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Application of Several Concentrations of Palm Fiber Liquid Organic Fertilizer and the Composition of Planting Media on the Growth of Moringa Oleifera L

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Abstract

This study aims to analyze the effect of the application of several concentrations of liquid organic fertilizer based on palm fiber and the composition of plant media on the growth of moringa plants (Moringa oleifera L.). Palm fiber liquid organic fertilizer was chosen because of its potential as a source of environmentally friendly nutrients that can increase plant productivity. The study was conducted using a random group design (RAK) with treatment of various concentrations of liquid organic fertilizer (0%, 15%, 20%, and 25%) as well as variations of plant media by volume (1:1) (top soil, top soil + cocopeat, top soil + husk charcoal, and top soil + compost). The observed growth parameters included plant height, number of leaves, stem diameter, leaf chlorophyll, plant wet weight, leaf wet weight and root wet weight. The results showed that the concentration of liquid organic fertilizer of palm fiber and the composition of the plant media significantly affected the growth of moringa plants. The combination of 20% palm fiber liquid organic fertilizer concentration and top soil + compost (P2M3) provides the best growth results compared to other treatments. These findings provide important insights for the development of more efficient and sustainable moringa cultivation techniques.

Introduction

Moringa (*Moringa oleifera L.*) was first found in the foothills of the Himalayas in India, Pakistan, Afghanistan, and Bangladesh and then spread widely in many sub-tropical and tropical areas including Indonesia. Moringa belongs to the group of woody plants (*shrubs*) with an average plant height of 7-11 meters, able to thrive in lowlands and high altitudes at an altitude of 700 m above sea level, this plant can thrive in various types of soil and can survive abiotic pressures such as tolerant of drought for up to 6 months, especially in the dry season (Funome et al., 2022; Mendieta-Araica et al., 2013). The moringa plant has many benefits and can help in the development of the pharmaceutical world and an additional source of nutrients for processed food products. In this case, the moringa plant has high market potential in the food and pharmaceutical industries. Moringa is a plant rich in nutrients and minerals including beta-carotene, amino acids, vitamins, proteins, polyphenols, phavionoids and natural antioxidants. Azeem et al. (2023) stated that the moringa plant has anti-inflammatory, anti-cancer, hepatoprotective, neuroprotective, and anti-aging properties.

Organic fertilizers are produced from microbiological activities that undergo decomposition, organic fertilizers have a slow release property in releasing nutrients will still be able to provide the needs of micro and macro elements for longer when compared to inorganic fertilizers because they are scientifically able to retain nutrients longer in the soil (Ameeta Sharma & Ronak Chetani, 2017); Dhaliwal et al., 2019. Organic fertilizers are divided into two forms,

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both solid and liquid, with a formation process through fermentation. According to Prasetyo & Evizal (2021), liquid organic fertilizer (POC) is a type of fertilizer that can be processed from agricultural waste using the fermentation method.

The oil palm (*Elaeis guineensis*) is a perennial and also tropical plant native to West Africa. The plant continues to develop and spread to tropical countries, such as in Southeast Asia including Indonesia and Malaysia. The Bogor Botanical Garden became an oil palm nursery brought by the Dutch in 1848. Since 1991, Indonesia has been growing oil palm commercially. According to the United States Department of Agriculture (USDA) in 2019, Indonesia has the largest oil palm plantation area, around 11.75 million ha, followed by Malaysia, Nigeria, Thailand, Colombia, Ivory Coast, Ghana, Guinea, Ecuador, Guatemala, and produces palm oil of around 42.5 million tons. The palm oil sector has contributed to the increase in foreign exchange in these countries.

These dried by-products of palm oil come from stems, fronds, and fruits. This can cause big problems for the environment because its use has not been seriously considered. This is because palm oil producers are still focused on the main products of palm oil (crude plam oil (CPO) and plam kernel oil (PKO)) (Bakri et al., 2022). This problem can be overcome by utilizing these by-products for various more organic applications such as the manufacture of liquid fertilizers, namely liquid organic fertilizers (POC) from palm fiber (coir) waste. Palm fiber is still rarely processed to be applied as POC where fiber can be extracted from the stems, fronds, and fruits. However, usually the fiber (coir) from palm oil is the result of packing in a screw press that comes from the mesocarp of palm fruit. According to Kurniawan & Yulianto (2020), palm fiber has a chemical content of glucan of around 219 kg/ton dry weight, xilan 153 kg/ton dry weight, lignin 234 kg/ton dry weight, $SiO2$ 632 kg/ton dry weight, $K2O$ 90 kg/ton dry weight, and CaO 72 kg/ton dry weight. Furthermore, Purba et al. (2023) adding that palm fiber contains nutrients, phosphorus (P), calcium (ca), magnesium (Mg), and carbon (C) which are beneficial for plants.

There are two methods in propagating moringa plants, namely generatively with seeds and vegetatively through plant stems. In planting moringa plants as a form of ensuring good quality for moringa plant nurseries, nurseries need good planting media, so that they are able to maintain the quality of seedling growth by fulfilling nutrients and being able to support water to encourage physical activity. A good plant medium must be able to maintain the humidity of the root area, provide enough air and nutrient availability (Krisnadi, 2015; Rici et al., 2022). The initial selection of seedlings by seeding seeds aims to ensure that the plants produced have a strong root system, are resistant to termite attacks and drought, and have a high biomass production capacity. During that time, research on moringa plant production was only limited to the use of chemical fertilizers containing NPK (Naben, 2021). While other research focuses on spacing treatment (Surahman, 2018) or different harvesting techniques (Rahmadyahningrum, 2020).

Planting media is said to be good when the media is able to become a foothold for plant roots which later the roots will absorb nutrients and nutrients for plant survival and development (Nugroho & Setiawan, 2022). As a root support, the planting medium must be of quality so that it is able to maintain plant fertility. A good planting medium will affect the fertility of plants. It should be noted that the key to a good planting medium indicator is the high level of organic matter (Fageria, 2012; Osman & Osman, 2013).

The method of comparing planting media has been widely used, for example the use of cocopeat, husk charcoal and compost. Cocopeat is very good when used as a plant medium because it has the ability to store a large amount of nutrients and water. This is reinforced by

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the statement of (Nurlina & Kusnarta, 2023) in her research where cocopeat is able to bind and store water because of the large level of porosity which is influenced by organic matter. Furthermore, Wuryaningsih & Andiyantoro (2004) in (Sukarman et al., 2012) added that cocopeat provides essential nutrients N 0.44%, P 119.1 ppm, K 31718 ppm, and C-organic 5.18%.

The chemical content of husk charcoal consists of SiO2 (52%), C (31%), Fe2O3, K2O, MgO, CaO, MnO, and Cu with a small amount of organic matter composition (Hamdani & Darmanto, 2022). The benefits of husk charcoal as a planting medium are useful for protecting soil conditions so that they remain loose, this is because husk charcoal has high porosity and is light. In addition, this used rice waste medium is able to be a comfortable medium for the growth (proliferation) of microorganisms needed by plants, maintain soil acidity (pH) so that it remains stable, maintain moisture, a source of soil fertility along with plants, crop production will increase, and can reduce the number of pathogens with absorbent capabilities. In addition, the absorption and binding to the soil is also an advantage of husk charcoal (Suryadi et al., 2023).

