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Effect of Water Hyacinth Bokashi and Stale Rice Microorganism Solution (MOL) Application on Growth and Yield of Cucumber (*Cucumis sativus* L.)

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Abstract

Background: *Cucumber (Cucumis sativus L.) is a vegetable plant from the Cucurbitaceae family whose production in Indonesia has decreased. Water hyacinth can be used as an organic fertilizer, and the application of Local Microorganisms (MOL) has been shown to improve the physical, chemical, and biological properties of the soil. This study aims to determine the effect of water hyacinth bokashi application and stale rice MOL on the growth and yield of cucumber plants and the most effective dose.* **Methodology:** *A factorial completely randomized design (CRD) was employed, utilizing 12 treatment combinations, which were repeated three times, resulting in 36 experimental units. The first factor is the Stale Rice MOL Factor (M), consisting of three levels, namely (M_0) Control (M_1) 100 ml/liter of water, (M_2) 150 ml/liter of water. The second factor is Water Hyacinth. th Bokashi (E) with three levels, namely (E_0) Control, (E_1) 80 g / polybag, (E_2) 130 g / polybag, (E_3) 180 g / polybag.* **Findings:** *The findings indicated that the implementation of water hyacinth bokashi in conjunction with stale rice MOL exerted an influence on plant height parameters at 30 DAP. The optimal dosage of water hyacinth bokashi was determined to be 180 g/polybag in combination with stale rice MOL, equivalent to 150 ml/liter of water.* **Contribution:** *These results suggest that the integration of organic matter and local microbial inputs can serve as a sustainable alternative to synthetic fertilizers in cucumber cultivation, contributing to improved soil health and supporting environmentally friendly agricultural practices.*

Keywords: *Cucumber; Stale Rice MOL; Water Hyacinth Bokashi*

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INTRODUCTION

Cucumber (*Cucumis sativus*) is a vine that is generally consumed directly or in processed form (Andri et al., 2015). It is one of the choices of horticultural commodities for farming activities. However, reported by the BPS (2018) in 2017 a decline in cucumber production has been observed in Indonesia over the past four years, with a decrease of 477,989 tons in 2014, 447,696 tons in 2015, 430,218 tons in 2016, and 424,918 tons. The decline in production can be attributed to various challenges faced by farmers during cultivation activities, including the procurement of seeds, plant maintenance, harvesting, and post-harvest handling. Additionally, Amin (2015) the quality of soil in the cultivation area has been identified as a contributing factor to the decline in cucumber yield. To address these challenges and enhance cucumber production, it is recommended that farmers focus on increasing land productivity through the application of fertilizers, compost, or bokashi.

Bokashi has been demonstrated to enhance soil physical, chemical, and biological properties, though it cannot be used to increase soil nutrients. Typically, bokashi is applied prior to the plowing process, with the objective of reducing soil stickiness to plow tools and machines. The utilization of bokashi has been shown to create favorable environmental conditions for plant growth, for example, by making bokashi from water hyacinth (Kaharuddin et al., 2015).

Water hyacinth (*Eichhornia crassipes*) has been identified as a potential source of organic fertilizer for use by plants (Jayati & Susanti, 2019). The utilization of water hyacinth as an organic fertilizer is anticipated to regulate its rapidly expanding population in aquatic ecosystems. Water hyacinth is characterized by its rapid growth rate, which contributes to its classification as a weed. This plant has the potential to damage aquatic ecosystems due to its ability to spread rapidly through waterways and reach other water bodies. Its characteristics, including its ability to obstruct the flow of water, can lead to the accumulation and siltation of rivers, thereby disrupting the ecological balance and hydrological functions of waterways (Wulandari et al., 2023; Wirawan & Nuraziza. 2022).

In addition to the application of water hyacinth bokashi fertilizer, the enhancement of the physical, chemical, and biological properties of soil can be achieved through the implementation of MOL (Local Microorganisms). MOL constitutes a liquid comprising organisms derived from natural ingredients that are readily available and inexpensive to procure (Aisyah, 2016). The role of MOL as a basic component of fertilizer is twofold: it is beneficial for plants and can also be used as a decomposer agent for organic materials, including agricultural, household, and industrial waste. One such material often used in MOL production is stale rice, which, although frequently discarded, contains valuable microbial potential that can benefit plant growth when properly processed.

