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Increasing the Growth and Yield of Cantaloupe (*Cucumis melo Var. Cantalupensis* L.) with the Combination of Planting Media and Seaweed Extract with Drip Irrigation Hydroponics

Arya Firmansyah[1], Didik Sutomo Pribadi[1,*], Sutini[1]

Abstract

Cantaloupe (*Cucumis melo* var. Cantalupensis L.) is a high-value horticultural crop, popular among consumers for its sweet taste and distinctive aroma. Hydroponic cultivation of cantaloupe using a drip irrigation system offers a promising solution to overcome land limitations, particularly in urban areas. The success of this system is largely influenced by the type of planting medium and the provision of appropriate nutrients. This study aimed to evaluate the effects of different combinations of planting media and seaweed extract doses on the growth and yield of cantaloupe plants. The experiment was conducted from October to December 2024 at the Puspa Lebo Greenhouse, Lebo Village, Sidoarjo District, Sidoarjo Regency, located at an altitude of 4 meters above sea level, with daily temperatures ranging from 26.9°C to 30.4°C. A completely randomized design (CRD) with two factors was used: planting media (cocopeat, rice husk charcoal, and a mixture of cocopeat and rice husk charcoal) and seaweed extract doses (0, 5, 10, and 15 g/plant). The results indicated that cocopeat as a planting medium had a significant positive effect on fruit weight. Additionally, a seaweed extract dose of 5 g/plant significantly enhanced vegetative growth parameters, including plant length and leaf number. In the generative phase, a dose of 10 g/plant significantly influenced the timing of flower emergence and harvest age.

Keywords: Aeration, Biostimulant, Cantaloupe, Humidity, Plant Length, Vegetative

1. Introduction

Cantaloupe (*Cucumis melo* var. cantalupensis L.) is a high-value horticultural crop widely favoured by Indonesians for its sweet taste and distinctive aroma. Market demand for cantaloupe continues to increase, especially during Ramadan; however, national productivity remains relatively low and cannot meet demand optimally. From 2018 to 2020, national cantaloupe production reached 99,189 tons, with East Java being the largest contributor (BPS, 2021). Therefore, efforts are needed to intensify cultivation practices that can sustainably increase plant productivity.

One of the challenges in cantaloupe cultivation is the limited availability of fertile land and water, particularly in urban areas. This constraint restricts production, as cantaloupes require a consistent supply of water and nutrients. Additionally, soil degradation and climate change further hinder plant growth. Therefore, a modern, efficient, and environmentally friendly cultivation system that optimizes resource use is essential to ensure sustainable cantaloupe production (Chrystia et al., 2018).

The use of modern cultivation systems, such as hydroponics with drip irrigation is a potential solution to address these challenges. This system enables efficient, controlled fertilization and irrigation and is suitable for use in small plots or urban areas (Pribadi & Sodiq, 2023). Drip irrigation is considered more efficient than conventional irrigation methods because it improves crop yield quality by providing even water distribution and minimizing water loss (Widiastuti & Susilo, 2018).

Growing media serve as plant supports and nutrient reservoirs. Growing media such as rice husk charcoal and

*Correspondence: didikutomo_mp@yahoo.com
1) Universitas Pembangunan Nasional "Veteran" Jawa Timur - Jl. Raya Rungkut Madya, Gunung Anyar, Surabaya, Jawa Timur, Indonesia

cocopeat are widely used in hydroponics due to their excellent water retention and drainage properties. Combining the two often provides the drainage and moisture plants need. Furthermore, to improve fertilizer efficiency, the use of biostimulants, such as seaweed extracts, is gaining popularity in modern cultivation practices. (Widiastuti & Susilo Wijayanto, 2018).

Selecting the right growing medium is crucial to the success of hydroponic cultivation. Cocopeat has a high water retention capacity and is rich in nutrients such as K, P, and Mg.(Irawan, 2015) Rice husk charcoal has high porosity, is sterile, and contains silica, which can strengthen plant structure (Dharmasika et al., 2019). The combination of the two can create an optimal growing environment, particularly for aeration, water retention, and root development (Ruli et al., 2023).