Meanwhile, compost media as organic matter for biofertilizers also has many benefits and can be a place for microorganisms to live that are beneficial for the availability of nutrients in the planting medium which has a positive impact on plants. Compost is actually a planting medium for fermented products, be it plants or organic waste such as plant product waste, namely straw, dry leaves and other organic waste. It will be beneficial for plants if applied because compost does not have a soil-like smell and can be a loose combination with soil. Based on the description above, it is necessary to conduct research on the use of liquid organic fertilizer (POC) concentration of palm fiber and types of plant media in moringa plant nursery (*Moringa oleifera L.*).

Methods

The type of research conducted is a type of research in the form of experiments. The research will be carried out at the Soil and Fertilizer Instrument Standard Testing Center (BPSI Soil and Fertilizer) Bogor City, West Java to check the POC laboratory and the type of planting media and in Ciheulang Village RT 003/ RW 001, Cimangeunteung Village, Rangkasbitung District, Lebak-Banten with an altitude of ±110.32 meters above sea level and the coordinates of the research site (6°22'06.1"S 106°17'50.6"E). This research was carried out in September-December 2024. The research location is at an average daily temperature of 27.27 ℃, the average air humidity ranges from 77.83%, the average rainfall is 10.13 mm/day, the average wind direction and speed is 0.53, and the intensity of solar irradiation is 87.43 hours/day (BMKG Center for Maritime Meterology Station Merak-Banten, 2024).

The tools used in this research are seedling trays, buckets, loose water, measuring cups, labels, cameras, stationery, *polybags* measuring (25x25) cm, 1.5 litre bottles, rulers, shovels, hoes, digital scales, SPAD (*Soil Plant Analysisi Development*), and a push-pull term. The materials used in this study were water, soil (*top soil*), 5 kg of oil palm *fibre* (coir), 200 ml dark molasses, 200 ml of agricultural EM4, 200 grams of *Trichoderma* sp, *cocopeat*, husk charcoal, compost, and pesticides. The environmental design used was a randomised group design (RAK) arranged factorially. The first factor is the concentration of liquid organic fertiliser (POC) of palm *fibre* (P) consisting of 4 levels and the second factor is the type of planting media (M) consisting of 4 levels.

The first factor is the concentration of liquid organic fertiliser (POC) of palm fibre (P) with 4 levels:

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P_0 : 0% concentration
P_1 : 15% concentration (15 ml POC + 235 ml water)
P_2 : 20% concentration (20 ml POC + 230 ml water)
P_3 : 25% concentration (25 ml POC + 225 ml water)

The second factor is the type of planting media in a ratio of 1: 1 (v: v) with 4 levels:

M_0 : Top soil
M_1 : Top soil + *Cocopeat*
M_2 : Top soil + Husk charcoal
M_3 : Top soil + Compost

The source of determining the concentration level is obtained from the results of research by & and Pratiwi (2023) based on the concept of equalizing the equivalent formulation of coconut fiber and palm fiber POC based on the similarity of chemical composition and practical experience which is used as a reference in determining the optimal formulation. While the composition of planting media is obtained from several relevant studies, such as those proposed by Hamdani & Darmanto (2022), Novita et al. (2023), Rasmani et al. (2018), and Saptorini et al. (2021). Therefore, the combination of factors resulted in 16 treatment combinations with each combination repeated 3 times, resulting in 48 experimental units. In table 1, there is a combination of treatments of palm fiber liquid organic fertilizer concentration and type of planting media.

Table 1. Treatment Combination of Palm Oil *Fibre* Liquid Organic Fertiliser (POC) Concentration (P) and Planting Media Type (M)

Concentration of Palm Oil *Fibre* POC	**Planting Media Type**			
	M_0	**M_1**	**M_2**	**M_3**
P_0	P_0M_0	P_0M_1	P_0M_2	P_0M_3
P_1	P_1M_0	P_1M_1	P_1M_2	P_1M_3
P_2	P_2M_0	P_2M_1	P_2M_2	P_2M_3
P_3	P_3M_0	P_3M_1	P_3M_2	P_3M_3

These two combinations are expected to increase the productivity of Moringa (Moriga olifera L.) plant growth. This research uses quantitative methods. This method includes data collection, data interpretation, and conclusions. Data processing in this study used DSAASTAT. If F count is greater than F table, then it is done with DMRT further test at 5% level.

Results and Discussion

Table 2 shows data on the macronutrient content of nitrogen, phosphorus, and potassium as well as pH contained in palm fiber POC.

Table 2. Results of analysis of liquid organic fertilizer (POC) content of *palm oil* fiber

Test Parameters	**POC Content *of Palm Oil* Fiber**	**Unit**	**Standart Nasional Indonesia (SNI)**
C-organik	0,25	%	Minimum 10
pH H_2O	6,8	-	4-9
N	0,28	%	2-6
P_2O_5	0,01	%	2-6
K_2O	0,15	%	2-6

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Source: Testing laboratory of the Bogor Soil and Fertilizer Instrument Standard Testing Center, 2024

Based on table 2, palm fiber liquid organic fertilizer has a nutrient content that does not comply with the Indonesian National Standard (SNI) based on the Decree of the Minister of Agriculture of the Republic of Indonesia No. 261 of 2019 concerning the minimum technical requirements for organic fertilizers, biological fertilizers, and soil amendments. Table 3 shows the data on the macronutrient content contained in the type of planting medium.

Table 3. Results of content analysis of types of planting media

Test Parameters	***Top Soil* (M0)**	***Top Soil* + *Cocopeat* (M1)**	***Top Soil* + Husk Charcoal (M2)**	***Top Soil* + Compost (M3)**	**Unit**
C-organik	1,72	5,71	2,33	2,56	%
pH H_2O	6,3	6,7	6,7	7,8	-
KCl	6,2	6,5	6,3	7,4	-
N	0,18	0,21	0,28	0,27	%
C/N	10	27	8	9	%
P_2O_5	30	63	121	291	ppm
K_2O	284	1396	1056	4983	ppm

Source: Testing laboratory of the Bogor Soil and Fertilizer Instrument Standard Testing Center, 2024

Based on table 3, the results of the M3 laboratory test have the most optimal nutrient content (pH, P_2O_5, K_2O) and can be the best planting medium for plants that require high potassium and phosphorus. This test aims to determine the level of nutrient adequacy needed by plants in the process of photosynthesis, root formation, and overall growth.

Based on the results of the recapitulation of various fingerprints on the application of oil palm fiber organic fertilizer concentration and type of planting medium on the growth of moringa plants (*Moriga olifera* L.) including plant height, number of leaves, diameter of primary stems, chlorophyll content, plant wet weight, leaf wet weight, and root wet weight. Using the ANOVA variety fingerprint method and DMRT 5% follow-up test, this result helps to identify the impact of factors that have a significant effect on plant growth so that improvements can be made in moringa plant cultivation techniques to achieve optimal results. Table 4 shows the recapitulation of the results of various fingerprints of the growth response of moringa plants (*Moriga Olifera* L.) to liquid organic fertilizers, palm fiber and types of media.

Table 4. Recapitulation of Fingerprint Results of Moringa Plant Growth Response Variety (*Moriga Olifera* L.) Against Palm *Oil Fiber Liquid Organic* Fertilizer and Types of Planting Media.