Despite the prevalence of research addressing the utilisation of bokashi and MOL as individual organic fertilizers, but studies on the effect of their combination, especially bokashi made from water hyacinth and MOL from stale rice, on the growth and yield of cucumber plants are still limited. The combination of these two materials has the potential to enhance soil fertility and boost plant productivity in a sustainable manner. Consequently, a more effective fertilization strategy is required, one such strategy being the combination of bokashi and MOL. The present study was conducted with the objective of examining the effect of a combination of water hyacinth bokashi and stale rice MOL on the growth and yield of cucumber plants. In addition, the study sought to determine the most effective combination dose in increasing vegetative growth and generative yield of plants.

METHOD

This research was conducted at the Agroecotechnology Greenhouse, Department of Agroecotechnology, Faculty of Agriculture, Lambung Mangkurat University for 60 days, from November 2022 to January 2023. The study utilized a variety of materials, including cucumber seeds, soil, polybags, water hyacinth, sugar, EM4 solution, water, and stale rice. To facilitate the research process, a range of tools were utilized, including meters, plastic ropes, hoes, watering can, hand sprayers, scissors, cutters, signs, analytical scales, buckets, calculators, stationery, and mobile phone cameras.

Data Collection

This research was conducted using a Factorial Completely Randomized Design (CRD), Subsequently, there are 12 teatment combinations repeated three times, resulting in 36 experimental units. Which involved two factors:

Table 1. Treatment Combinations of Stale Rice MOL and Water Hyacinth Bokashi

Code	Stale Rice MOL (ml/L)	Water Hyacinth Bokashi (g/polybag)
M0E0	0 (Control)	0 (Control)
M1E0	100	0 (Control)
M2E0	150	0 (Control)
M0E1	0 (Control)	80
M1E1	100	80
M2E1	150	80
M0E2	0 (Control)	130
M1E2	100	130
M2E2	150	130
M0E3	0 (Control)	180
M1E3	100	180
M2E3	150	180

Description: code M: Local Microorganisms (Stale Rice MOL); E: Water Hyacinth Bokashi.

Procedure Research

Preparation of Water Hyacinth Bokashi

The initial step involves the preparation of 20 kilograms of water hyacinth and EM4 solution, followed by the thorough chopping of the water hyacinth until it achieves a smooth consistency. Subsequently, a 1 x 0.6 x 1-meter hole is excavated, and the excavated hole is then covered with a tarpaulin. The next step involves the placement of the chopped and compacted water hyacinth, which should reach a height of 20 centimeters. The water hyacinth pile should then be covered with an even layer of EM4 solution. The water hyacinth pile should then be covered with a tarp. On the second day, the temperature of the fertilizer material will rise to 70 – 80 °C. The manufacturing process will be completed after 14 days, at which point the temperature will drop to ± 30 °C (Meilina, et al. 2022).

Process of Making Local Microorganisms (MOL)

The process takes 5 fistfuls of stale rice, equivalent in size to a ping pong ball, placed in an old cardboard box and covered with decaying banana leaves. After 3 days, yellow, orange, and red mushrooms were observed to have grown. In a separate experiment, 10 tablespoons of sugar were dissolved in 1 liter of water. The moldy rice was then placed in a bucket and mixed with the sugar solution. The bucket was left for 1 week. The readiness of the MOL can be determined by the odor of the liquid, which should resemble that of tapai (Setiawan & Saryono, 2010).

Application of Water Hyacinth Bokashi and Stale Rice Local Microorganisms

The application of water hyacinth bokashi fertilizer is implemented two weeks prior to the planting process. This involves the incorporation of bokashi into the soil, thereby facilitating nutrient enrichment. Application of stale rice local microorganisms MOL was applied by spraying into the soil at the age of 10, 20, and 30 Days After Planting (DAP).

Planting

The Mercy F1 cucumber seeds (*Cucumis sativus* L.), a hybrid variety developed by Panah Merah and widely recognized for its high yield potential and resistance to common diseases, were obtained from a local agricultural supply store. This variety is commonly used in commercial cultivation. The seeds were soaked in warm water before sowing. After sprouting, two healthy seedlings were transplanted into each polybag.

