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Optimization of Growth and Yield of Melon Plants (*Cucumis melo* L.) in Drip Irrigation Hydroponic System by Providing Various Planting Media and Doses of Magnesium Sulfate Fertilizer

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Abstract
Melon is a horticultural commodity with high sales value in both local and export markets. Consumer demand for sweet, fresh, and high-quality melons continues to rise. This rising demand for melons requires higher productivity. To achieve higher melon productivity, advanced agricultural cultivation technologies are required, including hydroponic melon cultivation. This study aims to determine the effects of planting media and magnesium sulfate fertilizer doses on the growth and yield of hydroponic melons using a drip irrigation system. The study was conducted at the Puspa Lebo greenhouse, Lebo Village, Sidoarjo District, Sidoarjo Regency, East Java, from September to November 2024. The research employed a Completely Randomized Design (CRD) with two treatment factors. The first factor was the type of planting media, consisting of three treatments: rice husk charcoal, cocopeat, and a 1:1 mixture of rice husk charcoal and cocopeat. The second factor was the magnesium sulfate fertilizer dose, with four treatments: 0 g/plant, 15 g/plant, 30 g/plant, and 45 g/plant. The results indicated that the rice husk charcoal planting medium treatment affected the fruit weight parameter. Meanwhile, the Magnesium fertilizer dose treatment of 15 g/plant affected plant length and leaf number. The use of rice husk charcoal as a planting medium increased melon fruit weight, and it is recommended that further research explore its advantages for use with other commodities.

Keywords: Cocopeat, Fruit Weight, Number of Leaves, Plant Length, Rice Husk Charcoal

1. Introduction

Melon (Cucumis melo L.) is a popular seasonal horticultural crop known for its sweet and refreshing taste. According to Daryono and Maryanto (2018), melon is a valuable source of energy, with 100 grams containing 21 calories, 5.1 grams of carbohydrates, 0.6 grams of protein, 0.1 grams of fat, and several essential vitamins and minerals. The exponential increase in population has also driven the demand for adequate food availability. Data from the Central Statistics Agency (2021) indicate that melon production in Indonesia has increased from 2018 to 2021. In 2018, melon production was recorded at 118,708 tons, rising to 129,147 tons in 2021. This increase in production underscores the significant potential to expand melon cultivation as part of efforts to support national food security.

The increasing demand for melons requires strategies to increase productivity. Additionally, limited land availability and land conversion require cultivation techniques suitable for restricted spaces. One effective approach is the use of modern agricultural technologies, such as hydroponic cultivation. This method offers several advantages, including efficient water use, optimized land utilization, and more precise nutrient management for plants. Among hydroponic systems, drip irrigation is particularly suitable for melon cultivation. This system offers several benefits over conventional methods. According to Sunaryanti and Dwiyana (2020), the drip irrigation system is an innovative agricultural technology that efficiently delivers water directly to the plant's root

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zone. Irrigation efficiency can reach up to 90%, potentially reducing labor, time, and operational costs during cultivation.

The chosen planting medium greatly influences success in plant cultivation. When cultivating melons hydroponically using a drip irrigation system, rice husk charcoal and cocopeat are commonly used media. According to Siregar's (2018) research, using a mixture of rice husk charcoal and cocopeat significantly increased the stem diameter of cherry tomato plants. This observation is due to the medium's ability to absorb and adjust nutrient availability in response to the plant's growth and development.

To achieve optimal yields, melon plants require supplementation with essential nutrients, including magnesium. Magnesium is an essential element for plant growth and development, as it plays a central role in photosynthetic metabolism and is a major component of chlorophyll, which determines plant productivity (Purba et al., 2021). Ceylan et al. (2016) added that magnesium accounts for approximately 10% of chlorophyll molecules and contributes significantly to photosynthesis. Furthermore, magnesium regulates the transport of other nutrients, particularly phosphate, and acts as a phosphorus carrier in seeds. This element also supports the synthesis of important compounds such as sugars and proteins, and contributes to the translocation of carbohydrates throughout the plant. Research by Parmila *et al. (2023) showed that* a magnesium dose of 6 g/plant affected melon fruit weight and diameter. Meanwhile, research by Yuwono and Basri (2021) found that an additional 10 g/plant dose of magnesium affected plant height and the Number of melon segments. Based on this, this study aims to evaluate the effects of various planting media compositions and optimal doses of magnesium fertilizer on vegetative growth, productivity, and the quality of melon fruit cultivated hydroponically with a drip irrigation system.