Observation Parameters	**Palm Oil Fiber POC**	**Types of Planting Media**	**Interaction**	**KK (%)**
Plant Height (cm)				
7 HSPT	tn	tn	*	12,79
14 HSPT	tn	tn	tn	17,99
21 HSPT	tn	tn	tn	20,94
28 HSPT	tn	tn	tn	23,52
35 HSPT	tn	tn	tn	24,85

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42 HSPT	tn	*	tn	25,42
49 HSPT	*	**	tn	13,24a
Number of Leaves (Helai)				
7 HSPT	**	*	*	13,85a
14 HSPT	*	*	tn	16,89a
21 HSPT	tn	tn	tn	20,73a
28 HSPT	tn	tn	tn	20,71a
35 HSPT	tn	tn	tn	22,90a
42 HSPT	tn	tn	tn	23,73a
49 HSPT	tn	tn	tn	23,71a
Rod Diameter (mm)				
7 HSPT	tn	tn	tn	13,32
14 HSPT	tn	tn	*	11,75
21 HSPT	*	tn	*	11,07
28 HSPT	tn	tn	*	11,64
35 HSPT	tn	tn	tn	13,33
42 HSPT	*	tn	tn	11,86
49 HSPT	**	tn	tn	13,01
Leaf humiliation/klorifil (mg/l)	tn	tn	tn	10,58
Wet Weight of Plants (g)	tn	tn	tn	19,99a
Leaf Wet Weight (g)	tn	**	tn	10,65b
Root Wet Weight (g)	tn	tn	tn	19,73a

Information: tn : Influence is not real
* : Real influence on the 5%
** : The influence is very real on the 1%
KK : Diversity Coefficient
HSPT : The day after transplanting
a : Transformation data $\sqrt{x + 0{,}5}$ 1 time.
b : Transformation data $\sqrt{x + 0{,}5}$ 2 times.

Based on the results of the recapitulation of the various fingerprints in table 4, it shows that the concentration treatment of palm fiber liquid organic fertilizer given to moringa plants has a real effect on the height parameters of 49 HSPT, the number of leaves is 14 HSPT, has a very real effect on the number of 7 HSPT leaves, the stem diameter has a real effect on 21 and 42 HSPT and has a very real effect on 49 HSPT.

The treatment of plant media based on table 4 on the plant height parameter had a real effect on 42 HSPT and had a very real effect on the plant height of 49 HSPT, the number of leaves had a real effect on 7 and 14 HSPT, besides that it also had a real effect on the wet weight of 49 HSPT leaves. There was an interaction between the two treatments of palm oil fiber POC and the type of planting medium on the plant height parameters of 7 HSPT and the number of leaves 7 HSPT, stem diameter 14, 21, and 28 HSPT.

Plant Height (cm)

The average height of moringa plants to the concentration of liquid organic fertilizer*, palm fiber* and type of planting medium at the age of 7 HSPT - 49 HSPT can be seen in table 5.

Table 5. Average Height of Moringa Plants to the Concentration of Liquid Organic Fertilizer of *Palm Oil Fiber and Types of Planting Media at the Age of 7 HSPT - 49 HSPT*

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Plant Lifespan (HSPT)	Plant Height (cm)					
		Types of Plant Media (M)				Average
	Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
7	P0 (Concentration 0%)	24,67ab	20,50abc	20abc	21abc	21,54
	P1 (Concentration 15%)	22,50abc	22,33abc	18c	24,33ab	21,79
	P2 (Concentration 20%)	20,33abc	23,67ab	25a	24,33ab	23,33
	P3 (Concentration 25%)	20,17abc	24,07ab	20,33abc	19,17bc	20,94
Average		21,92	22,64	20,83	22,21	
14	P0 (Concentration 0%)	33,33	24	24,67	23,33	26,33
	P1 (Concentration 15%)	27,67	29	22	28,67	26,84
	P2 (Concentration 20%)	27	31	33,33	31,33	30,67
	P3 (Concentration 25%)	28,33	29,33	27,50	24,67	27,46
Average		29,08	28,33	26,88	27	
21	P0 (Concentration 0%)	41	26,33	30	29,67	31,75
	P1 (Concentration 15%)	34	32,33	28,33	36,33	32,75
	P2 (Concentration 20%)	32	35	42,33	40,67	37,50
	P3 (Concentration 25%)	37,33	32	34,67	31	33,75
Average		36,08	31,42	33,83	34,42	
28	P0 (Concentration 0%)	43,33	28	32,67	33	34,25
	P1 (Concentration 15%)	39,33	32,67	29,33	41,67	35,75
	P2 (Concentration 20%)	37	36,67	47,67	45,67	41,75
	P3 (Concentration 25%)	43,67	35,33	37,67	35,67	38,09
Average		40,83	33,17	36,84	39,00	
35	P0 (Concentration 0%)	48,33	30,33	35,67	36,33	37,67
	P1 (Concentration 15%)	44,67	34,67	37,67	47,33	41,09
	P2 (Concentration 20%)	42,67	39	54,33	51,33	46,83
	P3 (Concentration 25%)	50	37,67	40,67	45,33	43,42
Average		46,42	35,42	42,09	44,08	
42	P0 (Concentration 0%)	54,67	32,33	41	41	42,25
	P1 (Concentration 15%)	52	40,67	46,33	53,67	48,18
	P2 (Concentration 20%)	51,67	39,67	62,33	55,33	52,25
	P3 (Concentration 25%)	57	44,67	51,67	55,67	52,25
Average		53,84a	39,34b	50,33ab	51,42a	
49	P0 (Concentration 0%)	56,33	32,67	44,67	46,33	45b
	P1 (Concentration 15%)	58	42,67	54,33	59	53,50ab
	P2 (Concentration 20%)	57	42	69,67	66,67	58,84a
	P3 (Concentration 25%)	63,67	48,33	60	66,33	59,58a
Average		58,75a	41,42b	57,17a	59,58a	

Information: Numbers followed by the same letter in the same row or column show unreal differences according to the DMRT test 5%.

Based on table 5, the height of moringa plants (*Moriga olifera* L.) with the concentration treatment of liquid organic fertilizer (POC) *palm fiber* was not significantly different at 14-42 HSPT and significantly different at 49 HSPT. The results of the high response of 49 HSPT plants to the concentration of POC *palm fiber* showed that P3 was not significantly different from P1 and P2, but was significantly different from P0. The POC treatment of *palm fiber* in 49 HSPT showed that the highest average plant height was found in the treatment of 25% (P3) 59.58 cm followed by 20% (P2) 58.83 cm, 15% (P1) 53.5 cm and the lowest 0% (P0)

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concentration of 45 cm. A concentration of 25% (P3) is the optimal concentration to increase the height of plants. This is based on the statement of (Nuryani et al., 2019) where plant growth and production will reach the optimum limit when supporting factors support the growth such as balanced nutrients and the right dose of fertilizer.