This research is novel because it specifically examines cantaloupe (*Cucumis melo* var. cantalupensis L.), a plant that has been rarely studied, particularly in hydroponic drip-irrigated systems. Unlike previous studies that focused on melons, watermelons, or cucumbers, this study evaluates the effects of a combination of growing media and seaweed extract dosage on cantaloupe growth and yield.

Furthermore, this study comprehensively analyzed growth and yield parameters across different developmental stages: the vegetative phase (plant length, number of leaves), the generative phase (flowering age, harvest age), and fruit production (fruit weight). The objective was to determine the effects of various growing media and seaweed extract dosages on the growth, generative phase, and yield of cantaloupe plants cultivated in a drip-irrigation hydroponic system, and to examine the interaction between these two factors.

2. Material and Methods

This research was conducted from October to December 2024 at the Puspa Lebo greenhouse, located in Lebo Village, Sidoarjo District, Sidoarjo Regency. The research site is located at 4 meters above sea level, with coordinates of 7°26′48″ south latitude, 112°41′30″ east longitude, and has an average daily temperature ranging from 26.9°C to 30.4°C.

The tools used for this research are shovel, trowel, meter, TDS meter, measuring cup, refractometer, scissors, knife, saw, small rope, water pump, water filter, *pressure gauge*, main pipe, 16 mm LDPE hose, 5 mm PE hose, *drip stick*, *valve*, micro tee and timer, while the materials used in this research are Blaster F1 variety melon seeds, 40x40 polybags, seaweed extract, seedling tray and AB-Mix nutrients.

This study used a completely randomized design (CRD) with two treatment factors. The first factor was the planting medium, with three treatments. The first factor was the planting medium, and the second factor was the dosage of Biosea seaweed extract. The three planting media were cocopeat, rice husk charcoal, and a mixture of cocopeat and rice husk charcoal.

Meanwhile, the Biosea seaweed extract dosage consists of 4 levels, namely: 0 g seaweed extract (Control), 5 g/plant, 10 g/plant, and 15 g/plant.

Based on the two treatment factors, 12 combinations were obtained, repeated three times, resulting in 36 experimental units, each consisting of three plants, or a total of 108 plants. Data were analysed using ANOVA in Microsoft Excel 2021, and if the F-count indicated a significant difference, a 5% BNJ test was performed. The parameters observed included: plant length, measured weekly with a meter; number of leaves, counted all leaves formed each week; age at flowering, recorded from planting until the first flower appears; age at harvest, recorded from planting until the fruit is ready to be harvested based on maturity criteria; and fruit weight, measured using a digital scale.

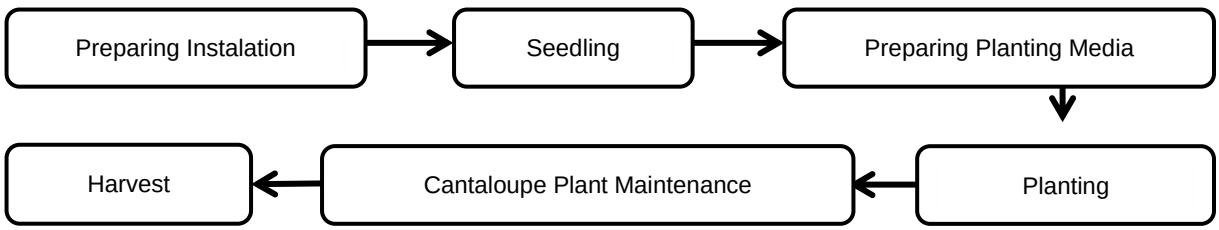

Figure 1 Research Flowchart

3. Results and Discussion

3.1. Plant Length

For the plant length parameter, there is a significant interaction between planting media type and seaweed extract dose on cantaloupe plant length at 35 HST, as shown in Table 1. The cocopeat planting media with a dose of 5 g/plant has the highest average plant length, namely 155.10 cm, compared to other treatments, but is not significantly different from any of them, except for the cocopeat and rice husk charcoal treatment with a dose of 0 g/plant, which is 149.33 cm.

The combination of cocopeat and 5 g of cocopeat per plant yielded the highest average plant length. These results indicate that this combination is most effective in supporting cantaloupe growth, particularly during the vegetative phase. Cocopeat has a porous, lightweight structure and can retain sufficient water and nutrients, supporting optimal root development. Maintained humidity and good aeration allows plant roots to absorb nutrients from the hydroponic solution more efficiently.