Fertilization of Basic Fertilizers

pFertilization is the process of supplying nutrients to plants in order to meet their nutritional requirements. The standard fertilizer dose employed in this context is half of the recommended dose. According to the recommendations provided by Balittanah, the formulation of standard NPK fertilizers for cucumber plants consists of urea, SP-36, and KCl at a rate of 100 kilograms of urea per hectare, 100 kilograms of SP-36 per hectare, and 200 kilograms of KCl per hectare, respectively. Installation of the bamboo stakes is installed 2 weeks after planting. Each plant is provided with a single bamboo stake positioned on its left side, which is then secured with raffia to facilitate the plant's propagation.

Maintenance

maintenance practices encompass watering, thinning, weeding, and pest control. The experiment was conducted on Ultisol soil. Watering was carried out twice daily, in the morning and evening using approximately 500 ml of water per plant per day, unless precipitation was sufficient to meet the plants' water requirements, in which case irrigation was suspended. Thinning was performed three weeks after planting to maintain optimal plant density, while weeding was conducted at the same time to reduce competition from surrounding weeds.

Observation Parameters

The observation parameters in the study of the Effect of Water Hyacinth Bokashi Application and Stale Rice MOL on Cucumber Growth and Yield are as follows: plant height, number of leaves, flowering time, number of fruits, fruit length, and fruit weight. Each observation parameter was measured at specific growth stages. Plant height was assessed at 30 days after planting (DAP) using a ruler or measuring tape, measured from the soil surface to the tip of the highest leaf. Number of leaves was recorded at 10, 20, 30, and 40 days after planting (DAP) through direct visual counting. Flowering time was recorded visually when the first flower appeared. The number of fruits, fruit length, and fruit weight were measured at harvest, specifically at 40 days after planting (DAP), using a ruler for length and a digital analytical scale for weight.

Data Analysis

The observation data were subjected to a Barlett's variance homogeneity test. In the event that the data is found to be homogeneous, the analysis of variance is subsequently conducted. In the event that the treatment has a genuine or substantial effect, the middle value test is continued using the Duncan Multiple Range Test (DMRT) at the 5% level.

RESULT AND DISCUSSION

Plant Height

The results of the analysis of variance at the 5% level show the impact of water hyacinth bokashi application and MOL stale rice on plant height at 30 DAP, can be seen in Figure 1. The average height of cucumber plants indicates that the provision of stale rice MOL in combination with water hyacinth bokashi exerts a substantial influence on cucumber plant height. This phenomenon occurs because the 30 DAP (Days After Planting) phase, representing the culmination of the vegetative phase, transitions into the generative phase where cucumber plants attain their maximum height. According to Putra & Maizar (2023), the phosphate content in water hyacinth bokashi promotes root growth, stem development, flowering, and fertilization, and also accelerates the ripening of seeds and fruit. The breakdown of organic matter by microbes leads to an increase in nutrients in the planting medium, thereby enabling optimal nutrient absorption and stimulating maximum plant height growth.

Nitrogen (N) is a nutrient that plays a pivotal role in numerous physiological processes within plants. It is required in substantial quantities by plants for optimal growth and development. Plants absorb nitrogen in the form of nitrate ions ($NO3^-$) and ammonium ions ($NH4^+$). Nitrogen directly contributes to protein formation, stimulates plant growth, particularly during the vegetative phase, and facilitates the

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formation of chlorophyll, amino acids, fats, enzymes, and other compounds (Irawan et al., 2021).

