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Differences in Growth and Yield of Green Mustard (*Brassica juncea* L.) Plants in Several Nutrient Film Technique (NFT) Hydroponic Growing Media

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Abstract

Hydroponic plant cultivation is a modern technology and an alternative method in agriculture. This study aimed to determine the differences in growth and yield of mustard greens (*Brassica juncea* L.) using various hydroponic nutrient film technique (NFT) growing media. The research was conducted in the greenhouse of the Enha Lima garden from January to March 2026, utilizing a non-factorial Randomized Block Design (RBD) with four treatments and three replications. The four treatments included cocopeat, rice husk charcoal, a combination of cocopeat and rice husk charcoal, and rockwool. The results showed that the combination of cocopeat and rice husk charcoal produced the best plant height, as well as the highest number of leaves, fresh weight, and root weight. The optimal plant heights were 42.03 cm (14 days after planting, DAP), 32.93 cm (28 DAP), and 39.53 cm (35 DAP). The average number of leaves was 8.33 (14 DAP), 13 (28 DAP), and 14.67 (35 DAP). The best-performing plants had a fresh weight of 148.33 grams and a root weight of 3.67 grams. The combination of cocopeat and husk charcoal as planting media can serve as a promising alternative for growing mustard greens in hydroponic systems.

Keywords: Cocopeat, Greenhouse, Production, Rice Husk Charcoal, Rockwool

1. Introduction

Agriculture is a crucial sector for Indonesians. The main obstacle to agricultural activity is land availability, particularly for horticultural crops like mustard greens. This limitation can impact the supply of mustard greens in the market. Technically, hydroponic cultivation systems can address this challenge (Subandi et al., 2015).

Hydroponic cultivation offers an alternative in areas where land is increasingly scarce. According to Roidah (2014), hydroponics is a farming system suitable for situations where agricultural land will be limited in the future. Hydroponics involves the cultivation of plants without soil. It offers many advantages, including higher crop yields, better plant quality, reduced land requirements, and more economical fertilizer use. Furthermore, according to Syidiq (2022), hydroponic cultivation makes it easier to control plant growth, allowing for more efficient and precise nutrient delivery tailored to the needs of the plants.

There are several hydroponic systems commonly used by farmers, one of which is the NFT (Nutrient Film Technique) hydroponic system. NFT is a cultivation system that places plant roots in a shallow layer of nutrient-rich water. The water circulates continuously according to the plants' needs, allowing the roots to develop properly. Since excess water can reduce the oxygen available to the roots, the maximum solution height in this system is typically 3 mm (Roidah, 2014).

Hydroponic vegetables have promising market opportunities because they serve consumers who prioritize quality, nutritional content, and hygiene (Karman et al., 2022). One vegetable that can be cultivated hydroponically is mustard greens *(Brassica juncea* L.). In 100 grams of mustard greens contain 2.3 grams of protein; 0.3 grams of fat; 4.0 grams of carbohydrates; 220 mg of Ca; 38 mg of P; 2.9 mg of Fe; 1.94 mg of vitamin A; 0.09 mg of vitamin B; and 22.0 calories of energy.

The growing medium is one of the external factors that influence the growth and yield of hydroponic plants. The function of the growing medium in a hydroponic system provides a medium for root growth and stores the

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nutrients plants need. A good growing medium supports plant growth and life. Besides providing a place for root attachment, the growing medium also supports the plants and serves as a medium for nutrient solutions. (Felix et al, 2023) .

Common media used in hydroponic vegetable cultivation systems include *cocopeat*, rice husk charcoal, and rockwool. Each growing medium has different characteristics. The results of research by Gafar et al. (2023) stated that the most effective growing medium for the growth of green mustard using NFT hydroponics is rice husk charcoal. Irawan and Kafiar (2015) explained that cocopeat has a higher water content than other growing media such as rice husk charcoal. This is because cocopeat media has micropores that can inhibit greater water movement, so that water availability is higher (Istomo & Valentino, 2012). According to Felix et al. (2023), rockwool growing media can retain large amounts of water and air, supporting plant development and growth. In research by Harahap et al. (2025), rockwool media produced the best green mustard plant height.