The quality criteria for palm *oil fiber* POC were determined by looking at the nutrient content of N, P, and K based on the analysis test in table 2, that the content of C-organic was 0.25%, P 0.01%, K 0.15%, N 0.28% and had a good pH of 6.8. The nitrogen (N) content has an important role in influencing the high growth of moringa plants, because nitrogen is an essential macronutrient for the process of protein synthesis and chlorophyll formation. Nitrogen supports healthy leaf development and optimal photosynthesis processes, which in turn increases the plant's ability to grow taller. According to Dami & Solle (2019) nitrogen nutrients are useful for determining overall plant growth, determining the composition of amino acids and plant proteins, and for stimulating plant growth on leaves (color, length, and width) and stems (height and diameter size). In addition to nitrogen nutrients, plants also need potassium (K), phosphorus (P), calcium (Ca), magnesium (Mg), and sulfur (S).

The treatment of planting media was not significantly different at the age of 14–35 HSPT and was significantly different at 42 and 49 HSPT. The plant height at 42 HSPT M0 is not significantly different from M3 and M2, but is significantly different from M1. The highest average yield of plant height was found in the top *soil* treatment (M0) of 53.83 cm, followed by *top soil* + compost (M3) of 51.42 cm, top *soil* + husk charcoal (M2) of 50.33 cm and the lowest *of top soil* + *cocopeat* (M1) of 39.33 cm. Meanwhile, the plant height in 49 HSPT treatments M0, M2, and M3 showed a real difference from M1. Thus, the highest average yield was found in the top *soil* + compost (M3) treatment of 59.59 cm, followed by top *soil* (M0) 58.75 cm, top *soil* + husk charcoal (M2) 57.27 cm and M1 (*top soil* + *cocopeat*) 41.42 cm. Moringa plants are plants that are rich in nutrients so that in their growth they need a lot of nutrients such as nutrients. Compost is a type of media that resembles soil and has a high nutrient content to help the process of supplying nutrients from the medium where the plant is planted to plants. In table 3, the results of laboratory tests of the type of planting medium show that the content of *the top soil* + compost (M3) soil treatment type has a C-organic content of 5.71%, N 0.27%, C/N ratio of 9%, P 291 ppm, and K 4983 ppm. Thus, fertilizers with N content are very important in vegetative growth such as plant height. Meanwhile, K can play an important role in strengthening plant roots and stems. This is suspected to be a mixture of *top soil* and compost which has a higher macronutrient content, especially P, than other media so that it can meet the optimal nutrient needs for the growth of moringa plants. According to (Saptorini et al., 2021), phosphorus (P) nutrients affect the development of young plant roots. Thus, it will correlate with the growth of plant height.

The interaction between the two factors of palm *oil fiber* POC and type of plant media had a real influence on 7 HSPTs with the highest sample, namely at a concentration of 20% and top *soil* + husk charcoal (P2M2) 25 cm. However, at the age of 14-49 HSPT, the difference is not real. Meanwhile, the highest sample in 49 HSPTs also showed that P2M2 had the highest result, which was 69.67 cm. This shows that the combination of P2M2 treatment provides the best effect on plant height so that it can stimulate the height of moringa plants. The fertility of the planting medium mixed soil and husk charcoal has the ability to bind and release water, which plays an important role in supporting the concentration of liquid organic fertilizer (POC) in the planting medium. According to Irawan & Kafiar (2015), burnt husks are able to improve the process which aims to facilitate the irrigation process at plant roots and maintain stable soil moisture. This is also reinforced by the statement of (Kusmarwiyah & Erni, 2011) one of the

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most important characteristics is the ability of the medium to support the right amount of moisture for the roots of the plant without making it appear waterlogged so that it can support the plant, retaining water and fertilizer for a while. Appropriate humidity is essential for plants to carry oxygen, but excessive moisture can cause root damage or cause disease. However, the treatment of palm *oil POC fiber* fertilizer concentration and the type of plant media each stand alone in influencing the growth of plant height. The structure of husk charcoal facilitates the retention of nutrients supplied from palm husk organic fertilizer so that it can retain good nutrients such as NPK. This is in line with the statement of Purwanto (2006): Suhardana (2022) that the advantages of husk charcoal are that it has good aeration and drainage, is quite porous (has many cavities) so that it can store oxygen needed for the respiration process (breathing) and is able to bind and store water and nutrients well.

Number of Leaves (strands)

The average number of moringa leaves to the concentration of liquid organic fertilizer, palm fiber and type of planting medium at the age of 7 HSPT - 49 HSPT can be seen in table 6.

Table 6. Average Number of Moringa Leaves to the Concentration of Palm *Oil Fiber* Liquid Organic Fertilizer and Type of Planting Media

	Number of Leaves (strands))					
Plant Lifespan (HSPT)		**Types of Plant Media (M)**				**Average**
	Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
7	P0 (Concentration 0%)	55,33de	82,67bcde	63,33cde	65bcde	66,58b
	P1 (Concentration 15%)	56de	75,33bcde	51,33e	77,67bcde	65,08b
	P2 (Concentration 20%)	56,33de	126,67a	109,33ab	130,33a	105,67a
	P3 (Concentration 25%)	93,67abcd	111abc	78bcde	59de	85,42ab
Average		65,33b	98,92a	75,50b	83ab	
14	P0 (Concentration 0%)	91	118	94	85	97b
	P1 (Concentration 15%)	77,33	117	77,33	125,33	99,25b
	P2 (Concentration 20%)	77,67	168	141,33	180,33	141,83a
	P3 (Concentration 25%)	131,33	171,33	106	78,33	121,75ab
Average		94,33b	143,58a	104,67b	117,25ab	
21	P0 (Concentration 0%)	130,67	128	87,33	103	112,25
	P1 (Concentration 15%)	122	148,33	99,33	151,67	130,33
	P2 (Concentration 20%)	101	210,33	212,33	225,33	187,25
	P3 (Concentration 25%)	177	147,33	129	115,33	142,17
Average		132,67	158,50	132	148,83	
28	P0 (Concentration 0%)	139,67	146,67	102,33	146,67	133,83
	P1 (Concentration 15%)	128,67	158,33	107	118,33	128,08
	P2 (Concentration 20%)	121	218,67	238	218	198,97
	P3 (Concentration 25%)	193,67	146,67	126,67	134,67	150,42
Average		145,75	167,58	143,50	154,42	
35	P0 (Concentration 0%)	154,67	157,33	122,33	210,67	161,25
	P1 (Concentration 15%)	141,67	183,33	143,33	130,33	149,67
	P2 (Concentration 20%)	128,33	233,67	255,67	250,33	217
	P3 (Concentration 25%)	218,33	149,33	153	148,67	167,33
Average		160,75	180,92	168,58	185	
	P0 (Concentration 0%)	184,67	147,67	170,67	169,33	168,09
	P1 (Concentration 15%)	232,67	169,33	205	306,33	228,33

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42	P2 (Concentration 20%)	157,33	270	338	339,67	276,25
	P3 (Concentration 25%)	293,33	198,67	203,33	334	257,33
Average		217	196,42	229,25	287,33	
49	P0 (Concentration 0%)	203,33	162,67	187,67	186,33	185
	P1 (Concentration 15%)	260,33	189,67	229,67	343	255,67
	P2 (Concentration 20%)	181	310,67	388,67	390,67	317,75
	P3 (Concentration 25%)	340,33	230,33	236	387	298,42
Average		246,25	223,34	260,50	326,75	