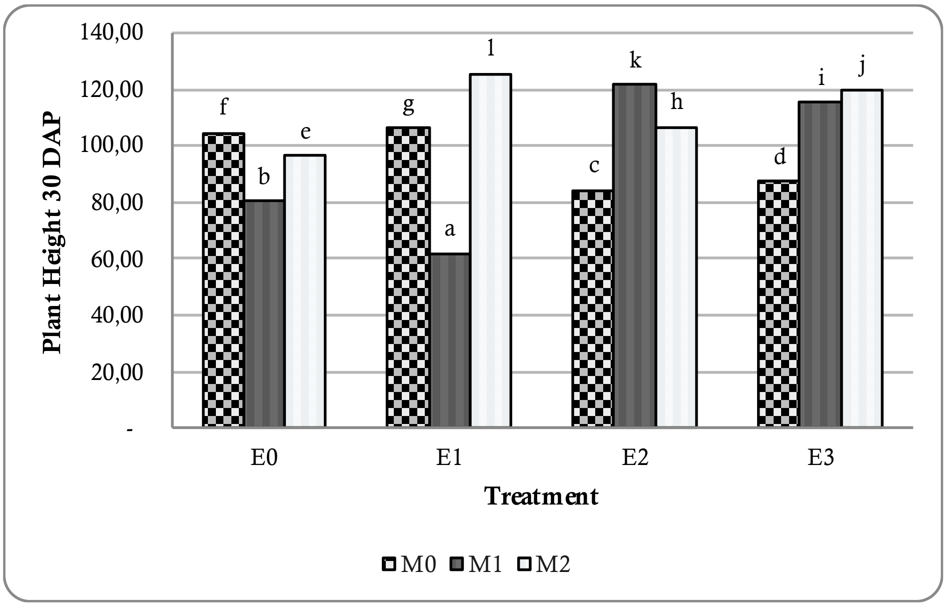

Figure 1. Average height of cucumber plants at 30 DAP. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). E_0 (Control equivalent to 0 g/polybag bokashi), E_1 (80 g/polybag bokashi), E_2 (130 g/polybag bokashi), E_3 (180 g/polybag bokashi), letters above the bars (a–l) indicate the results of a post hoc multiple comparison test at the 5% significance level.

The single treatment of water hyacinth bokashi exhibited no significant effect on plant height at 30 DAP because at 30 DAP marks the initial phase of cucumber fruit formation, during which the need for nutrients, especially phosphate, increases. Additionally, vegetative growth of plants continues even though they enter the generative period. The single treatment of stale rice MOL exhibited no significant effect on plant height at 30 DAP. This is because stale rice MOL is not classified as a nutrient-providing fertilizer, but rather as a liquid organic fertilizer that contains more microbial groups. This results in the process of forming cell division and elongation not running optimally.

Number of Leaves

The results of the analysis of variance at the 5% level show the impact of water hyacinth bokashi application and MOL stale rice on the number of leaves at 30 DAP, can be seen in Figure 2. The investigation found that the average leaf number of cucumber plants did not exhibit a significant response to the application of stale rice MOL combined with water hyacinth bokashi at 10, 20, and 40 DAP. However, the application exhibited a significant effect at 30 DAP. This outcome can be attributed to the imprecision in the application timing of bokashi and MOL stale rice, which hinders the optimal growth of cucumber plants. This viewpoint is corroborated by the findings

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of Rusmana et al., (2024), who contend that an excessive increase in nutrient adequacy can disrupt the nutrient equilibrium, thereby impeding optimal plant growth.

The single treatment of water hyacinth bokashi exhibited a highly significant effect on the number of leaves at the 10, 30, and 40 DAP, while it demonstrated a significant effect at the 20 DAP. Kumar et al. (2021) posit, plants require sufficient essential nutrients to support optimal growth and development. Nutrient deficiencies can have a detrimental impact on plant performance, encompassing both vegetative and generative phases. Moi et al., (2015) further underscore the significance of water hyacinth as a prospective raw material for the production of liquid organic fertilizers. These fertilizers have been demonstrated to enhance the growth and development of cucumber plants by supplying essential nutrients that facilitate plant metabolic processes. In the single treatment of MOL, stale rice exhibited a significant effect at the 10 DAP stage and a very significant effect at the 20, 30, and 40 days after planting (DAP). This is due to the presence of several nutrients in stale rice that can be utilized to improve soil fertility. As previously established by Jumriani et al., (2017), the optimal growth and production of a plant is contingent upon the sufficient and balanced availability of essential nutrients in the soil.Macronutrients such as nitrogen (N), phosphorus (P), and potassium (K) are foundational for plant growth, and imbalances or deficiencies in these elements within the soil can exert a deleterious effect on plant growth and productivity.

