

GROWTH AND PHYSICAL QUALITY OF OIL PALM *Elaeis guineensis* Jacq PRE NURSERY ON ULTISOL BASED MEDIA WITH ECOENZYME FERTILIZER

CRESCIMENTO E QUALIDADE FÍSICA DA PALMEIRA-DE-ÓLEO *Elaeis guineensis* Jacq. NA FASE PRÉ-VIVEIRO EM SUBSTRATOS À BASE DE ULTISOL COM FERTILIZANTE ECOENZIMÁTICO

Article received on: 9/1/2026

Article accepted on: 7/4/2026

Slamet Santosa*

*Hasanuddin University, Makassar, South Sulawesi, Indonesia

Orcid: <https://orcid.org/0000-0003-2662-0956>

slametsantosa@unhas.ac.id

Rizki Amalia Puji Santosa**

**High School of Statistics, Makassar, South Sulawesi, Indonesia

amaliapuji@bps.go.id

The authors declare that there is no conflict of interest

Abstract

The oil palm nurseries generally have two stages pre nursery and main nursery. This nursery system requires a large amount of topsoil. To prevent damage to the topsoil ecosystem, the study used ultisol soil based media with ecoenzyme fertilizer. This research aims to analyze the growth and physical quality of oil palm pre nursery. The results of M1 and M2 media packages analysis have a medium fertility status. But those media packages of M3 and M4 have low fertility status. Meanwhile, the results of the growth and quality analysis of oil palm pre nursery that there was no difference in several parameters between the M2, M3, M4 treatments compared to M1 which used top soil. The suitable package media as an alternative to top soil in oil palm pre nurseries is M2, which is made from 70% ultisol soil, 30% compost and 100mL ecoenzyme fertilizer.

Keywords: *Elaeis guineensis*. Marginal Soil. Organic Matter. Pre Nursery.

Resumo

Os viveiros de palma-de-óleo geralmente apresentam duas etapas: pré-viveiro e viveiro principal. Esse sistema de viveiro requer uma grande quantidade de solo superficial. Para evitar danos ao ecossistema do solo superficial, o estudo utilizou substratos à base de solo ultisol com fertilizante de ecoenzimas. Esta pesquisa tem como objetivo analisar o crescimento e a qualidade física do pré-viveiro de palma-de-óleo. Os resultados da análise dos pacotes de substrato M1 e M2 apresentam um status de fertilidade médio. Porém, os pacotes de substrato M3 e M4 apresentam baixo status de fertilidade. Enquanto isso, os resultados da análise de crescimento e qualidade do pré-viveiro de palma-de-óleo indicaram que não houve diferença em vários parâmetros entre os tratamentos M2, M3 e M4 em comparação com o M1, que utilizou solo superficial. O pacote de substrato adequado como alternativa ao solo superficial em pré-viveiros de palma-de-óleo é o M2, composto por 70% de solo ultisol, 30% de composto e 100 mL de fertilizante ecoenzimático.

Palavras-chave: *Elaeis guineensis*. Solo Marginal. Matéria Orgânica. Pré-Viveiro.



1 INTRODUCTION

The oil palm plant *Elaeis guineensis* Jacq. is a crucial plantation commodity for the Indonesian economy. It grows for 20-25 years, with a productive period of 10-20 years. Oil palms that reach 20 years of age are generally no longer productive and require rejuvenation. Rejuvenation requires a large number of oil palm seedlings (Sari, 2015). The common oil palm nursery system consists of two stages: the initial nursery (pre-nursery) until the seedlings are three months old. The second stage (main nursery) is carried out after the seedlings are three months old, and then they are transferred to large polybags until the seedlings are approximately 12 months old (Anonymous, 2010). This two stage oil palm nursery system requires a large amount of nursery media, generally using topsoil as the primary material. According to ITTO in Putri, (2008), to produce one billion seedlings, up to five million cubic meters of topsoil are required if utilization reaches 50 percent. Therefore, topsoil use must be reduced to prevent further damage to the soil ecosystem. Zulkifli (2020), the annual increase in oil palm plantation area has also led to a growing demand for oil palm seedlings. The availability of these seedlings requires a significant increase in the use of topsoil, which is often used. Topsoil availability is increasingly limited, necessitating the use of less fertile soil types.

Ultisol soil was used as an alternative material for nursery media. Ultisol soil is included in the category of marginal land that is poor in nutrients and low in organic matter but the area is large and less utilized. According to Yuwono, (2009), there are millions of hectares of marginal land spread across various islands in Indonesia, but it requires technological innovation to increase its productivity. Wahyono (2010), marginal land mixed with compost increases macro and micro nutrients. The nutrients contained in compost are very necessary for plant development and growth. The results of research Syukur and Indah (2006), compost and cow manure mixed into the soil increase the growth and yield of Ginger sp. The results of research Alfonsius .al. (2017), organic materials function to improve the soil structure to become crumbly. The use of organic materials to increase soil fertility in oil palm pre nursery.

