



REVIEW ARTICLE

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Response Growth and Yield of Pakcoy (*Brassica rapa* L.) Against Types of Planting Media and Fertilizer Concentration of Organic Liquid Banana Peels in a Hydroponics System-Wick System

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Abstract

The increasing demand for pakcoy (*Brassica rapa* L.) and limited land availability necessitate efficient cultivation techniques such as the wick hydroponic system. This study aimed to determine the effects of different growing media types, concentrations of Liquid Organic Fertilizer (LOF) derived from banana peel, and their interaction on the growth and yield of pakcoy. The experiment was conducted from January to February 2026 using a factorial completely randomized design (CRD) with two factors: growing media (rockwool, hydroton, cocopeat, and rice husk charcoal) and LOF concentration (10, 15, and 20 ml/L), each with three replications, along with a standard AB Mix control treatment. Results showed no significant interaction between the two factors for all measured parameters. Rice husk charcoal consistently produced the best growth, with the highest total fresh weight (49.34 g), plant height (6.24 cm), number of leaves (14.52), canopy width (21.88 cm), and leaf area (58.13 cm²). The 10 ml/L LOF concentration resulted in the best growth compared to higher concentrations, acting as an effective biostimulant. Conversely, the 20 ml/L concentration suppressed growth, likely due to low pH and nutrient imbalance. The key advantage of this finding is the identification of a cost-efficient cultivation strategy that reduces reliance on commercial AB Mix by utilizing household waste. It is recommended that home-scale growers adopt a combination of rice husk charcoal as the growing medium and weekly foliar spraying of 10 ml/L banana peel LOF as a biostimulant supplement to a low-dose AB Mix to optimize pakcoy growth.

Keywords: Bio-stimulant, Soilless Culture, Substrate, Waste Utilization, Vegetable

1. Introduction

Pakcoy (*Brassica rapa* L.) is a commodity vegetable with abundant nutritional content and wide adaptation to various agroclimatic conditions. The height of market demand for commodities pushes the need for improvement in production in a sustainable way. However, the fundamental problems faced by the agriculture sector at this moment are the more limited availability of land for production, especially in urban and suburban areas. The transfer of agricultural land to areas of settlement and industry. Keep going increase along growth population, so that wide land available for cultivation becomes more shrink in a way significant. Condition: This demands the

implementation of cultivation techniques that do not depend on fertile land and water, such as the wick system. This system is simple, cheap, and does not need electricity, so it is very suitable for implementation for cultivation on a small scale on land with limited space (Narulita et al., 2019)

Success in hydroponics depends heavily on the type of planting medium and the availability of nutrients. The ideal planting medium should have good aeration, be capable of retaining water, and be naturally acidic (Perwtasari et al., 2012). Well-aerated planting media allow roots to get enough oxygen, so that they optimize root respiration and support effective nitrogen absorption (Fambari et al., 2026).

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Rockwool is one of the most popular growing media used by gardeners. hydroponics. Planting media: This medium has its own superiority compared to other media, especially in terms of the ratio of water and oxygen that can be retained (Darmawan, 2023).

Rockwool is popular, but alternative media like charcoal, rice husk, hydroton, and *cocopeat* need to be tested for their advantages in the system axis. Organic liquid fertilizer (POC) from banana peels has potential as a supplemental nutrient. Banana peels contain organic C, N, P, and K, which can be utilized by plants (Agustiani et al., 2021), and biostimulant compounds that stimulate growth. Nevertheless, its effectiveness as a replacement for or AB Mix companion in various planting media in the system axis for plant bok choy has not yet been studied. This research aims to: 1) analyze the interaction between type of planting media and concentration of banana peel POC; 2) know the influence of the type of planting medium; and 3) know the influence of the concentration of banana peel POC on growth and yield of pakcoy in the hydroponics system axis.

2. Material and Methods

The study was carried out at the Green House Emak Farm and Hydroponic, Sidoarjo, which is located at coordinates 7.343689° LS and 112.767065° BT with a height of 5 m above sea level, in the months January – February 2026. Tools include buckets, 10 L tubs, glass measuring cups, bottle sprayer, TDS/pH meter, SPAD meter, scales, analytics, net pot, flannel fabric, impregnated board. Material: *rockwool*, charcoal husk, *cocopeat*, hydroton, seeds bok choy Nauli F1, liquid AB Mix, kepok banana peel, EM4, molasses, water.