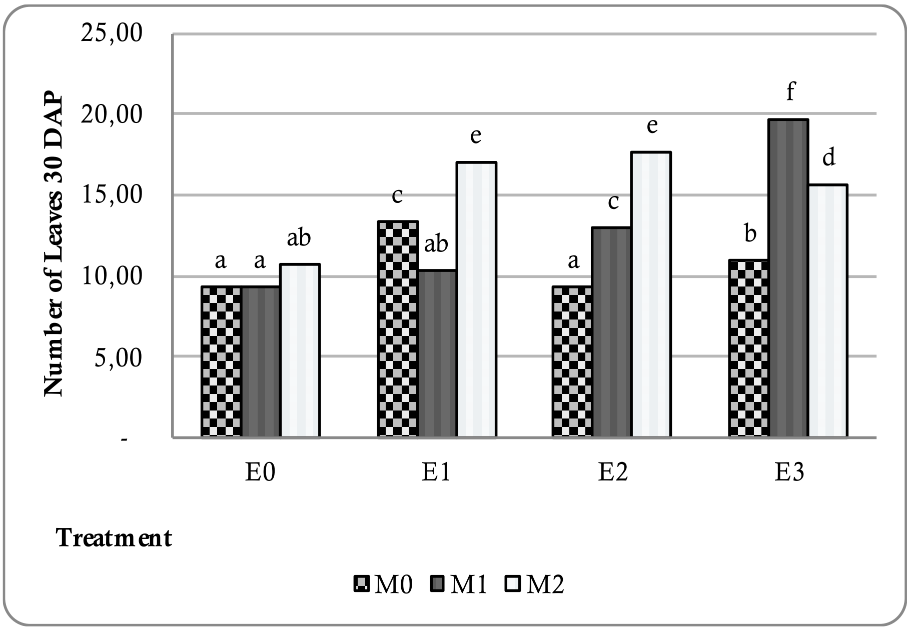

Figure 2. The average number of cucumber leaves at 30 DAP is influenced by the treatment of MOL stale rice and water hyacinth. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). E_0 (Control equivalent to 0 g/polybag bokashi), E_1 (80 g/polybag bokashi), E_2 (130 g/polybag bokashi), E_3 (180 g/polybag bokashi). Letters above the bars (a–f) indicate the results of a post hoc multiple comparison test at the 5% significance level.

Flowering Time

The results of the analysis of variance at the 5% level demonstrate the impact of water hyacinth bokashi application and MOL stale rice on the flowering time of cucumber plants. The process of plant growth and the impact of these factors can be seen in Figure 3. A study was conducted to determine the effect of MOL stale rice combined with water hyacinth bokashi on the flowering age of cucumber plants. The results showed that cucumber plants treated with M1E3 (100 ml/L stale rice MOL + 180 g/polybag bokashi) and M1E2 (100 ml/L stale rice MOL + 130 g/polybag bokashi) exhibited a faster flowering time, both initiating flowering at 15 days after planting (DAP). In contrast, cucumber plants under the M0E0 treatment (no stale rice MOL and no bokashi) demonstrated the slowest flowering response, initiating flowering at 22 days after planting (DAP). This accelerated flowering process is influenced by the application of MOL fertilizer, which is derived from stale rice and water hyacinth bokashi. This fertilizer plays a role in increasing the availability of essential nutrients that support the formation and development of flowers (Andina & Zulkifli, 2023).