Ecoenzyme is a solution resulting from the fermentation of complex organic compounds derived from organic waste such as vegetables and fruits with a mixture of sugar and water (Hemalatha and Visantini, 2020). *Sargassum* sp. is a brown algae

commonly found on Bira Beach, Bulukumba, South Sulawesi. Sargassum sp is utilized by the food and pharmaceutical industries, which produce organic waste (Kadi, 2005). Ecoenzyme products can be used as organic fertilizers because they contain a number of enzymes such as trypsin, amylase, organic acids and a number of plant nutrient minerals such as N, P, and K, and contain bacteria that have the potential to decompose organic materials, stimulate growth, and as agents for controlling pests and plant diseases (Susilowati *et.al.*, 2021). The results of research Tong and Liu (2020), ecoenzyme can increase total nitrogen and organic matter in the soil due to the presence of active enzymes, organic matter and micro flora in it. Arifin, *et.al.* (2009), organic matter in ecoenzyme can support the growth of microorganisms and other soil organisms to stimulate the decomposition process so that ecoenzyme can be used as fertilizer. Nurnawati *et.al.*, (2022), organic fertilizer is a fertilizer that plays a role in increasing the biological, chemical, and physical activity of the soil, causing the soil to be fertile and good for plant growth. Research results of Salsabila and Winarsih (2023), concluded that the administration of ecoenzyme as a liquid organic fertilizer produced a significant effect on the growth of Brassica rapa including plant height, number of leaves, root length, and wet biomass

Based on the background, this study was conducted with the aim of describing the quality of the seedling media package based on ultisol soil and ecoenzyme liquid fertilizer which is suitable for the growth and physical quality of oil palm *Elaeis guineensis* Jacq.pre nursery

2 MATERIAL AND METHODS

2.1 Research location, materials, and equipment

The research was conducted at Baraya, Kalukuang Village, and the Environmental and Marine Sciences Laboratory, Department of Biology, Faculty of Mathematics and Natural Sciences, Hasanuddin University, Makassar, Indonesia, for 5 months in 2025. The materials used were oil palm seeds, topsoil, ultisol soil, cow manure, compost, ecoenzyme solution, and water. The tools used were vernier calipers, measuring tape, digital scales, soil scoops, plastic buckets, watering cans, measuring cylinders,

Erlenmeyer flasks, and calculators.

2.2 Ecoenzyme fertilizer production

Ecoenzyme is made by fermenting *Sargassum* sp seaweed waste with brown sugar and water in a plastic bottle. *Sargassum* sp seaweed waste of 300g plus 100g of brown sugar and 600ml of water are put into a 1500mL plastic bottle. Then fermented for 1 month in a room that is not exposed to direct sunlight. During the fermentation process, the plastic bottle cap is opened every day to release the CO₂ formed. Next, the fermentation result in the form of a brownish yellow liquid is removed by filtering and collected in a plastic container to be used as fertilizer. .Ecoenzyme solution of 10mL is dissolved in 1000 mL of water to make ecoenzyme fertilizer. Then ecoenzyme fertilizer of 100mL is used as a seedling media package. The results of research of Hasanah (2021), ecoenzyme fertilizer contains of N 0.09%, P 0.01% and K 0.12%

2.3 Media packages production

The media packages is made from topsoil, ultisol soil, compost, and cow manure. While the media package is a treatment that has the following composition: 1) topsoil of 100% + 10mL urea fertilizer (M1), 2) ultisol soil of 70% mixed with 30% compost + 100mL ecoenzyme fertilizer (M2), 3) ultisol soil of 70% mixed with 30% cow manure + 100mL ecoenzyme fertilizer (M3), 4) ultisol soil of 70% mixed with 15% compost and 15% cow manure + 100mL ecoenzyme fertilizer (M4). All seedling media are incubated for 15 days and stirred evenly every 7 days Then the seedling media packages were analyzed for nutrient content and fertility status (Table 1).

Table 1

Soil fertility status (Rosmarkam, and Yuwono, 2002)

| Nutrients | Value | Fertility Status |
|-----------|-----------|------------------|
| N (%) | > 0,75 | Very high |
| | 0,51-0,75 | High |
| | 0,21-0,50 | Moderate |
| | 0,10-0,20 | Low |
| | < 0,10 | Very low |

| | | |
|-------------|---------|-----------|
| P (mg/kg) | >35 | Very high |
| | 26-35 | High |
| | 16-25 | Moderate |
| | 10-15 | Low |
| | <10 | Very low |
| K (me/100g) | >1,0 | Very high |
| | 0,6-1,0 | High |
| | 0,3-0,5 | Moderate |
| | 0,1-0,2 | Low |
| | <0,1 | Very low |

2.4 Oil palm *Elaeis guineensis* Jacq pre nursery

Oil palm pre nursery begins with planting 1 oil palm seedling in the morning. Planting 1 seedling is done with the radicle position planted completely in an upright position. Watering is done using a watering can evenly twice a day, in the morning and evening until field capacity. The addition of fertilizer is done to oil palm pre nursery aged 4 weeks after planting by watering the M1, M2, M3 and M4 seedling media. Urea fertilizer of 10mL is given to the M1 seedling media, while ecoenzyme fertilizer is given as much as 100mL each of M1, M2 and M3 seedling media. Fertilization is done once a week until the seedlings are 3 months old. Furthermore, oil palm pre nursery maintenance, namely weeding, is done manually by pulling out grass. After the oil palm pre nursery are 3 months old, the media is dismantled without damaging the root system and observed, measuring the roots, stems and leaves.