2. Material and Methods

The research has been conducted in September-November 2024 at the Puspa Lebo greenhouse, Lebo Village, Sidoarjo District, Sidoarjo Regency, with coordinates of 7°26′48″ south latitude and 112°41′30″ east longitude. The research location is at an altitude of 4 meters above sea level, with an average temperature of 26-30ºC and an average rainfall of 126-151 mm from July to August.

The tools to be used in this research are: shovels, irrigation installation drops, digital scales, TDS meter, measuring cup, camera, refractometer, scissors, rope, water pump, pipe, PE hose, drip stick, saw, connector, water filter, pipe connecting socket, and *timer*. The materials to be used in the research include charcoal planting medium, husk, cocopeat, melon seeds variety Amanda Tavi F1, polybag size 40x40, seedling tray, AB Mix nutrients, and magnesium sulfate fertilizer.

This study used a Completely Randomized Design (CRD) method with two treatment factors. The first factor was the type of planting media, with 3 treatments. The second factor was the magnesium fertilizer dose, with 4 treatment levels. The first factor was the planting media consisting of 3 types of treatments, namely: rice husk charcoal, *cocopeat*, and rice husk charcoal + *cocopeat* with a ratio of 1:1. The second factor was the dose of magnesium fertilizer: 0 g/plant (control), 15 g/plant, 30 g/plant, and 45 g/plant. The experiment was repeated 3 times with 3 sample plants per experimental unit. The research data were statistically analyzed using analysis of variance (ANOVA) using Microsoft Excel. Results showing a calculated F value greater than the F table were followed by a 5% BNJ test to determine whether the treatments were significantly different. The parameters observed were plant length, Number of leaves, Number of female flowers, fruit weight, and sugar content.

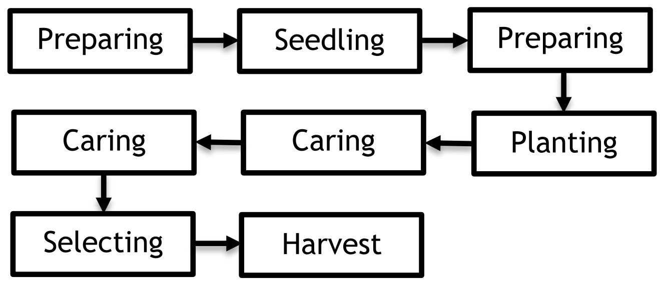

Figure 1. Research Flow Diagram

3. Results and Discussion

3.1. Plant Length

In the plant length parameter, there is an interaction between the combination of planting media treatment and magnesium sulfate fertilizer dosage on the length of melon plants aged 35 HST, as shown in Table 1. The results of the analysis show that there is a real interaction between the combination of planting media treatment and magnesium sulfate fertilizer dosage on plant length at 35 HST. Combination of planting media The combination of rice husk charcoal planting media with a magnesium sulfate fertilizer dosage of 15 g/plant has a higher average plant length value of 135.10 cm, compared to other treatments but is not significantly different from all treatments, except for the combination of planting media and magnesium sulfate fertilizer dosage, namely in the cocopeat treatment with a dosage of 0 g/plant of 129.33 cm.

The combination of rice husk charcoal and magnesium sulfate fertilizer at a rate of 15 g/plant yielded the highest average. This superiority can be attributed to the physical properties of rice husk charcoal, which has better aeration and porosity than other planting media, thus supporting optimal root system development and enabling better plant growth. This finding aligns with Sari and Supriyadi (2019), who reported that rice husk charcoal has a porous structure that allows optimal air circulation around the root zone. Furthermore, according to Nugroho (2018), rice husk charcoal can enhance root growth by combining good aeration with adequate water retention capacity.

Average plant length Table 2. Shows that the planting media treatment factor did not show a significant effect on the plant length parameter 7 HST-49 HST. The plant length parameter shows an average value that is not significantly different across planting media treatments.