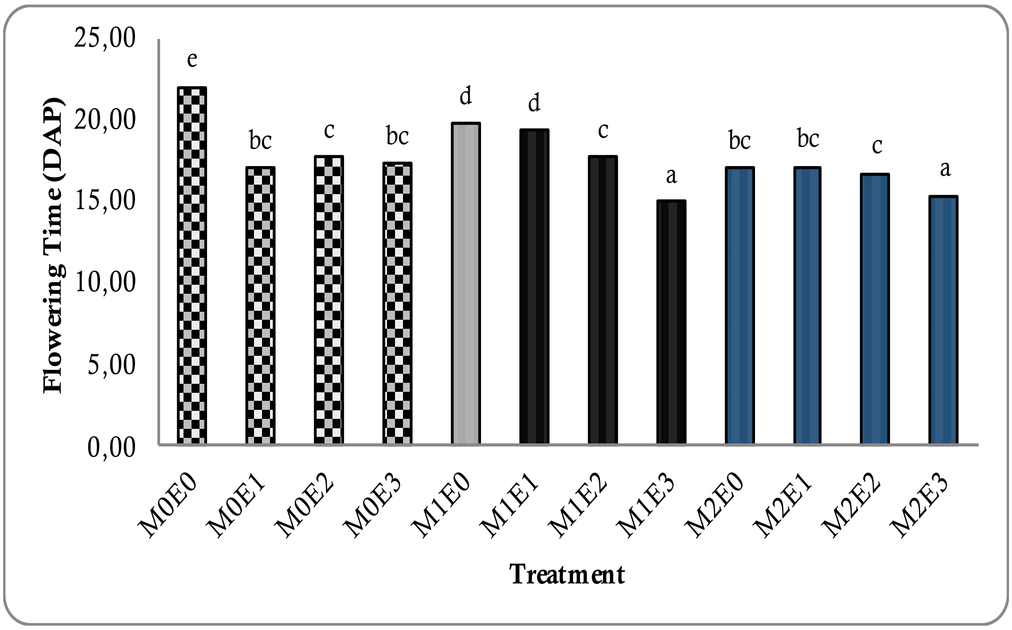

Figure 3. Average flowering time of cucumber plants in water hyacinth bokashi treatment. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). E_0 (Control equivalent to 0 g/polybag bokashi), E_1 (80 g/polybag bokashi), E_2 (130 g/polybag bokashi), E_3 (180 g/polybag bokashi). Letters above the bars (a–e) indicate the results of a post hoc multiple comparison test at the 5% significance level.

The short duration of the flowering phase in cucumber plants is influenced by the high availability of phosphorus in the soil.Phosphorus plays a role in accelerating flowering initiation by stimulating photosynthetic activity, and the photosynthetic products produced are then metabolized through respiration to produce assimilates, which are essential for the cell division process.Increased photosynthetic output and accumulation of assimilates contribute to an increase in cell number and size, thus accelerating the flowering process (Lingga, 1995).

Number of fruits

The results of the analysis of variance at the 5% level show the impact of water hyacinth bokashi application and MOL stale rice on the number of cucumber fruits at 34 DAP, can be seen in Figure 4. The average number of cucumber fruits from plants under investigation shows that the provision of MOL stale rice combined with water hyacinth bokashi has no significant effect on the number of fruits. This condition can be explained by the limited availability of nutrients needed in the process of fruit formation. According to Sutejo & Kartasapoetra (1992), the need for nutrients in plants varies greatly depending on the stage of growth and development, and requires different application times and doses. Therefore, fertilization should be administered during critical phases when plants require nutrients intensively to support optimal growth and development.

Furthermore, the number of seeds per plant also affects the productivity of the fruit produced. The greater the number of fruit ovules that survive and are supported by a high photosynthesis rate with optimal photosynthate accumulation, the greater the possibility of fruit formation in a plant. Sari et al., (2025) also state that the formation of fruit and the number of fruits formed by plants is determined by the flowering process of plants, which is influenced by factors contained in plants, such as hormones and genetics, as well as external factors, such as temperature, climate, water, sunlight, and food substances. Genetic factors determine whether pollination can lead to fertilization and whether the embryo that occurs after fertilization has the strength to survive into fruit.