2.5 Research parameters

This study analyzed the growth and physical quality of oil palm pre-nursery. Growth parameters observed and measured were height (cm), stem diameter (cm), number of leaves (strands), root length (cm), root volume (mL3), root dry weight (g), and dry weight of stem + leaves (g). Root volume was calculated using the method of Salsabila and Winarsih (2023). The roots were separated from the oil palm seedlings and placed in a 500 mL measuring cylinder filled with 250 mL of water. Root volume was calculated using the formula (1):

$$VA = V1 - V0 \quad (1)$$

where:

VA = root volume,

V1 = final water volume,

VO = initial water volume.

Seedling quality was analyzed using the formula (2) of Kurniaty *et.al.* (2010) :

$$SQI = (A+B) / (C/D+A/B) \quad (2)$$

where:

SQI = Seedling Quality Index;

A = Stem and leaf dry weight (g);

B = Root dry weight (g);

C = Plant height (cm);

D = Stem diameter (cm)

2.6 Data analysis

This study used a completely randomized design with 4 packages of seedling media as treatments. Each treatment was repeated 3 times, resulting in a total of 12 oil palm nurseries. Each treatment unit was sown with 3 oil palm seedlings, and only 1 seedling was randomly selected for testing. Data obtained from observations and research measurements were analyzed statistically (ANOVA) with the F test at the 95% level. If there was a significant effect of the treatment on the parameters, further testing was carried out using DMRT (Duncan's Multiple Range Test).

3 RESULTS AND DISCUSSION

3.1 Growth of oil palm pre nursery

Plant growth can be described by stable dry weight, which is the relationship between growth time and size. The general pattern is initialized by the actual plant size,

followed by a period of high growth followed by a period of declining growth or no growth at all. The growth curve can help identify and assess the general pattern of plant growth and development. Growth is influenced by internal factors: genetics, and external factors: nutrients, water, sunlight, and CO₂. This study used oil palm seeds from the Oil Palm Research Center, which provides high-quality seeds with good genetics and proven germination (Figure 1). Analysis of the M1, M2, M3, and M4 media packages showed contained 0.12-0.25% N; 10.81-18.18 ppm P₂O₅; and 0.19-0.35 cmol/kg K (Table 2). Meanwhile, the analysis of the liquid organic fertilizer ecoenzyme contained 0.25% N; P 0.04% K 0.14% and micro nutrients: Mn 0.43ppm; Fe 0.38ppm The availability of nutrients in the seedling media packages and ecoenzyme liquid organic fertilizer is an external factor that supports the growth of oil palm pre nursery. The results of oil palm pre nursery on M1, M2, M3 and M4 seedling media packages show very good root, stem and leaf growth (Figure 2).

Figure 1

Oil palm seed sprouts



Table 2

Nutrient content of media packages

| Media packages | pHH ₂ O | Organic C (%) | N (%) | C/N | P ₂ O ₅ (ppm) | K (cmolkg ⁻¹) | CEC (cmolkg ⁻¹) | Fertility Status* |
|----------------|--------------------|---------------|-------|-----|-------------------------------------|---------------------------|-----------------------------|-------------------|
| M1 | 6.21 | 3.24 | 0.25 | 13 | 18.81 | 0.35 | 19.22 | Moderate |
| M2 | 6.07 | 2.96 | 0.22 | 13 | 16.30 | 0.22 | 21.21 | Moderate |
| M3 | 5.77 | 1.93 | 0.15 | 13 | 12.26 | 0.19 | 16.81 | Low |
| M4 | 6.17 | 1.22 | 0.12 | 10 | 10.81 | 0.25 | 16.31 | Low |

* Fertility status category of soil by Rosmarkam and Yuwono , 2002

Figure 2*Growth performance of oil palm pre nursery*

The results of measuring the growth of oil palm pre nursery in M1, M2, M3, and M4 seedlings packages media showed an average height of 19.0 – 20.5cm, stem diameter of 1.0 - 1.2cm, number of leaves of 4.0 - 4.3 strands, longest root of 21.6 - 25.0cm, root volume of 3.5 - 3.7 mL³, dry weight of stem and leaves of 1.1 - 1.3g and dry weight of roots of 0.3 - 0.4g. Based on the results of statistical analysis, the growth of height and longest roots of oil palm pre nursery in M1, M2, and M3 seedling media packages was not significantly different. However, the growth of height and longest roots in M1, M2, and M3 seedling media packages showed a significant difference with the growth in M4 seedling medium package (Table 3). The highest growth of 3-month-old oil palm pre nursery was 20.5cm in M2 seedling media package and the lowest was 19.0cm in M4 seedling media package. Likewise, the longest root growth of oil palm pre nursery was 25.0cm in M2 seedling medium package and the shortest was 21.6 cm in M4 seedling medium package. The difference in height and longest root growth in M2 and M4 seedling media packages did not contribute to stem, leaf, and dry weight growth. The results of statistical analysis showed that the growth of stem diameter, number of leaves, root volume, dry weight of stem and leaves and dry weight of roots were not significantly different in M1, M2, M3, and M4 seedling media packages (Table 3).