Information: Numbers followed by the same letter in the same row or column show unreal differences according to the DMRT test 5%

Based on table 6, the number of moringa leaves (*Moriga olifera* L.) in the treatment of palm fiber POC concentration was significantly different in 14 HSPT, the response of P2 concentration was significantly different from P0 and P1, however, it was not significantly different from P3. The best treatment with the highest average number of leaves was a concentration of 20% (P2) 141.83 followed by a concentration of 25% (P3) 121.75, a concentration of 15% (P1) 99.25 and the lowest was P0 (0% concentration) 97. Meanwhile, at the age of 21-49 HSPT, the concentration of POC *palm fiber* is different. However, in 49 HSPTs, the number of leaves with the highest average in the palm fiber POC treatment, namely with a concentration of 20% (P2) of 317.75, this concentration gave the best results in a row from 7-49 HSPTs. The results of laboratory tests carried out in table 2, that the content of nutrients N is 0.28% greater than that of P and K nutrients. (2022) leaf growth is related to nitrogen content. The absorption of nitrogen in plants helps stimulate the formation and growth of new leaves. This is reinforced by the statement of (Aulia & Makmur, 2020) that when the composition of N needs is sufficient, the leaves of the plant are greener and more numerous. The average number of leaves is lowest at a concentration of 0% (P0), this means that POC *fiber* palm has an influence on the vegetative growth process of plants, especially the number of leaves.

The treatment of planting media type to the leaf count parameter was significantly different in 14 HSPT, M1 was significantly different from M0 and M2 however, it was not significantly different from M3. The highest average number of leaves was in *top soil* + *cocopeat* (M1) 143.58 followed by top *soil* + compos (M3) 117.25, top *soil* + husk charcoal (M2) 104.67 and the lowest *top soil* (M0) 94.33. Meanwhile, at the age of 21-49, the difference in HSPT is not real. According to Nurifah & Fajarfika (2020) which states that *cocopeat* can store water and contains several nutrients in its pores. So that the frequency of fertilization can be reduced, the water absorption is high, the content of nutrients from nature which of course is needed by plants, can support root growth quickly so that it is good for nurseries, especially plants with young age.

However, during the growth period at the end of the observation at 49 HSPT, the average plant height was in the *top soil* + compost (M3) soil treatment with an average height of 326.75. Leaves are products that are usually taken from moringa plants. The C/N ratio in table 3 shows that the *top soil* + *cocopeat* (M1) treatment has a higher C/N ratio of 27% when compared to (*top soil* + compost) has a C/N content of 9%. According to FOG (1988) that the high C/N ratio shows that organic matter is still not fully decomposed and is still undergoing the process of decomposition by the soil. According to Isroi & Yuliarti (2009) where the mature C/N is less than 20 if it is more, it is included in the high theory.

Thus, plant growth is not optimal when the C/N ratio is high. In addition, treating top *soil* + compost (M3) has better nutrients. According to Lakitan (1996) stated that the development

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and increase of the number of leaves and the size of leaves (meristematic activity) are greatly influenced by the availability of nutrients because water and nutrients in the planting medium will be absorbed by the roots and distributed to the plant so that it can increase the turgor pressure of leaf cells, the ability of leaves to photosynthesize will increase if supported by the availability of nutrients. In addition, the productivity of the number of leaves is affected by external factors such as rainfall, wind speed and sunlight intensity. Where the number of leaves in this study decreased in several samples due to weather conditions. Based on BMKG (2024) data in September-November for the Rangkasbitung District area, Lebak-Banten is at an average daily temperature of 27.27°C, the average air humidity ranges from 77.83%, the average rainfall is 10.13 mm/day, the average wind direction and speed is 0.53 knots, and the intensity of solar irradiation is 87.43 hours/day. The research was conducted in a shadow house with shade so that it does not get direct sunlight.

The interaction between the two factors of POC *palm fiber* and the type of planting medium was significantly different in 7 HSPTs with the best treatment of 20% concentration and *top soil* + compost (P2M3) of 130.33 but no significant difference with the concentration of 20% and *top soil* + *cocopeat* (P2M1) of 126.67. Meanwhile, at the age of 14-49 HSPT is not significantly different. The highest interaction in 49 HSPTs was also produced by a concentration of 20% and *top soil* + compost (P2M3) of 390.67 providing optimal growth in moringa plants from the beginning of growth. Liquid organic fertilizers derived from palm fiber contain a number of important nutrients, such as NPK which is easily absorbed by plants. Meanwhile, compost functions as an organic matter rich in beneficial microorganisms to increase soil fertility.

According to Rivier et al. (2022), compost can improve soil structure, increase soil ability to hold water, and improve soil aeration and drainage. In addition, compost also provides nutrients slowly so that it has a long-term effect on plant growth. When liquid organic fertilizer from palm fiber and compost are used together, they complement each other because of the properties of compost that are able to withstand water as well as liquid organic fertilizer. However, in this study, the influence of treatment, both the treatment of palm oil POC *fiber* fertilizer concentration and the type of plant media stood alone in influencing the growth of the number of leaves.

Rod Diameter (mm)

The average diameter of the stem of moringa plants to the concentration of liquid organic fertilizer, palm fiber and type of planting medium at the age of 7 HSPT - 49 HSPT can be seen in table 7.

Table 7. Average Moringa Stem Diameter to the Concentration of Palm Oil Fiber Liquid Organic Fertilizer and Type of Planting Media

Plant Lifespan (HSPT)	**Diamter Batang (mm)**					
		Types of Plant Media (M)				**Average**
	Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + Cocopeat**	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
7	P0 (Concentration 0%)	3,3	3,87	3,467	3,57	3,55
	P1 (Concentration 15%)	3,6	3,57	2,97	3,8	3,48
	P2 (Concentration 20%)	3,3	4,47	3,63	3,97	3,84
	P3 (Concentration 25%)	4,13	4,1	3,8	3,33	3,84
Average		3,58	4	3,47	3,67	

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14	P0 (Concentration 0%)	3,83abc	4abc	3,77bc	3,7bc	3,83
	P1 (Concentration 15%)	4,3ab	4,07ab	3,1c	3,97abc	3,86
	P2 (Concentration 20%)	3,63bc	4,73a	4,4ab	4,4ab	4,29
	P3 (Concentration 25%)	4,47ab	4,53ab	4abc	3,6bc	4,15
Average		4,06	4,33	3,82	3,92	
21	P0 (Concentration 0%)	4,13abcd	4,13abcd	3,87bcd	3,9bcd	4,01b
	P1 (Concentration 15%)	4,67ab	4,23abcd	3,43d	4,2abcd	4,13ab
	P2 (Concentration 20%)	3,73cd	4,93a	4,7ab	4,73ab	4,525a
	P3 (Concentration 25%)	4,63abc	4,67ab	4,27abcd	3,93bcd	4,375ab
Average		4,29	4,49	4,17	4,27	
28	P0 (Concentration 0%)	4,27ab	4,3ab	4,17ab	4,17ab	4,175
	P1 (Concentration 15%)	4,8a	4,3ab	3,73b	4,5ab	4,33
	P2 (Concentration 20%)	3,73b	4,93a	4,9a	4,93a	4,67
	P3 (Concentration 25%)	4,9b	4,67ab	4,37ab	4,13ab	4,49
Average		4,43	4,55	4,24	4,4	
35	P0 (Concentration 0%)	4,47	4,43	4,57	4,37	4,46
	P1 (Concentration 15%)	5,03	4,63	4,17	4,97	4,7
	P2 (Concentration 20%)	3,83	5	5,4	5,13	4,84
	P3 (Concentration 25%)	5,3	4,8	4,7	4,4	4,8
Average		4,66	4,72	4,71	4,72	
42	P0 (Concentration 0%)	4,73	4,53	4,67	4,73	4,67b
	P1 (Concentration 15%)	5,63	4,83	4,97	5,53	5,24a
	P2 (Concentration 20%)	4,6	5,2	5,77	5,8	5,29a
	P3 (Concentration 25%)	5,87	5,1	5,4	6,03	5,58a
Average		5,18	4,92	5,15	5,53	
49	P0 (Concentration 0%)	5	4,67	4,9	5	4,89b
	P1 (Concentration 15%)	5,93	4,77	5,27	5,7	5,4ab
	P2 (Concentration 20%)	4,73	5,4	5,77	6	5,475ab
	P3 (Concentration 25%)	6,23	5,3	5,8	6,53	5,97a
Average		5,48	5,03	5,41	5,82	