Table 1 Interaction between the combination of planting media treatment and seaweed extract dosage on the length of cantaloupe plants at 35 days after planting**.**

Growing media	Plant Length 35 HST (cm)			
	Seaweed Extract Dosage g/plant			
	0	5	10	15
Cocopeat	153.17 ab ± 1.1	155.10 b ± 1.1	153.93 ab ± 1.1	150.47 ab ± 1.1
Rice husk charcoal	150.90 ab ± 1.1	152.83 ab ± 1.1	150.23 ab ± 1.1	150.77 ab ± 1.1
Cocopeat + Rice husk charcoal	149.33 a ± 1.1	152.63 ab ± 1.1	153.20 ab ± 1.1	155.00 b ± 1.1
BNJ 5%	5.62			

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

Meanwhile, administering seaweed extract as a biostimulant also plays a crucial role in enhancing plant growth. Biosea contains plant growth regulators such as auxins, cytokinins, and gibberellins, which can stimulate cell division, stem elongation, and new tissue formation. The synergistic effect of the growing medium, which supports root growth, and the seaweed extract, which accelerates plant physiological processes, results in optimal plant length.

This finding is in line with research Siregar and Ginting (2020), which reported that the use of cocopeat in hydroponic systems with drip irrigation resulted in better plant length growth compared to other growing media. In addition, Fernandes et al. (2023) found that administering a 5 g dose of seaweed extract to watermelon plants (*Citrullus lanatus*) was able to increase plant length and number of leaves significantly. This finding is in line with research by Roosta et al. (2025), which reported that the use of cocopeat-perlite media in hydroponic systems resulted in better growth of cucumber plants (*Cucumis sativus*) compared to soil culture systems. Cocopeat-based media has been shown to improve growth parameters, such as plant height and leaf area, and contribute to more optimal fruit quality. This finding strengthens the evidence that cocopeat has superior capabilities in providing aeration and water retention while maintaining nutrient availability, thereby supporting photosynthetic efficiency and plant biomass accumulation.

Based on Table 2, the single treatment of growing media did not significantly affect cantaloupe plant growth over the 7 to 35 days after planting (HST). Conversely, the single seaweed extract treatment significantly affected plant length, particularly at 28 days after planting. The average plant length for each treatment is shown in detail in Table 2.

Table 2. Average Length of Cantaloupe Plants 7-35 HST in Planting Media Treatment and Seaweed Extract Dosage.

Treatment	Plant Length (cm)				
Growing media	7 HST	14 HST	21 HST	28 HST	35 HST
Cocopeat	16.63 ± 0.71	53.68 ± 0.63	81.94 ± 0.91	113.95 ± 0.87	153.17 ± 1.1
Rice husk charcoal	16.41 ± 0.71	53.86 ± 0.63	82.23 ± 0.91	113.67 ± 0.87	151.18 ± 1.1
Cocopeat + Rice husk charcoal	16.24 ± 0.71	54.04 ± 0.63	82.31 ± 0.91	114.58 ± 0.87	152.54 ± 1.1
BNJ 5%	tn.	tn.	tn.	tn.	tn.
Seaweed Extract Dosage g/plant					
0	16.59 ± 0.71	53.66 ± 0.63	82.69 ± 0.91	113.32 ab ± 0.87	151.13 ± 1.1
5	16.80 ± 0.71	53.82 ± 0.63	82.04 ± 0.91	115.89 b ± 0.87	153.52 ± 1.1
10	16.49 ± 0.71	53.85 ± 0.63	81.93 ± 0.91	114.64 ab ± 0.87	152.46 ± 1.1
15	15.83 ± 0.71	54.12 ± 0.63	81.97 ± 0.91	112.42 a ± 0.87	152.08 ± 1.1
BNJ 5%	tn.	tn.	tn.	tn.	tn.

Description: 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.

Administering seaweed extract at the correct dosage has been shown to impact the growth and development of cantaloupe plants. A dosage of 5 g/plant resulted in optimal plant length growth, indicating that this biostimulant plays a crucial role in supporting the vegetative phase. These results align with research by Fernandes et al. (2023), which reported that administering 5 g/plant of seaweed extract significantly increased watermelon plant growth, particularly plant length and leaf number, and positively impacted fruit number and weight.