3.2 Physical quality of oil palm pre nursery

Meanwhile, the physical quality of oil palm seedlings is influenced by the growth

of roots, stems, and leaves. The results of observations of root, stem, and leaf growth indicate a correlation between growth parameter values and the physical quality of pre-nursery oil palm seedlings. The growth values of roots, stems, leaves, and dry weight of plant organs determine the quality index of plant seedlings. The results of the calculation of the seed quality index (SQI) of 3-month-old oil palm pre nursery in the M1, M2, M3, and M4 seedling media packages ranged from 0.06 to 0.08 (Table 3) The use of compost on ultisol soil makes the M2 package media lighter and looser so that the root growth of oil palm seedlings is better than M1, M3, M4. Meanwhile, cow manure causes the M3 and M4 media packages to be somewhat dense. This seedling quality index value indicates that the oil palm pre nursery are not yet suitable for transfer to plantation land because the quality index is less than 0.09. This pre-nursery is only 3 months old, so if it is transferred to the main nursery which is older, the seed quality index will be more than 0.09. Oil palm nurseries are generally carried out in two stages: pre-nursery and main nursery. Oil palm pre nursery are carried out for 3 months, then transferred to the main nursery until the age of 12 months, then planted on plantation land.

Table 3

Average growth and physical quality of oil palm pre nursery

| Media packages | Height plant (cm) | Stem diameter (cm) | Root length (cm) | Number of leaves (Strands) | Root volume (mL) | Dry weight of stem +leaves (g) | Dry Weight of root (g) | Seed Quality Index |
|----------------|-------------------|--------------------|------------------|----------------------------|------------------|--------------------------------|------------------------|--------------------|
| M1 | 20.3a | 1.1a | 24.8a | 4.0a | 3.6a | 1.2a | 0.4a | 0.07a |
| M2 | 20.5a | 1.2a | 25.0a | 4.3a | 3.7a | 1.3a | 0.4a | 0.08a |
| M3 | 20.3a | 1.1a | 24.8a | 4.0a | 3.6a | 1.2a | 0.4a | 0.07a |
| M4 | 19.0b | 1.0a | 21.6b | 4.0a | 3.5a | 1.1a | 0.3a | 0.06a |

Note: numbers followed by the same letter are not significantly different at the 95% level

Oil palms *Elaeis guineensis* Jacq. can grow well in various soil types, such as ultisols, latosols, gray hydromorphic, alluvial, or regrosols (Mawardati, 2017). This oil palm pre nursery study used ultisol soil as the basic material for the media package. The use of ultisol soil is an effort to reduce topsoil use and prevent damage to the topsoil ecosystem from excessive removal. Although ultisol soil is classified as marginal land, poor in nutrients and low in organic matter, it is widely available and underutilized in Indonesia. According to Gunadi (2002), utilizing marginal land requires technological inputs such as organic matter. This study used compost and cow manure mixed with

ultisol soil to form the oil palm pre nursery medium package . During the nursery, the oil palm seedlings were fertilized weekly with ecoenzyme liquid organic fertilizer. Growth analysis showed that the roots, stems, and leaves of the oil palm pre nursery grew and developed well, but the seedling quality index was not yet suitable for transplanting to plantations.

The longest root growth and largest volume of oil palm pre nursery were observed on M2 medium package. This root growth was not significantly different from the root growth on M1 and M3 media packages. However, the longest root growth on M1, M2, and M3 media packages was significantly different from M4 medium package, while the root volume on all media packages was not significantly different (Table 3). Root growth is the process of root elongation and branching that occurs through cell division in the meristematic zone, behind the root cap. This process is essential for absorbing water and nutrients from the soil or nursery media for plant metabolism. Root growth is influenced by various factors, including soil or growing media conditions. A growing medium that is not dense, light, crumbly, and loose allows plant roots to grow and develop easily. These conditions in the nursery media are influenced by the materials used. In this study, the use of compost in M2 medium package is thought to cause a light and loose medium, resulting in the longest root growth of oil palm seedlings, 25.0cm, compared to M1 24.8cm, M3 24.8cm, and M4 21.6 cm of media packages. According to Thesiwati (2018), compost added to the soil media can improve the soil structure, so that the soil becomes crumbly and loose and has the ability to store water (drainage) and good air porosity (aeration). Gusmalina and Komarayat (2003), compost can improve the structure and texture of the media in polybags. This happens because the provision of compost will reduce the density of the media by increasing the pore space in the media. Good structure and texture will stimulate root growth so that the level of nutrient absorption will be higher to the needs of the plant. Mahfud in Sudomo (2010), that the soil media added with compost produces the best teak seedlings compared to the soil media added with rice husks and soil added with cow manure. Febri *et.al.*, (2025), compost and biochar can reduce the soil bulk density and improve the soil temperature, humidity, and pH. In addition, it can also increase the levels of other nutrients, such as C-organic and N,P, K nutrients