Information: Numbers followed by the same letter in the same row or column show an unreal difference according to the DMRT test 5%.

Based on the results in table 7, it shows that the POC treatment of *palm fiber* is not significantly different for the stem diameter of moringa plants (*Moriga olifera* L.) at the age of 7 and 35 HSPT. Then it has a real effect on 42 and 49 HSPT. The diameter of the 42 HSPT rod shows that P1, P2, and P3 are significantly different from P0. Thus, the best average rod diameter at a concentration of 25% (P3) 5.58 mm was followed by a concentration of 20% (P2) 5.29 mm, a concentration of 15% (P1) 5.24 mm and the lowest result at a concentration of 0% (P0) 4.67. Meanwhile, in 49 HSPT, P3 is significantly different from P0, however, it is not significantly different from P2 and P1. The stem diameter with the average plant height of 49 HSPT was best at a concentration of 25% (P3) 5.97 mm followed by a concentration of 20% (P2) 5.475 mm, a concentration of 15% (P1) 5.4 mm and the lowest yield at a concentration of 0% (P0) 4.89 mm. So that POC *palm fiber* has a good influence on the diameter of the primary stem of moringa plants.

The diameter of the stem increased in size due to an increase in nutrient content because in this study, the interval of giving POC palm *fiber* was carried out once for 7 times. According to

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Sayekti & Putarta (2016) that moringa plant seedlings will utilize photosynthesis for the growth of crowns, stems to leaves so that the increase in the size of the plant stem diameter is caused by the rate of photosynthesis is well distributed. Phosphorus (P) is a part of essential nutrients that affect plant cells because they are able to channel energy and increase early growth. According to Maulanda et al. (2024) that phosphorus is able to accelerate the formation of fruits and roots and strengthen the stems so that they do not collapse easily. So that the size of the diameter of the primary stem in moringa plants will affect the sturdiness of the plant.

The treatment of planting media types was not significantly different in 7, 35, 42, and 49 HSPT. However, in 49 HSPTs*, the top soil* + compost (M3) treatment showed the best growth yield with an average of 5.82 mm. The *top soil* (M0) treatment did not have a significant difference with the M1, M2, and M3 treatments. This is suspected because the soil in *the top soil* treatment and POC *oil fiber* in the treatment has sufficient nutrient content for the needs of moringa plants. This is reinforced by the research of (Novita et al., 2023) that when the treatment has a good nutrient content both macro and micro, it will be able to provide maximum growth for moringa plants. This is in line with the opinion of (Bustami et al., 2012) stated that balanced nutrients, proper fertilizer dosing, and nutrients are fulfilled, then these factors will affect plant growth optimally. The lowest growth result in 49 HSPTs from this study was M1 treatment (*top soil* + *cocopeat*). This is suspected because the C/N ratio, namely the M1 planting medium, is high at around 27%, which affects the plant growth process.

The interaction between the two POC treatments *of palm fiber* and different types of planting media was not evident in HSPT 7, 35, 42 and 49. However, there was a real influence on the plant ages of 14, 21 and 28 HSPT. The interaction of 14 HSPT showed that the average stem diameter height was found in the 20% concentration treatment and the top *soil* + *cocopeat* (P2M1) was 4.73 mm. The effect was evident at the age of 21 HSPT where the highest average was found in the treatment of 20% concentration and 4.93 *mm top soil* + *cocopeat* (P2M1). In addition, there was a real effect on 28 HSPTs with the best average being 20% concentration treatment and 4.93 mm *top soil* + *cocopeat* soil (P2M1) but not significantly different from the 20% concentration treatment and *top soil* + husk charcoal (P2M2) which was 4.9 mm and 20% concentration and *top soil* + compost (P2M3) 4.93 mm.

The development of moringa plants is caused by the use of planting media which results in excess and lack of nutrients. According to (Aisyah, 2016), the application of fertilizer to plants must be in accordance with the needs of plants because excess or lack of nutrients in the planting medium can make plant growth less than ideal. From the results of the research of (Rasmani et al., 2018) Soil and cocopeat mixed media is the best medium for moringa plant nurseries, especially in the growth response of seed crowns and stem diameters. This is because *cocopeat* is able to meet a good level of porosity, maintains moisture content and has a relatively high NPK macronutrient. So that POC palm *fiber* can be absorbed well by M1 planting medium (*top soil* + *cocopeat*). Meanwhile, the interaction with the highest yield was at the age of 49 HSPT P3M3 (concentration of 25% and top *soil* + compost) with an average of 6.53 mm.

Greenish Leaves/ Chlorophyll (mg/I)

The average chlorophyll of moringa plants to the concentration of liquid organic fertilizer*, palm fiber* and type of planting medium at the age of 49 HSPT can be seen in table 8.

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Table 8. Average Greeniness of Leaves/Chlorophyll (mg/I) Moringa on the Concentration of Liquid Organic Fertilizer of Palm Oil Fiber and Type of Planting Media.

Greenish Leaves/ Chlorophyll (mg/I)					
	Types of Plant Media (M)				**Average**
Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
P0 (Concentration 0%)	33,1	29,1	32,27	33,57	31,96
P1 (Concentration 15%)	31,53	30,97	30,97	32,83	31,58
P2 (Concentration 20%)	30,33	29,5	32,53	32,37	31,28
P3 (Concentration 25%)	29,03	28,67	32,67	33	30,82
Average	31	29,56	32,18	32,89	

Information: Numbers followed by the same letter in the same row or column show an unreal difference according to the DMRT test 5%.