This study used cocopeat, rice husk charcoal, a mixture of cocopeat and rice husk charcoal, and rockwool. This study aimed to determine differences in the growth and yield of mustard greens (*Brassica juncea* L.) in several NFT hydroponic growing media.

2. Material and Methods

This research was conducted in January–March 2026 at the Enha Lima Experimental Garden, Jl. Lintas Timur Km 26, Pelalawan Regency, Riau Province, at the coordinates 0.463793 South Latitude and 101.594730 East Longitude with an altitude of 50 meters above sea level.

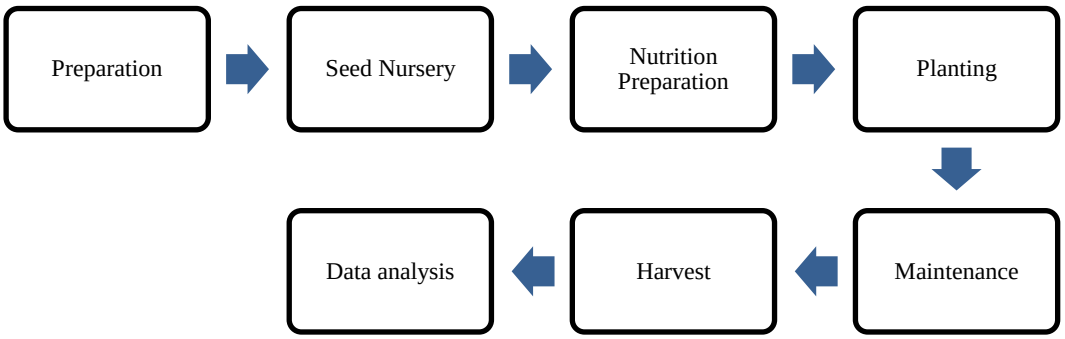


Figure 1. Research Flow Diagram

The equipment used in this study included NFT gutters, net pots, a water pump, a seedling tray, a TDS meter, a pH meter, a nutrient tank, an analytical balance, and stationery. Materials included Tosakan mustard green seeds, AB mix nutrients, *cocopeat*, rice husk charcoal, and rockwool.

This study was a non-factorial experiment arranged using a Randomized Block Design (RBD). The treatment levels in this study were rockwool media, *cocopeat* media, rice husk charcoal media, and a mixture of *cocopeat* and rice husk charcoal media. Each treatment was repeated three times, resulting in 12 experimental units. Figure in shows the research flow.

Observation parameters included plant height, number of leaves, fresh weight, and root weight. Plant height was measured with a measuring tape from the base of the stem above the surface of the planting medium to the highest point of the plant at the ages of 14, 28, and 35 days after planting. We determined the number of leaves by counting all fully opened leaves on each plant at the ages of 14, 28, and 35 days after planting. Fresh weight and root weight were measured by weighing the sample plants at harvest time (30 days after planting) using a digital scale.

The data analysis of the experimental results was performed using analysis of variance in accordance with the design used, namely the Randomized Block Design (RAK). If the calculated F is greater than the F-table at the 5% level, the treatment has a significant effect; conversely, if the calculated F is smaller than or equal to the F-table value at the 5% level, the treatment has no significant effect. If there is a significant effect, then it will be continued with the BNJ test at the 5% level. Data analysis used Minitab Version 21.

3. Results and Discussion

3.1. The Effect of Hydroponic Growing Media on Plant Height.

The analysis results show that the growing medium significantly affects the height of mustard greens. Table 1 shows the average height of mustard greens is shown in Table 1.

Table 1 shows that the best treatment was a mixture of *cocopeat* and rice husk charcoal planting media at 14, 28, and 35 HST. At 35 HST, the mixture of *cocopeat* and rice husk charcoal produced a plant height of 39.53 cm, higher than the other planting media. Rice husk charcoal planting media produced the lowest plant height at 35 HST, namely 36.97 cm (Figure 1). This may be because the combination of cocopeat + rice husk charcoal creates conditions that strongly support plant growth, especially in the root system. In the study of (2025), the use of rice husk charcoal planting media produced a lower plant height (28.39 cm)

than the use of rockwool planting media (31.76 cm) in mustard greens.