Plant roots function to absorb nutrients and water in the soil or growing medium

for plant growth and survival. Roots transport water and nutrients absorbed from the growing medium to the upper part of the plant through a vascular system connected to the stem and leaves. The availability of nutrients and water in the medium affects the growth of stems and leaves. The results of chemical analysis of seedling media packages show that M1, M2, M3 and M4 contain N, P and K nutrients (Table 2). The nutrients of N, P and K are needed for plant growth. According to Sukmawan (2016), nutrients of N, P and K can increase plant growth and also have a role in increasing the production of fronds, stem circumference, leaf area, and frond length of oil palm seedlings. Mohidin, *et.al.*, (2015), physiologically, nitrogen plays a role as a component of chlorophyll, amino acids, proteins, alkaloids, and protoplasm. Phosphorus plays a role in energy transfer and storage, and is a component of nucleic acids, nucleotides, and coenzymes. Phosphorus can increase the percentage of photosynthate partition to the roots, resulting an increase in the root to stem ratio. Low phosphorus availability is a limiting factor for plant growth. Potassium is essential for maintaining osmotic balance, phloem transport, and photosynthesis. Optimal concentrations of potassium in the nutrient solution increase plant height, stem diameter, leaf area, and other growth characteristics. Balanced application of nitrogen, phosphorus, and potassium increases the accumulation of oil palm biomass.

The highest pre-nursery oil palm seedlings were 20.5cm in M2 medium package but were not significantly different from the height growth in M1 20.3cm and M3 20.3cm. The height growth of oil palm seedlings in the M1, M2 and M3 media packages was significantly different from the height growth in M4 media 19.0cm. Based on chemical analysis of the seedling media packages, it showed that M4 medium package contained the lowest N 0.12% compared to M1 media N 0.25%, M2 N 0.22% and M3 N 0.15%. According to Asari *et.al.* (2019), nitrogen is very much needed during the growth of stems and leaves of oil palm pre nursery. Rasaq, *et.al.*, (2017), nutrients of N can increase cytokinin production which can affect cell wall elasticity, the number of meristematic cells, and cell growth, so that it can produce vegetative growth including good height. Setyorini, *et.al.*, (2020), N nutrients stimulate vegetative growth of plants, one of which is the height of oil palm pre nursery. Then the results of the study of Purwosetyoko, *et.al.*, (2022), the highest growth of oil palm pre nursery was 25.40cm which were given *Muccuna bracteata* extract which contains N, P, K nutrients.

This oil palm pre nursery uses urea inorganic fertilizer on M1 seedling medium packages (control) and ecoenzyme liquid organic fertilizer on M2, M3 and M4 seedling media packages. Ecoenzyme liquid organic fertilizer contains N 0.25%, P 0.04% and K 0.14%, included in the low category, but there are several enzymes that can support plant growth. According to Ginting et al., (2021), ecoenzyme fertilizer contains α -amylase, maltase, and proteolytic enzymes. These enzymes play a role in breaking down starch compounds found in the endosperm, a food reserve, into glucose. Glucose is a source of energy for plant growth. Then Tong and Liu (2020), ecoenzyme can increase total nitrogen and organic matter in the soil due to the presence of active enzymes. The results of the analysis of the height of oil palm seedlings ranged from 19.0 - 20.5cm and root length ranged from 21.6-25.0cm showing that the growth value was not different from the results of research by several other researchers. The results of research of Astutik, *et.al.*, (2019), reported that the growth of pre-nursery oil palm seedlings had a height ranging from 19.38-22.54cm and the longest roots ranging from 14.87-20.7cm on 3 types of growing media with nutrient B. The results of research Razaq *et.al.*, (2017), the growth of pre-nursery oil palm seedlings using 20% liquid organic fertilizer from banana peel and 2.50g NPK fertilizer had a height ranging from 18.87-22.67cm and a root length of 16.0-19.32cm. The results of research of Purwosetyoko, *et.al.*, (2022), the growth of pre-nursery oil palm seedlings using organic fertilizer from *Muccuna bracteata* leaves at several concentrations ranged from 22.43-25.40cm. Then the results of research of Riswandi, *et.al.*, (2023), the growth of pre-nursery oil palm seedlings using several solid doses on clay soil had a height ranging from 20.14-23.32cm and a root length ranging from 19.56-23.82cm

The growth of stems and leaves of pre-nursery oil palm seedlings had an average stem diameter ranging from 1.0-1.2cm and the number of leaves ranging from 4.0-4.3 strands in M1, M2, M3 and M4 media packages. The average growth of the largest stem diameter was 1.2cm and the average number of leaves was 4.3 strands in M2 medium packages. However, based on statistical analysis, there was no significant difference in the average growth of stems and leaves in all M1, M2, M3 and M4 media packages. However, the leaf and stem growth of these oil palm pre nursery met seedlings standards. According to Anonymous (2010), in oil palm pre-nursery , normal leaf growth is 4-5 strands and a stem diameter of 1-1.3cm. Then, based on the chemical fertility analysis,