Based on the results in table 8, the leaf greenness level parameters in 49 HSPTs were different for all treatments of both palm *oil fiber POC* and planting media types. The average greenness of leaves (chlorophyll) was the highest in the treatment of palm fiber POC at a concentration of 0% (P0) which was 31.96 mg/l. So that POC *palm fiber* did not have a significant effect on leaf chlorophyll. Leaves are the main part that is used so that leaf productivity is the main thing. (Suwardi et al., 2023) stated that the availability of nutrients, namely nitogens, in relatively sufficient quantities, will be characterized by a high photosynthesis process, good vegetative processes, and the chlorophyll color of dark green leaves. Based on the results of the analysis in table 2, it is found that liquid organic fertilizer (POC) *of palm oil fiber has a low nitrogen content of 0.28%.* According to Prasetyawati et al. (2019) POC can also promote and increase chlorophyll production in leaves, improve plant photosynthesis ability, and absorb nitrogen from the air. If the nitrogen absorbed by plants is at a low level, it will affect the level of greenness of the leaves, considering that nitrogen is an important element in the synthesis of chlorophyll.

The treatment of the type of planting medium with the best average greenness of the leaves is found in *the treatment of top soil* + compost (M3), which is 32.89 mg/l of compost mixture can have a positive effect on the growth of moringa plants because it contains better macronutrients contained in table 3, the results of laboratory tests of the type of planting media show that the content of the type of soil *treatment top soil* + Compost (M3) has a C-organic content of 5.71%, N 0.27%, C/N ratio of 9%, P 291 ppm, and K 4983 ppm. So that the nutritional needs for plants can be met. This is in line with the opinion of Yudono (2014) in (Rasyidi et al., 2024) that organic fertilizer in the form of compost is composed according to the material of biological creatures as the *output* of decomposition of plant residues, animals, and microorganisms containing nutrients into nutrients for plants. According to Masud (1993) in (Saputri et al., 2019) nitrogen is part of the chlorophyll molecule and controls the ability of plants to photosynthesize so that nitrogen acts as a component of chlorophyll.

There was no interaction between the treatment of palm fiber POC concentration and the type of planting medium on chlorophyll content. This is suspected because the POC treatment of *palm fiber* and the type of planting medium did not show results that had a real effect on the chlorophyll content of plants. The best interaction was found in the treatment of 0% concentration and *top soil* + compost (P0M3) 33.57 mg/l, so it can be concluded that compost

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has an important role in the level of leaf greenness in moringa plants. This means that in this study, the influence of treatment, be it the treatment of POC *fertilizer* concentration, palm fiber and the type of plant media each stand alone in influencing leaf chlorophyll.

Environmental factors such as sunlight also affect the increase in chlorophyll levels at the research site, the average irradiation intensity during the study is 87.43 hours/day for the Rangkasbitung-Lebak District, Banten (BMKG, 2024). However, in this study, shade was given so that it did not get direct sunlight. Moringa plants when they are not sufficiently illuminated by sunlight do not contain much chlorophyll which results in a slow growth rate of plants. This opinion is supported by (Mahardika et al., 2023) that light will hypnotize the formation of chlorophyll which has assimilate storage for the plant growth process. (Esteban et al., 2015) stated that the disparity of solar intensity and nutrients resulted in changes in the properties of plants, changes in photosynthetic pigment content and morphology.

Wet Weight of Plant (g)

The average wet weight of moringa plants to the concentration of liquid organic fertilizer*, palm fiber* and type of planting medium at the age of 49 HSPT can be seen in table 9.

Table 9. Average Wet Weight of Moringa Plants to the Concentration of Liquid Organic Fertilizer of Palm Oil Fiber and Type of Planting Media.

Wet Weight of Plants (g)					
	Types of Plant Media (M)				**Average**
Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
P0 (Concentration 0%)	22,53	14,4	14	14,93	16,57
P1 (Concentration 15%)	24,7	18,3	23,7	27,93	23,66
P2 (Concentration 20%)	15,57	20,84	34,63	32,3	25,81
P3 (Concentration 25%)	26,57	17,5	22,67	32,23	24,72
Average	22,29	17,76	23,75	26,85	

Information: Numbers followed by the same letter in the same row or column show an unreal difference according to the DMRT test 5%.

Based on the results in table 9, the wet weight of the plants differed from one treatment to another. However, the plant weight with palm oil fiber POC treatment at a concentration of 20% (P1) gave the best average of 25.81 g while the lowest average yield was found in the treatment of 0% (P0) concentration of 16.57 so that palm oil fiber POC had a positive response to the wet weight of the plant. The nutrient content of palm fiber POC based on the analysis test in table 2, that the content of C-organic is 0.25%, P 0.01%, K 0.15%, N 0.28% and has a good pH of 6.8. The wet weight of the plant can be affected by the availability of nutrients, including NPK (nitrogen, phosphorus, and potassium) contained in POC palm *fiber* which is applied at intervals every week as many as 7 times. According to Moi (2015) that liquid organic fertilizer contains many microorganisms that help balance N and P and K levels, increase macro and micronutrient levels, and increase the growth rate and development of plants.

The average result of the best type of planting media treatment was *top soil* + compost (M3) providing an average wet weight of 26.85 g. A mixture of soil and compost media was able to provide good nutrients and good absorption for the growth of moringa plants. This is reinforced by the statement of Yudono (2014) in (Rasyidi et al., 2024) that organic fertilizer in the form

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of compost is composed according to the material of biological creatures as the *output* of decomposition of plant residues, animals, and microorganisms containing nutrients into nutrients for plants. So that moringa plants, which are plants rich in nutrients, will need planting media that has a lot of nutrient content.

The highest interaction in this parameter was the concentration of 20% and the top soil + husk charcoal (P2M2) which was 34.63 g. According to Irawan & Kafiar (2015) husk was able to improve the process which aimed to facilitate the irrigation process at the roots of plants and maintain stable soil moisture. The wet weight of plants is affected by nutrients derived from the planting medium, so that the absorption of roots to nutrients will be optimal which correlates with the increase in plant growth vegetatively. The wet weight of the plant will be affected by the elements potassium, nitrogen and phosphorus. According to Karismaningrum et al. (2024) Good nutrients in the planting medium will be able to be absorbed by plant roots along with water. So, with better growth, the plant will produce a greater wet weight.

Leaf Wet Weight (g)

The average wet weight of moringa leaves to the concentration of liquid organic fertilizer, palm fiber and type of planting medium at the age of 49 HSPT can be seen in table 10.

Table 10. Average Wet Weight of Moringa Leaves on the Concentration of Liquid Organic Fertilizer of Palm Oil Fiber and Type of Planting Media

Leaf Wet Weight (g)					
	Types of Plant Media (M)				**Average**
Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
P0 (Concentration 0%)	6,8	1,3	3,5	3,7	3,83
P1 (Concentration 15%)	5,37	2,33	5,3	5,43	4,58
P2 (Concentration 20%)	4,13	2,97	5,83	7,1	5,01
P3 (Concentration 25%)	4,67	2,63	4,57	8,03	4,95
Average	5,23a	2,31b	4,78a	6,07a	

Information: Numbers followed by the same letter in the same row or column show an unreal difference according to the DMRT test 5%.

Based on the results in table 10, the difference in leaf wet weight was not evident in the POC treatment *of palm oil fiber*, but the highest average was found in the concentration of P2 (20% concentration) of 5.01 g. While the lowest average leaf wet weight was P0 (0% concentration) of 3.83 g. Leaf growth was affected by sufficient nitrogen content. The results of laboratory tests carried out in table 2, that the nutrient content N is 0.28% so that the application of POC *palm fiber* consistently for 7 times affects the wet weight of the leaves. According to (Fauziah et al., 2022) that leaf growth is related to the content of nitrogen. The absorption of nitrogen in plants helps stimulate the formation and growth of new leaves. This is reinforced by the statement of (Aulia & Makmur, 2020) that when the composition of N needs is sufficient, the leaves of the plant are greener and more numerous. So that it can affect the wet weight of the leaves.