Table 1. Average height of mustard green plants in several planting media

Growing media	Plant Height		
	14 HST	28 HST	35 HST
Cocopeat	20.50 ± 0.58 bc	30.70 ± 0.40 ab	36.87 ± 0.46 ab
Rice husk charcoal	18.93 ± 0.58 c	29.83 ± 0.40 ab	35.97 ± 0.46 b
Cocopeat + Rice husk charcoal	24.03 ± 0.58 a	32.93 ± 0.40 a	39.53 ± 0.46 a
Rockwool	21.7 ± 0.58 b	31.27 ± 0.40 ab	37.87 ± 0.46 ab

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test.

Cocopeat has excellent water absorption and nutrient retention capabilities, with a water retention capacity of up to 69%. According to Tripama et al. (2025), *cocopeat readily absorbs and retains water* and has pores that facilitate air exchange. *Cocopeat* has a pH between 5.0 and 6.8. However, the high tannin content in *cocopeat* can interfere with plant nutrient absorption. This can prevent the cocopeat growing medium from producing optimal plant height. Meanwhile, rice husk charcoal is porous and lightweight. Although it has good porosity for plant root development, its low water retention capacity also results in suboptimal nutrient absorption. According to Tarigan et al. (2015), rice husk charcoal takes a long time to provide nutrients for plants. This results in the lowest plant height of mustard greens in rice husk charcoal media.

The combination of cocopeat and rice husk charcoal creates favorable conditions for plant growth. Cocopeat's excellent water absorption and the porous nature of rice husk charcoal support the development of important plant organs, namely roots. Research by Magfiratunnisa et al. (2024) found that a mixture of rice husk charcoal (50%) and cocopeat (50%) produced porosity of up to 72.46% and a pH of 5.9. Good root development affects plant nutrient absorption, facilitating physiological processes such as photosynthesis. This, in turn, will impact the height of mustard greens.

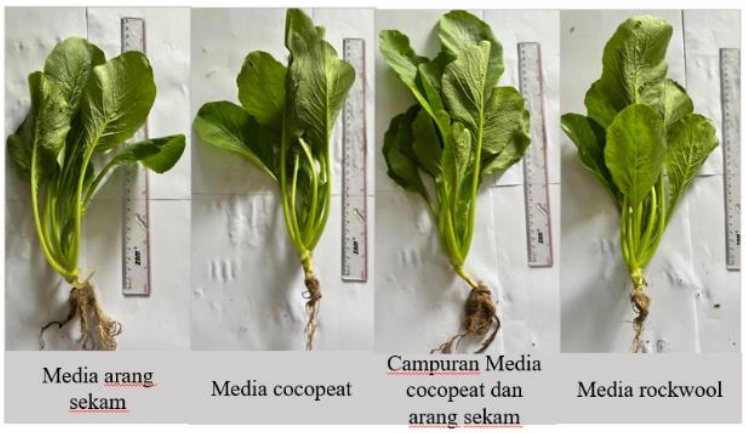


Figure 2. Green mustard plants in several hydroponic growing media

3.2. The Effect of Hydroponic Plant Media on the Number of Plant Leaves

The analysis results showed that the growing medium had no significant effect on the number of mustard green leaves at 14 days after planting. However, it did significantly affect the number of mustard green leaves at 28 and 35 days after planting. This suggests that the growing medium does not significantly influence the number of leaves at the beginning of mustard green growth. At this stage, the genetic characteristics of the plant still dominate. The average number of mustard green leaves is presented in Table 2.

Table 2. Average number of leaves of mustard greens in several planting media.