M2 media had organic C, N, P, K and cation exchange capacity (CEC) including moderate fertility status whose status was the same as M1 media (control). While M3 and M4 media had low fertility status (Table 2). The use of liquid organic fertilizer ecoenzyme is thought to increase media nutrients which caused the growth of stems and leaves of pre-nursery oil palm seedlings in all M1, M2, M3 and M4 media packages to be no significant difference. The growth of the stem diameter and number of leaves of these oil palm seedlings is better than the results of research of Razaq *et.al.*, (2017), the growth of pre-nursery oil palm seedlings that use liquid organic fertilizer from banana peels has a stem diameter ranging from 0.6-0.63cm and an average number of leaves of 3.75-4.08 strands. The results of research of Anhar *et.al.*, (2021), pre-nursery oil palm seedlings that use liquid fertilizer from 'kepok' banana peels have a stem diameter of 0.59-0.66cm and a number of leaves of 3.41-3.87 strands. Then the results of research of Wahyono, *et.al.*, (2023), the growth response of pre-nursery oil palm seedlings that are given liquid palm waste has a stem diameter of 0.90-0.99cm and a number of leaves of 3.8-4.8 strands.

Plant growth can also be described by stable dry weight, namely the relationship between time and growth size. The results of weighing the dry weight of oil palm seedlings have a dry weight of the stems and leaves ranging from 1.1-1.3g and a dry weight of roots of 0.3-0.4g in the M1, M2, M3 and M4 seedling media packages (Table 3). The results of this dry weight analysis of oil palm seedlings are higher than those of several other researchers. The results of research of Astutik *et.al.* (2019), reported that the dry weight of pre-nursery oil palm seedlings on 3 types of growing media with nutrient B had a dry weight of the stems and leaves ranging from 0.77-1.10g and a dry weight of roots ranging from 0.24-0.37g. The results of research of Razaq *et.al.*, (2017), the dry weight of pre-nursery oil palm seedlings using liquid organic fertilizer banana peels had a dry weight of the stems and leaves of 0.60-0.69g and a dry weight of roots of 0.22-0.30g. Then, according to research results of Astutik *et.al.*, (2019), the dry weight of pre-nursery oil palm seedlings that used solids in clay soil had an average dry weight of the stem and leaves of 0.93g and root dry weight of 0.23g.

The quality of plant seeds can be determined based on the physical characteristics of the seeds. The physical characteristics of the seeds are the height of the seeds, the diameter of the seedling stem, the number of leaves, the length of the seedling roots and the sturdiness of the seeds. According to Pramono and Suheandi (2006), the quality of

plant seeds is generally determined by the results of calculations or assessments of 3 criteria, namely genetic quality, physical quality (shape), and physiological quality. Genetic quality is seen from the seed source, while physical quality such as sturdiness, stem diameter and number of leaves and plant health. Physiological quality reflects the physiological processes that have implications for the growth and development of plant seeds. According to Hendromono (2003), the quality of seeds can be seen from the value of the seedling quality index. The greater the value of the seedling quality index, the better the quality of the seeds. A seedling quality index value ≥ 0.09 indicates that the seeds are easy to live and have high adaptability when planted in the field. This oil palm nursery has height, stem diameter, root length on M1, M2, M3 and M4. Seedling media packages are not significantly different except for the different height on M4 medium package. The results of statistical analysis show that the dry weight of stems + leaves and dry weight of roots on all media packages are not significantly different (Table 3). Based on the growth value of the oil palm seedlings, the calculated value of the seedling quality index in the M1 media was 0.07, M2 0.08, M3 0.07 and M4 0.06. The value of the pre-nursery oil palm seedling quality index in all M1, M2, M3 and M4 seedling media packages indicated that it was not yet suitable to be moved to the plantation land because the seedling quality index was <0.09 . This seedling quality index value was low because it still needed time for the nursery. According to Corlev (2003), the common oil palm nursery system is a two-stage nursery (double stage) consisting of the initial nursery stage (pre-nursery) until the seedlings are 3 months old. After the seedlings are 3 months old, the seedlings are transplanted into large polybags at the main nursery stage until the seedlings are ready to be planted (12 months) on the plantation land

4 CONCLUSION

Ultisol soil can be an alternative pre-nursery oil palm seedling media but must be mixed with organic materials. Organic materials that can be used are compost, manure which enriches nutrients and improves the structure of the media. Media package of M2 mixture 70% ultisol soil and 30% compost supplemented with 100 mL of ecoenzyme fertilizer is the most suitable medium for oil palm pre nursery

ACKNOWLEDGEMENT

The researcher would like to thank the staff of the soil chemistry and fertility laboratory, soil department, Hasanuddin University for the analysis of the fertility status of the package media.