Table 1. Interaction of Planting Media Treatment Combination and Magnesium Sulfate Fertilizer Dose on Melon Plant Length at 35 Days After Planting

Plant Length 35 HST (cm)				
Growing media	**Magnesium Fertilizer Dosage g/plant**			
	0	15	30	45
Rice husk charcoal	132.83 ±1.09 ab	135.10 ±1.09 b	133.93 ±1.09 ab	130.37 ±1.09 ab
Cocopeat	129.33 ±1.09 a	131.97 ± 1.09 ab	133.10 ±1.09 ab	135.00 ±1.09 b
Rice husk + cocopeat	132.83 ±1.09 ab	130.20 ±1.09 ab	130.23 ± 1.09 ab	132.10 ±1.09 ab
BNJ 5%	5.58			

Note: Numbers followed by the same letter indicate no significant difference in the 5% BNJ test; HST = Days After Planting

Table 2. Average Length of Melon Plants in Planting Media Treatments and Magnesium Sulfate Fertilizer Doses at 7-42 HST

Treatment	**Plant Length (cm)**					
	7 HST	14 HST	21 HST	28 HST	42 HST	49 HST
Growing media						
Rice husk charcoal	10.46 ±0.45	42.69 ±0.99	82.95 ±1.01	114.13 ±1.74	153.15 ±1.14	171.51 ±1.27
Cocopeat	10.75 ±0.45	42.28 ±0.99	83.09 ±1.01	113.60 ±1.74	152.37 ±1.14	172.53 ±1.27
Rice husk + cocopeat	10.85 ±0.45	42.99 ±0.99	83.30 ±1.01	113.27 ±q.74	152.22 ±1.14	171.67 ±1.27
BNJ 5%	tn	tn	tn	tn	tn	tn
Magnesium Fertilizer Dosage						
0 g/plant	10.56 ±0.45	41.51 ±0.99	81.63 ±1.01	115.02 ±1.74	151.23 ±0.66 a	170.49 ±0.73 a
15 g/plant	11.03 ±0.45	43.15 ±0.99	83.62 ±1.01	113.23 ±1.74	153.84 ±0.66 b	173.40 ±0.73 b
30 g/plant	10.54 ±0.45	43.37 ±0.99	83.58 ±1.01	112.29 ±1.74	153.62 ±0.66 ab	171.19 ±0.73 ab
45 g/plant	10.62 ±0.45	42.57 ±0.99	83.61 ±1.01	114.11 ±1.74	151.61 ±0.66 ab	172.53 ±0.73 ab
BNJ 5%	tn	tn	tn	tn	2.57	2.86

Note: Numbers followed by the same letter in the same column and treatment and age show no significant difference in the 5% BNJ test; tn = not significant; DAP = Days After Planting

Applying magnesium sulfate fertilizer at the correct dosage positively impacts melon plant growth. A dosage of 15 g/plant has been shown to yield the best results for plant length. This finding indicates that magnesium plays a crucial role in photosynthesis and chlorophyll formation, which are essential for supporting overall plant growth (Adnan, 2020). Magnesium is a macronutrient required in relatively large quantities by plants and is distributed throughout plant tissues, especially in leaves, because it is a major component of chlorophyll molecules. In addition, magnesium plays an important role in seed germination, fruit and seed formation, and chlorophyll synthesis. According to Biswas et al. (2013), magnesium strengthens cell wall structure and increases the efficiency of nutrient absorption, including nitrogen, phosphorus, and sulfur.

3.2. Number of Leaves

The analysis showed that the combination of planting media treatment and magnesium sulfate fertilizer dosage did not significantly affect leaf number. The single factor of planting media treatment had no significant effect on leaf number. The single factor of magnesium sulfate fertilizer dosage significantly affected the Number of leaves at 35 days after planting (DAP), as seen in Table 3.

Magnesium sulfate fertilizer dosage treatments significantly affected the Number of leaves at 35 days after planting, with a dose of 30 g/plant producing the highest average value. These results indicate that magnesium sulfate plays a crucial role in supporting photosynthesis, as magnesium is essential for chlorophyll formation and for various plant metabolic activities. Adequate magnesium availability can optimize plant growth. This finding aligns with the statement by Hauer and Trankner (2019) that magnesium is a core atom in the chlorophyll structure, which is responsible for photosynthesis. Approximately 15–30% of magnesium in plant tissue is stored in chlorophyll molecules, and a deficiency of this element can directly inhibit the rate of photosynthesis and reduce carbohydrate production.

