activity in soil, including microbes that release the phosphatase enzyme, by acting as an energy source for microorganisms. This enzyme promotes plant growth by converting the P element into an accessible form. Plants can increase the availability on P element and inhibit the ability of Fe element and Al element to bind P element by applying POME as an organic fertilizer. Plants utilize P element for root formation, as well as to seek and absorb nutrients and water (Ramadan *et al.*, 2021).

The effects of POME treatment on plant height, leaf area, crown dry weight, and root fresh weight were observed in significantly affect. The control treatment showed the lowest results in the four metrics mentioned above. The level of nutrients that low, it is thought to exist in soils that are not equipped with organic matter. Because of the soil that not fertilized lacking organic matter to retain water and bind nutrients, plants cannot receive the nutrients needed for healthy growth. The plant cannot grow properly as a result (Setiono, 2020). Therefore, a control treatment without organic matter seriously inhibits plant growth. As a result, it adds organic matter, such as POME, to the soil will help improve its physical, chemical, and biological qualities, as well as help increase the availability of water and nutrients, all of which will encourage the growth of larger plants (Rohmanah, 2016). POME can improve soil fertility to increase organic matter contained in the soil and contribute to environmental sustainability. The addition of POME also affects the leaf area per plant, plant height, and leaf chlorophyll content in plants (Palihakkara *et al*., 2022).

CONCLUSION

1. In the combination of application of various soil types and POME, there was a significant interaction on chlorophyll parameters and dry weight of oil palm roots in pre-nursery. The best is regosol soils with POME 450 ml/polybag and the worst Sare latosol and grumusol 150 ml/polybag.
2. POME treatment had a significant effect on the parameters of plant height, leaf area, crown dry weight, root fresh weight and root volume. In the five parameters above, the POME treatment of 450 ml / polybag is the best.
3. The treatment of various types of soil significantly influences the parameters of plant height, fresh weight of crown, dry weight of crown, fresh weight of roots, and volume of roots. In the five parameters above, the best type is regosol soil.

REFERENCES

1. Genesiska, G., Mulyono, M., & Intan Yufantari, A. (2020). Effect of Soil Type on the Growth and Yield of Corn Plants (Zea mays L.) Varieties of Sulawesi Pulut. *Plantronics: Journal Of Agricultural Science*, *5*(2), 107–117. Https://Doi.Org/10.21776/Ub.Jpt.2020.005.2.2
2. Hardian Putra Perdian. (2021). Effect of POME on Seedling Growth in Main Nursery (*Elaeis guineensis* Jacq). *Indonesian Journal of Agronomy*, *9*, 1–9.