Study: This was done using a Design Random Complete (RAL) factorial two factors: (1) Type of planting media: *rockwool*, hydroton, *cocopeat*, charcoal husk; (2) Concentration of banana peel POC: 10 ml/L, 15 ml/L, 20 ml/L. There are 12 combination treatments, each repeated up to 3 times. AB Mix treatment concentration standard hydroponics, used as control. A previous study about bok choy hydroponics system axis generally only tests one factor at a time, such as substitution of AB Mix with banana peel POC at a high concentration (Annisa, 2026). Research by Desmasari (2021) and Maharani (2025) has tested interactions between nutrients and planting media, but neither used banana peel POC. Meanwhile, Maulana (2023) reported interactions between real POC banana peel with planting medium, but on the land system, not hydroponics.

Novelty study This located in: (1) combination four types of planting media (*rockwool*, hydroton, *cocopeat*, charcoal husk) with three banana peel POC concentration (10, 15, 20 ml/L) simultaneous; (2) POC treatment as biostimulan dose low through leaves, not AB Mix substitution; (3) exploration range low POC concentration

(10-20 ml/L), which is still seldom researched on pakcoy hydroponics.

POC creation is carried out with fermentation of 10 kg of banana peel, 250 ml of EM4, 10 L of water, and 250 ml of molasses for 2 weeks. POC is given every Sunday through spraying leaves until wet, starting 3 days after moving the plant and continuing through week 5. All tub treatments (except control) received AB Mix at a low, gradually increasing dose of 300–500 ppm to ensure basic nutrient requirements. The pH value is maintained at 5.5–6.5. Observation parameters covered tall plants, number of leaves, wide leaves, wide header and total fresh weight. Measurement of wide leaves was done with a Java 8-based ImageJ application. All data were analyzed using ANOVA in Microsoft Excel (Windows 11), and further testing of the difference between treatments was performed using DMRT at the 5% level.

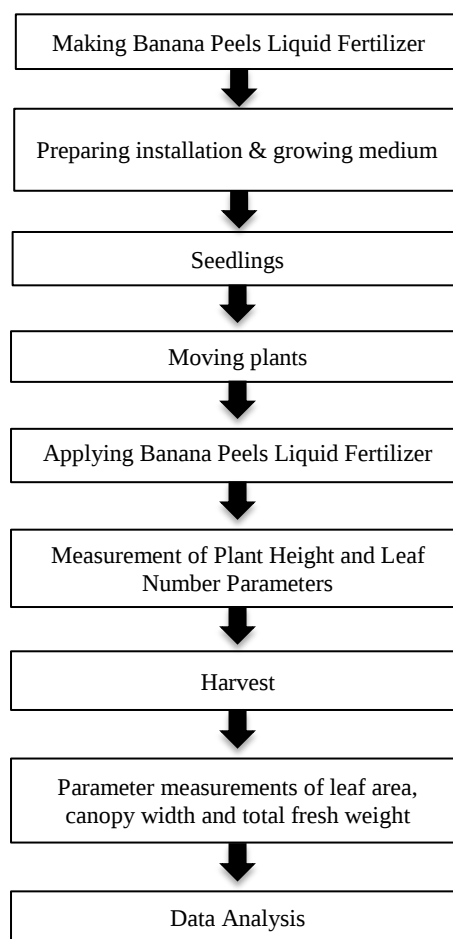


Figure 1. Research Flow Diagram

3. Results and Discussion

Analysis results show that there is no interaction between the type of planting media and POC concentration in all parameters, so that the influence of each factor can be discussed separately. Treatment AB Mix control produces the highest: height 7.59 cm, number 17.00 leaves, leaf area 58.17 cm², width 27.07, and total fresh weight 73.83 g at 35

HST.

In a single planting, charcoal husk consistently produced the best growth in all parameters and differed significantly with other media (Table 1). At 35 HST, charcoal husk produced a height of 6.24 cm, 14.52 leaves, leaf area 58.13 cm², width 21.88, and total fresh weight 49.34 g. Hydroton occupies second position. *Rockwool* shows the lowest achievement with a total fresh weight of only 32.33 g. Regarding the POC concentration factor, the 10 ml/L treatment gave the best growth, with a higher concentration (Table 2). Increasing the concentration to 20

ml/L; decrease all parameters drastically, with total fresh weight decreasing to 32.50 g.

Difference in morphology of plant bok choy at the moment of harvest at age 35 HST can be seen visually in Figure 2. Documentation shows that plants in charcoal media treatment husk with POC concentration of 10 ml/L appears own more posture tall as well as level lushness more optimal and uniform leaves. The visual advantages of this treatment are proven consistent and mutually support with quantitative proof measured in Table 1 and Table 2.