3.3. Number of Female Flowers

The analysis results showed that the combination of planting medium type and magnesium sulfate fertilizer dose did not significantly affect the Number of female flowers. The single factor of planting medium type and magnesium sulfate fertilizer dose did not significantly affect the Number of female flowers, as shown in Table 4.

Table 3. Average Length of Cucumber Plants in Gibberellin Concentration Treatment and NPK Fertilizer Dose at 7-42 HST

Treatment	Number of leaves (blades)						
	7 HST	14 HST	21 HST	28 HST	35 HST	42 HST	49 HST
Growing media							
Rice husk charcoal	4.37 ±0.19	7.48 ±0.20	9.51 ±0.25	13.59 ±0.29	17.11 ±0.44	21.81 ±0.37	25.76 ±0.39
Cocopeat	4.24 ±0.19	7.41 ±0.20	9.48 ±0.25	13.56 ±0.29	17.63 ±0.44	22.01 ±0.37	26.15 ±0.39
Rice husk + cocopeat	4.42 ±0.19	7.46 ±0.20	9.56 ±0.25	13.67 ±0.29	17.71 ±0.44	22.18 ±0.37	26.42 ±0.39
BNJ 5%	tn	tn	tn	tn	tn	tn	tn
Magnesium Fertilizer Dosage							
0 g/plant	4.36 ±0.19	7.21 ±0.20	9.27 ±0.25	13.54 ±0.29	17.20 ±0.25 ab	21.92 ±0.37	26.01 ±0.39
15 g/plant	4.41 ±0.19	7.66 ±0.20	9.66 ±0.25	13.80 ±0.29	17.56 ±0.25 ab	22.21 0.37	26.21 ±0.39
30 g/plant	4.25 ±0.19	7.48 ±0.20	9.62 ±0.25	13.52 ±0.29	18.14 ±0.25 b	21.98 ±0.37	26.17 ±0.39
45 g/plant	4.35 ±0.19	7.45 ±0.20	9.52 ±0.25	13.57 ±0.29	17.06 ±0.25 a	21.88 ±0.37	26.06 ±0.39
BNJ 5%	tn	tn	tn	tn	1.01	tn	tn

Note: Numbers followed by the same letter in the same column and treatment at the same age show no significant difference in the 5% BNJ test; tn: not significant; DAP = Days After Planting

Table 4. Average Number of Female Flowers of Melon Plants in Planting Media Treatments and Magnesium Sulfate Fertilizer Doses

Treatment	Number of Female Flowers
Growing media	
Rice husk charcoal	5.39 ±0.35
Cocopeat	5.40 ±0.35
Rice husk + cocopeat	5.55 ±0.35
BNJ 5%	tn
Magnesium Fertilizer Dosage	
0 g/plant	5.52 ±0.35
15 g/plant	5.28 ±0.35
30 g/plant	5.48 ±0.35
45 g/plant	5.50 ±0.35
BNJ 5%	tn

Note: tn: not significant

Based on the analysis results presented in Table 4, the combination of growing media treatment and magnesium fertilizer dosage did not significantly affect the Number of female flowers in melon plants. Individually, the type of growing media also showed no significant effect on these parameters. This finding indicates that the Number of female flowers tends to be influenced by genetic factors and supportive environmental conditions, rather than by growing media treatment or magnesium fertilizer dosage. Annisa and Helfi (2017) reported that female flower initiation in melon plants is influenced by high light intensity, whereas male flower formation is triggered by low light intensity. Furthermore, the overall Number of flowers is determined by internal factors, such as plant hormones (phytohormones) and genetic traits, as well as external factors, such as the environment, particularly sunlight intensity. High sunlight intensity can more effectively stimulate the formation of female flowers.