3. Haryati. (2014). Response *of Growth of Oil Palm Seedlings (Elaeis guineensi Jacq) in Pre Nursery to the Application of Liquid Waste from Oil Palm Mills and Npkmg Fertilizer (15:15:6:4). 2*, 400–415.
4. Herman, S. (2019). Physical Properties and Soil Ripening and Production in Oil Palm Plantation Land (*Elaeis guineensis* Jacq.) Consequences of PALM *OIL MILL EFFLUENT* (POME) APPLICATION at PT Perkebunan Nusantara VII Bekri Business Unit, Central Lampung. In *Department of Chemical Engineering, USU* (Vol. 3, Issue 1).
5. Hettiarachchi, Dissanayake, & Palihakkara. (2020). *Effect Of Application Of* POME *and Recommended Fertilizer On Immature Oil Palm Intercropping With Pineapple, Low Country Wet Zone* (WL2a) In Sri Lanka. *International Journal For Research In Applied Sciences And Biotechnology*, *7*(5), 106–112. Https://Doi.Org/10.31033/Ijrasb.7.5.15
6. Igun, M., Suryanti, S., & Setyawati, E. (2023). Bio-Slurry Utilization in Different Soil Types for the Growth of Oil Palm Seedlings in *the Main Nursery. Kingdom (The Journal Of Biological Studies)*, *9*(2), 131–137. Https://Doi.Org/10.21831/Kingdom.V9i2.19538
7. Marlina, Napoleon, A., & Budianta, D. (2018). Changes in Several Chemical and Biological Properties of Ultisol and Nutrient Uptake of N, P, K, and Production of Fresh Fruit Bunches Given LCPKS. *Chlorophyll*, *13*(1), 37–41. Https://Doi.Org/10.32502/Jk.V13i1.1105
8. Palihakkara, I. R., Rodrigo, W. D. P., & Ekanayake, E. M. U. I. (2022). *Growth Performances Of Cocoa (<Em>Theobroma Cacao</Em>) Varieties Under Mature Oil Palm With Palm Oil Mill Effluent As Growing* Media. *Sri Lankan Journal Of Agriculture And Ecosystems*, *4*(2), 79–93. Https://Doi.Org/10.4038/Sljae.V4i2.99
9. Putri, V. J., Mabun, R., Rizal, M., & Sari, V. I. (2023). Interaction of Oil Palm Liquid Waste and Kiesrit Fertilizer on the Growth of Oil Palm Plants (*Elaeis Guineensis* Jacq) in *the Main Nursery*. *Journal of Agrotela*, *3*(1), 17–23.
10. Ramadhan, R., Tampubolon, G., & Ermadani, E. (2021). Effect of Oil Palm Mill Liquid Waste Feeding on Several Soil Chemical Properties and Growth of Oil Palm Seedlings in Main Nurseries. *Journal of Tropical Silva*, *5*(1), 339–356. Https://Doi.Org/10.22437/Jsilvtrop.V5i1.12429
11. Rohmanah, S. (2016). Effect of Dosage and Frequency Variants of Biofertilizer on the Growth and Productivity of Mung Bean Plants (Vigna Radiata L.). *Thesis*, 1–9.
12. Roni, N. G. K., & Witariadi, N. M. (2015). Soil as a medium for growing plants. *Udayana University, Bali*, 1–33.
13. Rosenani, A. B., Rovica, R., Cheah, P. M., & Lim, C. T. (2016). *Growth Performance and Nutrient Uptake Of Oil Palm Seedling In Prenursery Stage As Influenced By Oil Palm Waste Compost In Growing* Media. *International Journal Of Agronomy*, *2016*. Https://Doi.Org/10.1155/2016/6930735
14. Saputra, F., Tampubolon, G., & Ahmad Mahbub, I. (2022). Effect of Application of Liquid Waste from Palm Oil Mills on Nutrient Uptake of N, P, and K in Oil Palm Plants. *Journal of Agroecotania : National Publication of Agricultural Cultivation Science*, *4*(2), 51–62. Https://Doi.Org/10.22437/Agroecotania.V4i2.20441
15. Saputra, I., Setyowati, E. R., & Rahayu, E. (2017). The Effect of Organic Fertilizers on the Growth of Oil Palm Seedlings in Different Soil Types. *Agromast*, *2*(1), 1–10.
16. Saragi, G. N., Andayani, N., & Noviana, G. (2023). Effect of Planting Media and NP Fertilizer Dosage on the Growth of Oil Palm Seedlings (*Elaeis guineensis* Jacq) in the *Pre Nursery Phase*. *Agroforetech*, *1*(1), 147–151. Https://Jurnal.Instiperjogja.Ac.Id/Index.Php/JOM/Article/View/435
17. Setiono, S., & Azwarta, A. (2020). Effect of Cow Manor Application on the Growth and Yield of Sweet Corn Plants (*Zea mays L*). *Journal of Agro Sciences*, *5*(2). Https://Doi.Org/10.36355/Jsa.V5i2.463
18. Wafa, A. (2023). Application of Chicken Manure to the Growth of Broadleaf Mahogany Seedlings (*Swietenia macrophylla King*.) on Latosol Soil. *Agromast*, *4*(1), 88–100.