In addition to stimulating growth during the vegetative phase, seaweed extract also enhances plant resistance to abiotic stresses, such as drought. (Numanovich & Abbosxonovich, 2020)**,** reported that the application of seaweed extract can significantly increase plant growth and yield. The polysaccharide content in Biosea helps reduce the impact of environmental stress, enabling plants to maintain optimal physiological processes (Mukherjee & Patel, 2020). In addition, macronutrients such as nitrogen, phosphorus, and potassium support vegetative and generative growth, including increasing plant length, leaf number, and flower and fruit formation (Afrendi et al.,

2024).

3.2. Number of Leaves

The analysis showed that the combination of growing media and seaweed extract dosage affected the number of leaves on cantaloupe plants from 7 to 35 days after planting. A single growing media treatment did not significantly affect the number of leaves throughout the observation period. In contrast, a single seaweed extract treatment significantly affected leaf number at 28 days after planting. The average number of leaves on cantaloupe plants, influenced by growing media and Biosea seaweed extract dosage, is shown in Table 3.

Table 3 Average number of leaves of cantaloupe plants in the treatment of planting media and seaweed extract doses at the age of 7-35 HST**.**

Treatment	Number of leaves (blades)				
Growing media	**7 HST**	**14 HST**	**21 HST**	**28 HST**	**35 HST**
Cocopeat	6.21 ± 0.36	12.18 ± 0.62	14.83 ± 0.69	17.87 ± 0.17	20.21 ± 1.1
Rice Husk Charcoal	6.12 ± 0.36	12.31 ± 0.62	14.78 ± 0.69	17.98 ± 0.17	20.47 ± 1.1
Cocopeat + Rice husk charcoal	6.00 ± 0.36	12.40 ± 0.62	14.48 ± 0.69	18.18 ± 0.17	20.40 ± 1.1
BNJ 5%	tn.	tn.	tn.	tn.	tn.
Seaweed Extract Dosage g/plant					
0	6.14 ± 0.36	12.45 ± 0.62	15.04 ± 0.69	17.59 a ± 0.17	20.63 ± 1.1
5	5.96 ± 0.36	12.18 ± 0.62	14.50 ± 0.69	18.40 b ± 0.17	20.30 ± 1.1
10	6.48 ± 0.36	11.98 ± 0.62	15.17 ± 0.69	18.02 ab ± 0.17	20.93 ± 1.1
15	5.86 ± 0.36	12.59 ± 0.62	14.07 ± 0.69	18.02 ab ± 0.17	19.57 ± 1.1
BNJ 5%	tn.	tn.	tn.	0.68	tn.

Description: 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.

Treatment with 5 g/plant of seaweed extract produced the highest average number of leaves and had a significant effect at 28 HST. These results indicate that a dose of 5 g/plant can stimulate physiological activities related to leaf formation during vegetative growth. The increase in the number of leaves is directly related to the photosynthetic surface area, thereby increasing the plant's ability to assimilate nutrientseeded to support growth and the formation of subsequent generative organs (Ali et al., 2023). The content of growth regulators, such as cytokinins, in seaweed extract is thought to stimulateell division at the growing point, thereby spurring the formation of new leaves (Al-Juthery et al., 2020). This effect is in accordance with the results of research by Fernandes et al. (2023), which reported that the application of seaweed extract at moderate doses was able to increase the number of leaves in watermelon plants significantly.

3.3. Flower Appearance Age

The analysis results showed that the combination of growing media and seaweed extract dosage did not significantly affect the flowering time in cantaloupe plants. Neither growing media treatment showed a significant effect. Conversely, a single seaweed extract dosage treatment significantly affected the flowering time. The average flowering time values for the various treatments are shown in Table 4.

Table 4 Average Flower Age of Cantaloupe Plants in Planting Media Treatments and Seaweed Extract Doses**.**

Treatment **Growing media**	**Flowering Age (DAP)**
M1	23.43 ± 0.38
M2	24.09 ± 0.38
M3	24.17 ± 0.38
BNJ 5%	Mr.
Seaweed Extract Dosage g/plant	
0	24.92 b ± 0.38
5	23.52 ab ± 0.38
10	23.18 a ± 0.38
15	23.97 ab ± 0.38
BNJ 5%	1.49

Description: 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.