Figure 2. Harvest yield of pakcoy at 35 days after planting (DAP) under various planting media and concentrations of banana peel liquid organic fertilizer (POC). Description: M₀K₀: AB Mix; M₁: *Rockwool*; M₂: Hydroton; M₃: *Cocopeat*; M₄: Charcoal husk; K₁: Banana Peel POC Concentration 10 ml/l K₂: 15 ml/l; K₃: 20 ml/l.

Table 1 Average Plant Height, Number of Leaves, Leaf Area, Crown Width, and Total Fresh Weight of Pakcoy at 35 HST Due to Treatment Types of Planting Media

Growing media	Plant Height (cm)	Amount of Leaf (strands)	Leaf Area (cm ²)	Header Width (cm)	Total Fresh Weight (g)
Rockwool	4.69 a ± 0.78	12.48 a ± 1.72	34.34 a ± 0.83	18.06 a ± 0.89	32.33 a ± 1.65
Hydroton	5.13 b ± 0.78	13.67 b ± 1.20	44.04 a ± 0.89	21.08 b ± 0.66	47.12 b ± 0.55
Cocopeat	5.01 a ± 0.86	11.70 a ± 0.75	37.22 a ± 1.43	19.43 a ± 0.99	37.70 a ± 1.88
Charcoal husk	6.24 c ± 1.19	14.52 b ± 1.40	58.13 b ± 2.34	21.88 b ± 1.05	49.34 b ± 1.51
Control	7.59 ± 0.27	17.00 ± 0.66	58.17 ± 2.21	27.07 ± 0.14	73.83 ± 0.15

Description: Numbers in the following column show real differences (DMRT 5%). Control No. was not entered in statistical tests.

Table 2. Average Plant Height, Number of Leaves, Leaf Area, Crown Width, and Total Fresh Weight of Pakcoy at 35 HST Due to Treatment POC Concentration

POC Concentration	Plant Height (cm)	Amount Leaf (strands)	Leaf Area (cm ²)	Header Width (cm)	Total Fresh Weight (g)
10 ml/l	6.16 c ± 0.90	14.36 b ± 1.38	53.75 b ± 2.33	23.79 c ± 0.44	47.86 b ± 0.90
15 ml/l	5.27 b ± 0.65	12.97 a ± 1.52	39.44 b ± 1.08	20.61 b ± 0.33	44.51 b ± 1.58
20 ml/l	4.38 a ± 0.51	11.94 a ± 1.08	37.11 a ± 1.51	15.93 a ± 0.47	32.50 a ± 1.75
Control	7.59 ± 0.27	17.00 ± 0.66	58.17 ± 2.21	27.07 ± 0.14	73.83 ± 0.15

Description: Numbers in the following column show real differences (DMRT 5%). Control No. was not entered in statistical tests.

No real interaction between the planting medium and the concentration of POC shows that the second factor Works in a way independent through a different physiological mechanism. Planting media provides a physical and regulatory support environment for roots

(aeration and humidity), while the POC is sprayed onto the leaves to be absorbed as biostimulants through stomata. Analysis results show that there is no real interaction between the type of planting media and the concentration of banana peel POC. In general, these results differ from

those of Munirotul Wahyuningsih (2024), who actually finds interactions on several main parameters. In this case, the combination of AB Mix 1,200 ppm with POC NASA 9 ml/l produces a heavy wet weight of 21.87 g, while in the study this combination of charcoal husk with 10 ml/l banana peel POC results in a total fresh weight of 49.34 — or about 2.25 times more weight. Different achievements. Differences in the types of planting media and types of POC mainly account for this possibility.

This result differs from the study by Rizky Wahyu Lestari (2023), who also reported significant interaction between the planting media and the AB Mix concentration at high plant age parameters (5 and 35 HST, number of leaves, and long roots. The existence of interaction in the study by Rizky Wahyu Lestari (2023) shows that when the main source of nutrition originates from AB Mix with a wide range of concentrations (1,000–1,400 ppm), the planting media factor becomes more determinant in moderate nutrient availability. Meanwhile, there is no interaction in the study. This confirms that banana peel POC has low nutrient content. It is not capable of modulating plant response in a way specific to the characteristics of each planting medium. In the study, the basic AB Mix concentration is low because the plant response is more determined by the physical characteristics of the media, and the POC dosage is independent.