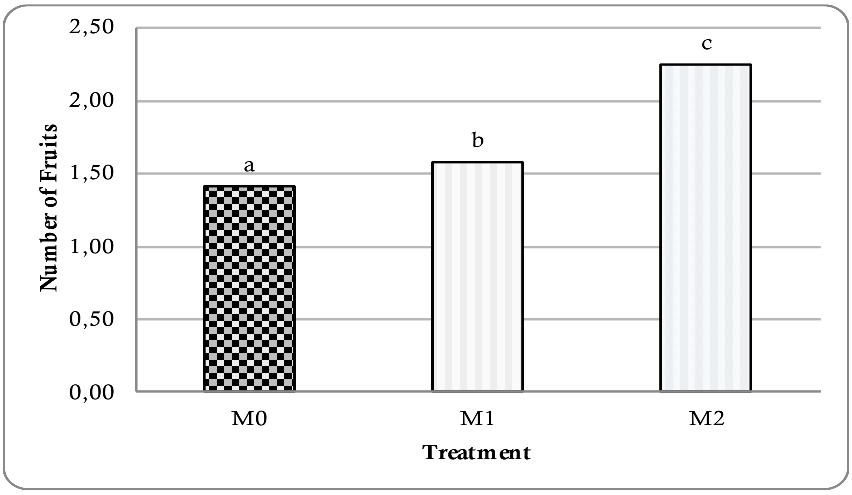

Figure 4. Average number of cucumber fruits in the treatment of stale rice MOL. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). Letters above the bars (a–c) indicate the results of a post hoc multiple comparison test at the 5% significance level.

Fruits length

The results of the analysis of variance at the 5% level show the impact of water hyacinth bokashi application and MOL stale rice on fruits length of cucumber plants at 40 DAP, can be seen in Figure 5 and 6. As presented in Figures 5 and 6, the average fruit length of cucumber plants demonstrates that the application of stale rice MOL in conjunction with water hyacinth bokashi exerts a substantial influence on the length of cucumber fruit. Statistical analysis shows that the single application of stale rice MOL (M_2) had a highly significant effect, while the single application of water hyacinth bokashi (E_3) had a significant effect on fruit length. Furthermore, the combination treatment M_2E_3 (150 ml/L MOL + 180 g/polybag bokashi) produced the longest average fruit length, indicating a positive interaction between the two organic inputs. This outcome aligns with the findings of Zulyana (2011), who posited that the length of cucumber fruit is contingent on the availability of nutrients in the soil and the efficiency of nutrient uptake by plants.

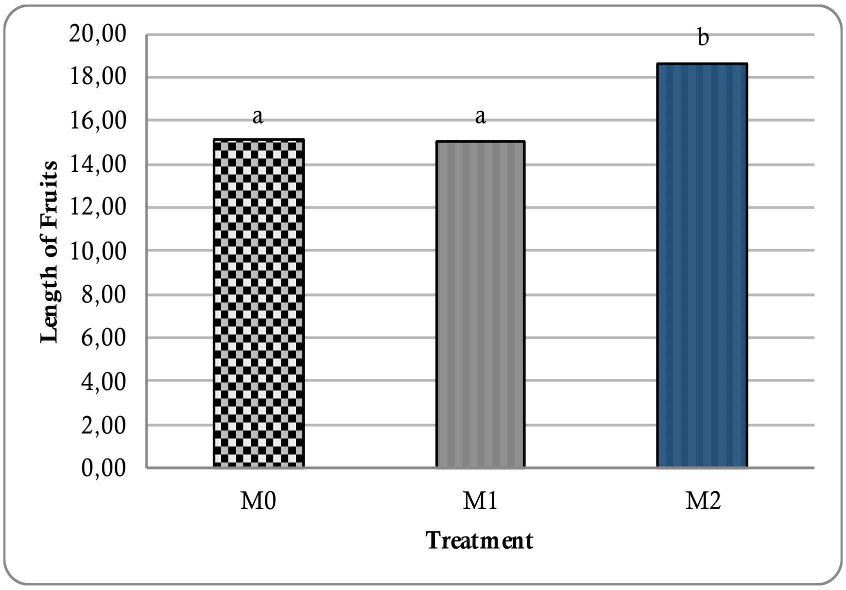

Figure 5. Average fruit length of cucumber plants in the treatment of stale rice MOL.
Description : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). Letters above the bars (a–b) indicate the results of a post hoc multiple comparison test at the 5% significance level.