The wet weight of the leaves showed a significant difference in the treatment of M3, M0, and M2 planting media that was significantly different from M1. The average weight with the highest weight was *top soil* + compost (M3) of 6.07 g followed by top *soil* (M0) 5.23 g, top *soil* + husk charcoal (M2) 4.78 g and the lowest average weight in top *soil* + *cocopeat* (M1)

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treatment of 2.31 g. C/N ratio affects leaf wet weight, where changes in the ratio of carbon to nitrogen can affect leaf growth and development, including the wet weight.

A low C/N ratio will indicate that the maturity of organic matter is very mature, while in table 2, it shows that the C/N ratio contained in the *top soil* + *cocopeat* (M1) soil media treatment reaches 27% higher than the maximum limit. The C/N ratio is the ratio between organic C and total N in the soil. Decomposing organisms use carbon as an energy source and nitrogen as a protein source. According to Rezeki et al. (2023) The C/N ratio of a good soil or planting medium is 10-12 so that C/N will affect the availability of nutrients for plants. According to Ridwandi *et al*. (2023) the C/N ratio is inversely proportional to the availability of nutrients, meaning that when the C/N ratio is high, the nutrient content available to plants is small, while if the C/N ratio is low, the availability of nutrients is high and plants can meet their life needs. Liquid organic fertilizer as a form of increasing nutrients, especially nitrogen when faced with a C/N ratio that is too high in the planting medium even though POC is applied consistently, the nitrogen in the soil (planting medium) cannot be absorbed effectively by plants. According to (Hodiyah et al., 2018) states that when macronutrients are low such as nitrogen elements available for absorption by plants, it will produce lighter leaf weight with a small amount and a smaller and thinner leaf shape.

The different interactions were not noticeable on the average parameters of leaf wet weight. However, the best interaction was in the treatment of 25% concentration and *top soil* + compost (P3M3) of 8.03 g. Thus, in this study, the influence of treatment, both the treatment of palm oil fiber POC fertilizer concentration treatment and the type of plant media stood alone in influencing the wet weight of the leaves.

Wet Root Weight (g)

The average wet weight of moringa roots to the concentration of liquid organic fertilizer*, palm fiber* and type of planting medium at the age of 49 HSPT can be seen in table 11.

Table 11. Average Wet Weight of Moringa Roots on the Concentration of Liquid Organic Fertilizer, Palm Fiber, and Type of Planting Media

wet root weight (g)					
	Types of Plant Media (M)				**Average**
Palm Oil Fiber POC (P)	**M0 (*top soil*)**	**M1 (*top soil*) + *Cocopeat***	**M2 (*top soil*) + Husk Charcoal**	**M3 (*top soil*) + Compost**	
P0 (Concentration 0%)	9,9	10,2	7,67	9,1	9,23
P1 (Concentration 15%)	11	9,67	10,17	7,8	9,63
P2 (Concentration 20%)	6,67	13,37	15,7	13,83	12,34
P3 (Concentration 25%)	13,13	10,03	9,57	11,73	11,09
Average	10,15	10,79	10,73	10,62	

Information: Numbers followed by the same letter in the same row or column show an unreal difference according to the DMRT test 5%.

Based on the results in table 11, the wet weight of the roots was different in each treatment. However, the root weight with POC *treatment* of palm oil fiber at a concentration of 20% (P2) gave the best average of 12.34 g. The average result of the highest type of planting medium treatment was found in *top soil* + *cocopeat* (M1) soil of 10.79 g. However, it was not so different from the treatment of other plant media. Statement from the results of the research of (Rasmani et al., 2018) soil mixture and *cocopeat* is the best medium for seeding moringa plants,

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especially in the growth response of seed crowns, and stem diameter, in addition to P levels of 9.03 ppm (0.000903%), K2, 12 ppm (0.000212%), and N 0.16%. Based on the results of the analysis in table 3, the mixed medium of *top soil* and *cocopeat* (1:1) showed a content of N 0.21%, P 63 and K 1396. Therefore, the response to the roots in moringa seedlings which is included in wet weight, has good growth for the *soil-cocopeat* mixture. This is because *cocopeat* is able to meet a good level of porosity, maintain moisture content and has good NPK macronutrients. So, it is very good in the development of the roots of moringa plants. Root development has a function as a tool to absorb nutrients in the planting medium as a support for the growth of leaves and stems. The roots will develop well on a good growing medium. Overall the M0, M1, M2, and M3 treatments had an average root wet weight that did not differ significantly. In the treatment of soil media, it produces a lower root length and root volume than other types of planting media. This is suspected as time goes by soil compaction which causes root development to be disrupted. According to Handani and Darmanto (2022), the lack of soil pores occurs due to soil compaction so that the roots are difficult to develop.

The interaction for different root wet weight parameters was not real. Meanwhile, the best interaction was found in the combination of 20% concentration treatment and 15.7 *g top soil* + husk charcoal (P2M2). (2018) showed that soil mixture media with husk charcoal is the best medium for the growth of moringa seedlings in terms of the chemical composition of burnt husk consisting of SiO2 (52%), C (31%), Fe2O3, K2O, MgO, CaO, MnO, and Cu with small levels and organic matter. Meanwhile, based on table 3, the content of the soil mixture and husk charcoal has a content of 0.28% N, 121 ppm P and 156 ppm K. Planting media and fertilizer can provide optimal results when used in the right combination, but they can also function effectively if applied separately according to the specific needs of the plant. This means that in this study, the influence of treatment, be it the treatment of POC fertilizer concentration, *palm fiber* and the type of plant media each stand independently in influencing the growth of root wet weight.

Moringa plants are able to adapt to the environment when transplanted. This is suspected because the moringa plant has a strong root system. The lateral roots of the moringa plant will grow swollen to resemble primary roots. Krisnadi (2015) stated that moringa plants have white taproot and enlarged like radish. The roots that come from the seeds will be hump, swollen, white, and have a distinctive odor. Moringa plants that come from seeds (generative) will have deep roots, forming wide root taps and thick fibers, so it will be difficult to distinguish between primary and lateral roots. Root hairs will grow from the lateral roots, which means that if the moringa plant is done slowly or if the transplant is done from the young or old phase, that is, from the fishing rod phase to the perfect leaf bloom phase, then the moringa plant can adapt.

Conclusion

The treatment of applying a concentration of liquid organic fertilizer (POC) of palm fiber with a concentration of 20% and 25% had the best effect on the growth of moringa plants. The treatment of mixed plant media with top soil and compost has the best influence on the growth of moringa plants. There was an interaction between the treatment of palm fiber POC concentration and the type of planting medium. So that to get good growth and yield of moringa plants (*Moriga olifera* L.), liquid organic fertilizer POC *palm fiber* with concentrations of 25% and 20% can be used and plant media with a mixture of (v;v) (1:1) top soil and compost can be used. Further research was carried out on the research of moringa plants (*Moriga olifera* L.) with liquid organic fertilizers and other types of media.

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