FUNDING

This research was funded by the University of Hasanuddin through the Research Grant of professor with Contract Number 42292/UN4.1.2/HK.07.00/2025. Thank you to the Rector of Hasanuddin University for providing research grant funds.

DECLARATION

The authors declare that there is no conflict of interest

REFERENCES

- Alfonsius Evaritus Su Seda, Elisabeth Nanik Kristalisasi, Enny Rahayu .(2017). The effect of application of mycorrhiza doses and organic materials as planting media on the growth of oil palm pre nursery. *Agromast*, 2 (2)
- Arifin LW, Syambarkah A, Purbasari HS, Ria R, and Ayu V. (2009). Introduction of Eco-Enzyme to Support Organic Farming in Indonesia. *Asian Food and AgroIndustry, Special*, 356–359
- Anhar, T.M.S., Rama R. Sitinjak, Edy Fachrial, Bayu Pratomo. (2021). Growth Response of Oil Palm Seedlings in the Pre-Nursery Stage with the Application of Liquid Organic Fertilizer from Kepok Banana Peels. *Agrium*, 23, 94-99. <https://doi.org/10.30596/agrium.v21i3.2456>
- Anonymous. (2010). Oil palm cultivation. *Palm Oil Research Center*. Medan, North Sumatra.
- Asari, Nadhira, A., & Zulkifli, T. B. H. (2019). Response of Urea and Cow Urine Fertilizer Application on the Growth of Oil Palm *Elaeis guineensis* Jacq. Seedlings in Early Nurseries. *AgriNula: Journal of Agrotechnology and Plantations*, 2, 28-32. <https://doi.org/10.36490/agri.v2i2>
- Astuti Y.T.M., , Retni Mardu Hartati, Tejo Triwaluyo. (2019). The Growth of Oil Palm

Pre-Nursery in the Nutrient Modifications and Various Growing Mediums of a Hydroponic System. *AGROISTA Journal of Agrotechnology*, 3, 81-92

- Corley, R.H.V. and P.B. Tinker. (2003). *The Oil Palm*. Blackwell Science Ltd. Oxford,
- Febri Arif Cahyo Wibowo, Dea Alkornea, Mochamad Chanan. (2025). Conservation of Soil Physical and Chemical Properties by Application of Compost and Biochar in Tambakrejo Village, Malang Regency. *Journal of Natural Resources and Environmental Management*, 15, 435-447. <https://doi.org/10.29244/jpsl.15.3.435>
- Ginting, N.A., Ginting, N. Sembiring, I, and Sinulingga. S. (2021). Effect of Eco Enzymes Dilution on the Growth of Turi Plant (*Sesbania grandiflora*). *Jurnal Peternakan Integratif*, 9(1), 29-35. <https://doi.org/10.32734/jpi.v9i1.6490>
- Gunadi, S. (2002). Technology for Utilizing Marginal Coastal Land. *Journal of Environmental Engineering*, 3, 232-236
- Gusmailina, G. P., and S. Komarayati. (2003). Developing the Use of Charcoal for Land Rehabilitation. *Bulletin of Forestry Research and Development*, 4, 21-30.
- Hasanah, Y. (2021). Ecoenzymes and their benefits for organic rice production and disinfectant. *Journal of Science and Technology Transfer*, 3, 119–128 <https://doi.org/10.32734/jst.v3i2.4519>
- Hemalatha M and Visantini P. (2020). Potential Use of Eco-Enzyme for the Treatment of Metal-Based Effluent. IOP Conference Series: *Materials Science and Engineering*, 716.
- Hendromono. (2003). Criteria for Assessing the Quality of Containerized Seedlings Ready for Planting for Forest and Land Rehabilitation. *Bulletin of Forestry Research and Development*, 4
- ITTO. (2006). Status of Tropical Forest Management , A Special Edition of The Tropical Forest Update. Yokohama, Japan,
- Kadi, A. (2005). Some Notes on the Presence of the Sargassum Genus in Indonesian Waters. *Oceana*, 30, 19-29
- Kurniaty, R., B. Budi, and S. Made. (2010). The Effect of Media and Shade on the Quality of Suren Toona sureni Merr Seedlings. *Journal of Plantation Forest Research*, 7, 77–83
- Mahfudz, Supriyo, Suryanaji, and Supriyanto. (2005). The Effect of Biostimulant Use, Media Type, and Volume on Teak Seedling Growth. PPPHT., Yogyakarta
- Mawardati. (2017). Palm Oil Agribusiness: Analysis of Technical and Management Aspects of Smallholder Palm Oil Plantations. *Unimal Press*.
- Mohidin, H., M. M. Hanafi, Y. M. Rafii, S. N. A. Abdullah, A. S. Idris, S. Man, J.i. Idris,