Based on the analysis results, a dose of 10 g/plant resulted in the fastest flowering time, namely 23.18 HST, which was significantly earlier than the treatment without seaweed extract (0 g), where flowers appeared at 24.92 HST. These results indicate that the levels of natural growth hormones in seaweed extracts, such as auxin,

gibberellin, and cytokinin, play an important role in accelerating flowering initiation. These hormones can stimulate cell division, accelerate the growth of generative tissue, and increase photosynthetic efficiency, enabling plants to transition more quickly from the vegetative to the generative phase (Chen et al., 2021).

In addition, the content of macronutrients such as nitrogen, phosphorus, and potassium in seaweed extract also supports the flowering process. Nitrogen helps form chlorophyll and supports the growth of new tissue; phosphorus plays a role in the formation and development of flower organs; while potassium regulates the distribution of photosynthates to the generative organs, thereby optimizing flower development (Afrendi et al., 2024). The application of seaweed extract significantly advanced the timing of first flower appearance in cucumber plants (Cucumis sativus), especially in greenhouse-grown hybrid varieties. These results are consistent with findings in cantaloupe plants in this study, which indicate that moderate doses of seaweed extract can provide optimal physiological signals to accelerate the transition between growth phases without causing hormone saturation or disrupting plant metabolism (Allela et al., 2020).

3.4. Harvest Age

The analysis showed that the combination of growing media and seaweed extract dosage had no significant effect on harvest-age parameters. The single growing media treatment had no significant effect. Conversely, the seaweed extract treatment had a significant effect on harvest age. The average harvest age values for the various treatments are shown in Table 5.

Table 5. Average Harvest Age of Cantaloupe Plants in Planting Media Treatments and Seaweed Extract Doses.

Treatment	Harvest Age (DAP)
Growing media	
Cocopeat	53.99 ± 0.61
Rice husk charcoal	53.34 ± 0.61
Cocopeat + Rice husk charcoal	53.32 ± 0.61
BNJ 5%	Mr.
Seaweed Extract Dosage g/plant	
0	54.51 b ± 0.61
5	52.06 a ± 0.61
10	53.45 ab ± 0.61
15	54.19 ab ± 0.61
BNJ 5%	2.41

Description: 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.

Based on the analysis, a dose of 5 g/plant resulted in the fastest harvest time (52.06 days after planting [DAP]), which was significantly faster than the treatment without seaweed extract (0 g), which had the slowest harvest time (54.51 DAP). These results indicate that administering seaweed extract at the appropriate dose can accelerate the transition of plants from the generative phase to the fruit-ripening phase.

This accelerating effect is due to the natural growth hormones in seaweed extract, such as auxins, gibberellins, and cytokinins, which can increase cell division and elongation, accelerate flower formation, and support fruit development, enabling it to reach maturity faster (Chen et al., 2021). Furthermore, the bioactive compounds and polysaccharides in seaweed extracts also help plants optimise nutrient and water absorption, thereby improving the efficiency of physiological processes. (Mukherjee & Patel, 2020).

Research by Allela et al. (2020) on cucumber plants (Cucumis sativus) showed that spraying seaweed extract can increase fruit nutrient content, encourage vegetative growth, increase total chlorophyll levels, and accumulate phosphorus in plant tissues. This high phosphorus content contributes to more efficient photosynthesis, thus supporting flowering and fruiting.

This ultimately results in accelerated fruit ripening and improved crop quality. Similar results have been reported for several other horticultural crops, where the use of seaweed-based biostimulants has been shown to accelerate flowering and fruit ripening, resulting in shorter harvest times (Sahana et al., 2022).

3.5. Fruit Weight

The analysis of variance showed that the combination of planting media and seaweed extract dosage did not significantly affect fruit weight. The single factor of planting media significantly affected fruit weight, while the single factor of seaweed extract dosage did not significantly affect fruit weight. The average fruit weight values for the various treatments are shown in Table 6.

Based on the analysis of variance, the cocopeat growing medium produced the highest fruit weight, at 0.59 kg, significantly different from the rice husk charcoal (0.45 kg) and the cocopeat-rice husk charcoal mixture (0.48 kg). This finding indicates that cocopeat is better at supporting fruit formation in cantaloupe plants. Cocopeat has a high water-absorption capacity and can store nutrients, thereby maintaining water and nutrient availability. This condition

allows the roots to function optimally in channelling water and nutrients, thereby increasing fruit weight.