3.4. Fruit Weight

The results of the analysis of variance showed that the interaction between planting media type and magnesium sulfate fertilizer dose was not significant for the fruit weight parameter. The single factor of planting media type treatment had a significant effect on the fruit weight parameter, while the single factor of magnesium sulfate fertilizer dose treatment had no significant effect on the fruit weight parameter, as seen in Table 5

Table 5. Average Fruit Weight of Melon Plants in Planting Media Treatments and Magnesium Sulfate Fertilizer Doses

Treatment	Fruit Weight (kg)
Growing media	
Rice husk charcoal	1.80 ±0.18 b
Cocopeat	1.64 ±0.18 a
Rice husk + cocopeat	1.74 ±0.18 ab
BNJ 5%	0.15
Magnesium Fertilizer Dosage	
0 g/plant	1.71 ±0.18
15 g/plant	1.74 ±0.18
30 g/plant	1.70 ±0.18
45 g/plant	1.75 ±0.18
BNJ 5%	tn

Note: Numbers followed by the same letter in the same treatment show no significant difference in the 5% BNJ test; tn: not significant

Average fruit weight. Table 5 shows that the growing media treatment factor significantly affected fruit weight parameters. The highest average fruit weight was in the rice husk charcoal growing media treatment of 1.80 kg. This finding is due to the characteristics of rice husk charcoal growing media, which have good porosity and aeration, as well as the ability to store the nutrients plants effectively need. These conditions allow melon plants to grow optimally and produce higher fruit weights because water and nutrients are continuously available. Indrawan *et al*. (2021) stated that rice husk charcoal has porous properties that support early plant growth. The rough surface texture produces a high total pore volume, mainly composed of medium-sized pores. When water is applied to the growing media, some seeps into the soil, while the rest remains in the media's pores and can be readily absorbed by plant roots. According to Agustin et al. (2014), rice husk charcoal serves as a temporary nutrient storage, is lightweight, and has good water-absorption capacity. In addition, Simbolon and Suryanto (2019) stated that the use of a substrate-based hydroponic system had a significant effect on increasing the weight of melon fruit.

3.5. Sugar Content

The analysis of variance showed that the combination of planting medium type and magnesium sulfate fertilizer dose did not significantly affect the sugar content parameter. Neither the planting medium type nor the magnesium sulfate fertilizer dose significantly affected the sugar content parameter, as shown in Table 6.

Table 6. Average Melon Sugar Content in Planting Media Treatments and Magnesium Sulfate Fertilizer Doses

Treatment	Sugar Content (Brix°)
Growing media	
Rice husk charcoal	10.42 ±0.27
Cocopeat	10.26 ±0.27
Rice husk + cocopeat	10.16 ±0.27
BNJ 5%	tn
Magnesium Fertilizer Dosage	
0 g/plant	10.22 ±0.27
15 g/plant	10.53 ±0.27
30 g/plant	10.18 ±0.27
45 g/plant	10.20 ±0.27
BNJ 5%	tn

Not: tn: not significant

The analysis results in Table 6 show that the combination of growing media treatment and magnesium fertilizer dosage did not significantly affect the sugar content of melon fruit. Magnesium supplementation has not been shown to increase sugar content, as this parameter is not solely influenced by magnesium but is primarily determined by potassium availability. Ikhsan and Aini (2020) explain that the level of fruit sweetness arises from the enzymatic breakdown of carbohydrate compounds, which involves the enzymes phosphorylase, glucoamylase, and amylase. These enzymes convert carbohydrates into sucrose, glucose, and fructose during fruit ripening, thereby increasing sweetness. Potassium plays a crucial role in activating these enzymes, thus supporting the breakdown of photosynthesis products into simple sugar compounds, which contribute to an increase in total soluble solids (TPT) in melon fruit. In addition to increasing sugar content, potassium also plays a role in sugar translocation to various parts of the plant (Wijiyanti and Soedradjad, 2019).

Figure 2. Melon Fruit Yield in All Treatment Combinations. Note: M = Planting Media; D = Dosage of Magnesium Sulfate Fertilizer; M_1 = Rice Husk Charcoal; M_2 = *Cocopeat* ; M_3 = Rice Husk Charcoal + *Cocopeat* ; D_0 = 0 g/plant; D_1 = 15 g/plant; D_2 = 30 g/plant; D_3 = 45 g/plant

4. Conclusion

Based on this research, it can be concluded that rice husk charcoal as a growing medium influenced melon fruit weight, and that a magnesium sulfate fertilizer dose of 15 g per plant had the most positive effect on plant length and leaf number. However, no significant effect was observed on the Number of female flowers or the sugar content of the melon fruit.

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