- & M. Sahebi. (2015). Determination of optimum levels of nitrogen, phosphorus, and potassium of oil palm seedlings in solution culture. *Bragantia, Campinas*, 74, 247-254 <https://doi.org/10.1590/1678-4499.0408>
- Nurnawati AA, Syarifuddin RN, and A. Samsu AK, (2022). Reducing Inorganic Fertilizer Dosage in Purple Corn Plants with Liquid Organic Fertilizer Application. *Agro Bali: Agricultural Journal*, 5 (1), 137–143. <https://doi.org/10.37637/ab.v5i2> .
- Pramono and H. Suhaendi. (2006). Benefits of Seed Source Certification, Seed Quality, and Seedling Quality in Supporting Gerhan. Research . *Proceedings. Center for Forestry and Nature Conservation Research and Development*. Bogor,
- Purwosetyoko, N.S., Nasruddin, Muhammad Rafli, Faisal, Muhammad Yusuf N. (2022). Growth of Oil Palm (*Elaeis guineensis* Jacq) Seedlings in the Pre-Nursery Phase Using *Muccuna Bracteata* Leaf Extract. *Scientific Journal of Agroecotechnology Students*, 1, 34-38. <https://doi.org/10.29103/jimatek.v1i2.8463>
- Putri, A.I. (2008). The effect of organic media on the quality index of sandalwood. *Journal of Forest Plant Improvement*, 21, 1- 8
- Razaq, M., Zhang, P., Shen, H. L., & Salahuddin. (2017). Influence of nitrogen and phosphorus on the growth and root morphology of Acer mono. *PLoS ONE*, 12, 1–13 [.https://doi.org/10.1371/journal.pone.0171321](https://doi.org/10.1371/journal.pone.0171321)
- Riswandi, Sri Manu Rohmiyati, Sri Suryanti. (2023). Growth of Pre-Nursery Oil Palm Seedlings on Sandy and Clay Soil with Solid Fertilizer Application. *Agroforestech*, 1, 84-89
- Rosmarkam, A. and N.W. Yuwono. (2002). Soil Fertility Science. *Kanisius. Yogyakarta*
- Salsabila, R. K., and Winarsih. (2023). The Effectiveness of Giving Fruit Peels Ecoenzyme as Liquid Organic Fertilizer on the Growth of Pakchoy Mustard Plant (*Brassica rapa* L.). *LenteraBio*, 12 (1) 50–59 . <https://doi.org/10.26740/lenterabio.v12n1.p50-59>
- Sari, V. I., Sudrajat, Sugiyanta, (2015). The role of organic fertilizer in increasing the effectiveness of NPK fertilizer on oil palm seedlings in the main nursery. *Indonesian Journal of Agronomy*, 43 (2), 153-160. <https://doi.org/10.24831/jai.v43i2.10422>
- Setyorini, T., Hartati, R. M., & Damanik, A. L. (2020). Growth of Oil Palm Seedlings in a Pre-Nursery with Liquid Organic Fertilizer (Banana Peel) and NPK Fertilizer. *Agritrop: Journal of Agricultural Science*, 18, 98-106.
- Sudomo, A., R. Encep, and M. Nina. (2010). The Quality of Manglid (*Manglieta glauca* BI) Seedlings on Seven Types of Weaning Media. *Journal of Plantation Forest Research*, 7, 265-272
- Sukmawan, Y. (2016). The Role of *Organic* Fertilizer and Compound NPK on the Growth of TBM 1 Oil Palm on Marginal Land. *Indonesian Journal of Agronomy*, 43,

242. [https://doi.org/ 10.24831/jai.v43i3.11251](https://doi.org/10.24831/jai.v43i3.11251)

Susilowati LE, Mansur M, and Zaenal A. (2021). Learning About the Utilization of Household Organic Waste as Raw Material for Eco-Enzymes. *Journal of Community Service for Master of Science Education*, 4, 356–362.

Syukur, A. and N. M. Indah. (2006). Study of the Effect of Various Organic Fertilizers on the Growth and Yield of Ginger Plants in Inceptisols, Karanganyar. *Journal of Soil and Environmental Science*, 6, 124-131

Thesiwati, A.S. (2018). The Role of Compost as an Environmentally Friendly Organic Material. *Dewantara Community Service Journal*, 1

Tong Y and Liu B. (2020). Test research of different material-made garbage enzymes' effect on soil total nitrogen and organic matter. *IOP Conference Series: Earth and Environmental Science*, 510

Wahyono, D, Fathurrahman, Muh Nur Sangadji. (2023). Response Growth of Oil Palm Seedlings (*Elaeis guineensis* Jacq.) in the Pre-Nursery Towards the Provision of Palm Oil Mill Effluent. *Jurnal Agrotech*, 13 (2), 135-143. <https://doi.org/10.31970/agrotech.v13i2>

Wahyono, S. (2010). Review of the benefits of compost and its application in various agricultural fields. *Journal of Environmental Engineering*, 6, 29-31

Yuwono, N.W. (2009). Building soil fertility on marginal land. *Journal of Soil and Environmental Science*, 9, 137-141

Zulkifli, E.H. (2020). The Effect of Kiambang Compost Application to Various Soil Layers on the Growth of Oil Palm Seedlings *Elaeis guineensis* Jacq. *Agrica Ekstensia*, 14, 146–147