Types of planting media: charcoal husk has been proven to be the best medium for cultivation in the bok choy system axis. Its very porous structure creates an ideal balance between water retention and aeration in the root zone (Jamilah et al., 2022). In the passive system, the risk of puddling is high; the porous charcoal husk prevents anaerobic conditions, inhibiting root respiration and nutrient absorption. On the other hand, rockwool with very high water-holding capacity becomes saturated, causing a lack of oxygen and visible roots, leading to reduced growth parameters. Hydroton is sterile and highly aerated, ranking second. Because it supports healthy roots, while cocopeat, even though it is rich in nutrients, has humidity overload on the system. Advantages of charcoal husk: These results align with Ishak's (2024) findings, which showed that the fresh weight of shoots and roots was highest in pakcoy grown on charcoal husk media.

This Finding is also reinforced by the results of the study by Rizky Wahyu Lestari (2023), where charcoal husk produced the highest wet weight (74.11 g) compared to cocopeat and rockwool in the hydroponics axis, although with a higher AB Mix concentration. The second result confirms that charcoal husk excels at various levels of nutrition because of its supportive physical characteristics, gas exchange and preventing root decay.

The concentration of banana peel POC is 10 ml/L, which is optimal. At this low concentration, banana peel POC is an effective biostimulant that stimulates plant physiology of supplying plant-growth hormones, amino

acids, and micronutrients (Sitepu et al., 2022; Nasution et al., 2018). Laboratory analysis results for the POC used in the study. This shows that the total N content is only 0.02%, the total P is 0.02%, and the total K is 0.43%. This value, far below the standard for organic liquid fertilizer, is based on Minister of Agriculture Regulation No. 261 of 2019 and requires a minimum total NPK of 2–6%. This nutrient content confirms that banana peel POC does not function as a main source of nutrition, but rather only as a working complement through its biostimulant effect (Kristianto et al., 2023). Although so, kepok banana skin contains organic compounds like amino acids and simple sugars absorbed by leaves, and the growth auxins and gibberellin in small amounts capable of spurring cell division and elongation (Anbarasu et al., 2025; Nasution et al., 2018)

This is in harmony with the study by Octanine Laksita Rini (2025), which shows that the combination of 75% AB Mix + 25% POC (kepok banana peel) gives optimal growth in the pakcoy system axis, confirming that POC plays a role as a supplement, not a substitute for AB Mix. Effect: negative improvement in POC concentration up to 20 ml/L in research; this is very clear, pressing growth. A phenomenon similar to that reported by Nur Hasanah et al. (2025) on lettuce curly hydroponics raft floating, where the addition of banana peel POC concentration tall precisely press growth because it causes nutrient imbalance.

Relative potassium content is high in banana peel POC (0.43% K₂O) at a concentration of 20 ml/L, which can trigger nutrient antagonism, especially hindering much-needed nitrogen absorption for vegetative growth (Syavira, 2023). As a result, chlorophyll synthesis declined, and vegetative growth was hampered.

Anbarasu et al. (2025) found that a 5% concentration extract from banana peel results in a significant increase in peanut greenness. In contrast, a 10% concentration decreases its effectiveness, leading to phytotoxicity and disturbance of absorption. In research conducted on plants, carrots (Howeidi et al., 2022) reported that spraying banana peel extract at 20 ml/L produces the highest total yield, while 40 ml/L is more effective in quality parameters but does not increase harvest. The same pattern is seen in this research, where 10 ml/L is the optimal point before the effect becomes negative.

POC provision through leaves with a weekly interval is proven enough to maintain the supply of biostimulants without causing accumulation of excess. This strategy is similar with Hanif's (2023) recommendation found that the spraying interval of 3 days with NASA POC 10 ml/L provides the best in pakcoy hydroponics. In this research, a week interval was low enough to support growth because roots still obtained basic nutrients from AB Mix, so that leaves only needed additional stimulation.

In a way, overall, 10 ml/L Kepok banana peel POC was applied as a biostimulant through leaves, combined with charcoal media and superior husk physically,

becoming an effective and economical strategy for the cultivation of bok choy at scale in House stairs. However, the dependence on AB Mix as the main source of nutrients cannot yet be fully removed, because POC with low nutrient content is not capable of fulfilling the total plant nutrition needs.

4. Conclusion

There is interaction between the planting medium and

banana peel POC. Charcoal media husk and POC 10 ml/L single produce growth and yield best for bok choy. Recommended: use charcoal media husks and spray 10 ml/L of banana peel POC every Sunday as an AB Mix companion dose, low. Combination This is efficient and economical; however, it cannot yet fully replace AB Mix as the main.

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