Table 6 Average Weight of Cantaloupe Fruit in Planting Media Treatment and Dosage of Biosea Seaweed Extract.

Treatment	**Fruit Weight (kg)**
Growing media	
Cocopeat	0.59 b ± 0.06
Rice husk charcoal	0.45 a ± 0.06
Cocopeat + Rice husk charcoal	0.48 ab ± 0.06
BNJ 5%	0.12
Seaweed Extract Dosage g/plant	
0	0.52 ± 0.06
5	0.49 ± 0.06
10	0.45 ± 0.06
15	0.56 ± 0.06
BNJ 5%	Mr.

Description: 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.

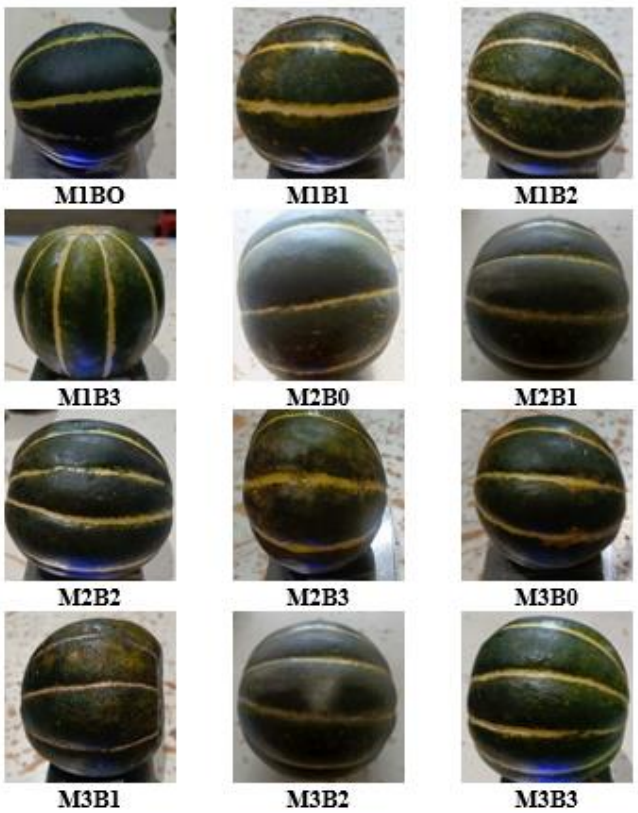

Figure 2 Cantaloupe Fruit Results in All Treatment Combinations. Description: M = Planting Media; B = Dosage of Seaweed Extract; M1 = Cocopeat; M2 = Rice Husk Charcoal; M3 = Rice Husk Charcoal + Cocopeat; B0 = 0 g/plant; B1 = 5 g/plant; B2 = 10 g/plant; B3 = 15 g/plant.

This finding is in line with research by Bilalang and Maharia (2021), which reported that the use of cocopeat as a growing medium for melon (*Cucumis melo* L.) significantly increased fruit weight compared to rice husk charcoal or other mixed media. Nabiela (2019 stated that cocopeat can maintain the humidity of the growing medium while providing good aeration, thereby supporting healthy root growth and increasing nutrient absorption efficiency. Furthermore, Ruli et al. (2023 confirmed that a growing medium with stable moisture and good porosity can increase photosynthesis and carbohydrate distribution to the fruit, thereby optimising fruit growth. This finding is especially important in drip hydroponics, where the medium acts as a water reservoir and root support. Cocopeat has been shown to retain moisture and nutrients longer than rice husk charcoal, resulting in better plant growth and heavier fruit (Wilujeng et al., 2024).

4. Conclusion

Research shows that cocopeat growing media significantly increases cantaloupe fruit weight. Applying 5 g of seaweed extract per plant effectively supports vegetative growth, including plant length and leaf number, while a dose of 10 g per plant has a greater impact on the generative phase, such as flowering and harvesting. These findings confirm that the effectiveness of seaweed extract dosage varies across growth stages. Further research is recommended to determine the optimal dosage and to assess its long-term effects on fruit productivity and quality.

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