Growing media	Number of Leaves		
	14 HST	28 HST	35 HST
Cocopeat	7.33 ± 0.18 a	11.00 ± 0.33 b	12.00 ± 0.39 b
Rice husk charcoal	7.33 ± 0.18 a	10.33 ± 0.33 b	11.67 ± 0.39 ab
Cocopeat + Rice husk charcoal	8.33 ± 0.18 a	13.00 ± 0.33 a	14.67 ± 0.39 a
Rockwool	8.00 ± 0.18 a	11.00 ± 0.00 b	13.33 ± 0.39 ab

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test.

Table 2 shows that the best treatment was found in *cocopeat* + rice husk charcoal planting media, which produced the best results at 14, 28, and 35 days after planting. At 28 days after planting, the best number of

leaves was 13, and at 35 days after planting, the best number of leaves was 15. The combination of *cocopeat* and rice husk charcoal created good conditions for leaf growth.

The characteristics of *cocopeat,* which can absorb water and nutrients well, and the porous nature of rice husk charcoal significantly influence plant root development. Good root growth affects nutrient absorption, which in turn affects the growth of other organs such as leaves. In a study by Magfiratunnisa et al. (2024), a planting medium of 50% rice husk charcoal and 50% cocopeat produced the same positive effect on the number of mustard green leaves, with a result of 7 leaves.

3.3. The Effect of Hydroponic Plant Media on Plant Fresh Weight

The analysis results showed that the growing medium significantly affected the fresh weight of mustard greens. The average fresh weight and root weight of mustard greens are presented in Table 3.

Table 3. Average fresh weight and root weight of mustard greens in several planting media.

Growing media	Fresh Weight	Root weight
Cocopeat	134.38 ± 2.14 bc	2.71 ± 0.15 bc
Rice husk charcoal	131.64 ± 2.14 c	3.31 ± 0.15 ab
Cocopeat + Rice husk charcoal	148.33 ± 2.14 a	3.67 ± 0.15 a
Rockwool	141.48 ± 2.14 ab	2.48 ± 0.15 c

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% BNJ test.

Table 3 shows that the best treatment was found in a mixture of *cocopeat* and rice husk charcoal planting media, namely 148.33 grams for fresh plant weight and 3.67 grams for plant root weight. The lowest fresh weight was found in rice husk charcoal planting media, namely 131.64 grams. Rice husk charcoal has good properties in maintaining soil porosity and moisture. However, the water retention properties of rice husk charcoal are poor, resulting in less-than-optimal nutrient availability. According to Gafar et al. (2023), the use of planting media that still cannot support optimal nutrient absorption through the roots will inhibit plant growth, which affects yields. This is thought to be the cause of low plant weight in rice husk charcoal media.

The combination of *cocopeat* and rice husk charcoal influences root development and plant fresh weight. This organic media combination creates optimal rooting conditions. Cocopeat's excellent water retention capacity maintains the moisture of the medium. Meanwhile, the high porosity of rice husk charcoal improves garden aeration. This combination maintains and water-oxygen balance in the medium, supporting plant physiological growth.

According to Charitsabita et al. (2019), good planting media humidity will increase plant metabolism so that plant growth and weight increase because the process of nutrient absorption by the media takes place well. This opinion is supported by Rahmah et al. (2014), who stated that increasing biomass because plants can absorb more nutrients will stimulate the development of plant organs such as roots, so that water and nutrient absorption will be greater. Furthermore, photosynthetic activity will increase and affect plant weight. In addition, the ability of rice husk charcoal in maintain the porosity of the planting media strongly supports plant growth. According to Aksa et al. (2016), the planting media used in hydroponics must have good porosity so that air and nutrients can be absorbed optimally by the roots.

In the mixed planting media treatment of cocopeat and rice husk charcoal, the best lettuce plant weight was produced, namely 152.4 grams. Meanwhile, the planting media of cocopeat and pure rice husk charcoal produced a lower fresh weight.

4. Conclusion

Research shows that a mixture of cocopeat and rice husk charcoal significantly influences plant growth. This mixture effectively supports plant growth, including mustard plant height, leaf number, plant fresh weight, and root weight. These findings confirm that the effectiveness of the growing medium varies by growth stage. Further research is recommended to determine the optimal growing medium and assess its long-term impact on mustard plant productivity and quality.

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