Treatment with water hyacinth bokashi exerts a substantial impact on the length of cucumber fruit at harvest time. This phenomenon can be attributed to the nutrient content of water hyacinth bokashi, which provides essential nutrients that facilitate physiological processes associated with fruit formation and growth. These nutrients play a crucial role in energy synthesis and cell division during fruit development. As stated by Koswara (1992), during the reproductive phase, plants undergo alterations in the distribution of photosynthetic products, with the allocation of energy being more concentrated on the reproductive area and the distribution of assimilation results for the vegetative growth area being reduced or even halted. This phenomenon is attributed to physiological mechanisms that redirect a greater proportion of the photosynthate produced to plant components involved in fruit formation and development. Consequently, metabolic processes associated with vegetative growth, such as leaf and stem formation, are constrained, while greater resources are allocated to support fruit development to achieve optimal reproductive output.

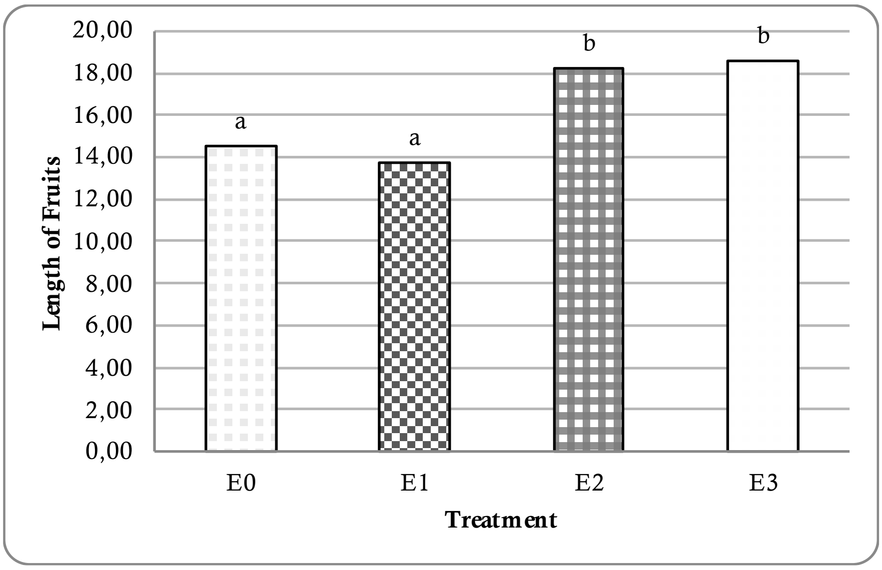

Figure 6. Average fruit length of cucumber plants in water hyacinth bokashi treatment. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. E_0 (Control equivalent to 0 g/polybag bokashi), E_1 (80 g/polybag bokashi), E_2 (130 g/polybag bokashi), E_3 (180 g/polybag bokashi). Letters above the bars (a–b) indicate the results of a post hoc multiple comparison test at the 5% significance level.

The single treatment of stale rice MOL exerted a highly significant effect on the length of cucumber fruit at harvest. This effect is attributable to the presence of microbes in MOL stale rice, which function to improve soil structure and increase soil aeration, thereby enhancing overall soil conditions. This improvement in soil structure increases the soil's capacity to retain moisture and facilitates better air circulation, which in turn improves soil microbial activity. The presence of these microbes has been shown to enhance nutrient uptake by plant roots, thereby increasing nutrient availability in the soil. This process is particularly crucial during the fruit formation phase, when the plant's demand for nutrients, especially macro elements such as nitrogen, phosphorus, and potassium, escalates rapidly to support optimal cell division and fruit growth (Julita et al., 2017).

Fruit Weight

The results of the analysis of variance at the 5% level show the effect of water hyacinth bokashi application and MOL stale rice on the fruit weight of cucumber plants at the age of 38 DAP, can be seen in figures 7 and 8. As shown in Figures 7 and 8, the average fruit weight of cucumber plants indicates that the single application of stale rice MOL and water hyacinth bokashi respectively had a highly significant effect on fruit weight. The highest fruit weight was observed in treatment M_2 (150 ml/L MOL) and E_3 (180 g/polybag bokashi). However, the combination of both treatments did not show a statistically significant effect. According to Kurniawan et al., (2017), macronutrients play a crucial role in plant growth and production, particularly during the fruit formation stage. These nutrients work synergistically to support tissue development and nutrient utilization in plants. Inadequate availability of such nutrients during this critical stage can negatively affect cucumber fruit weight.

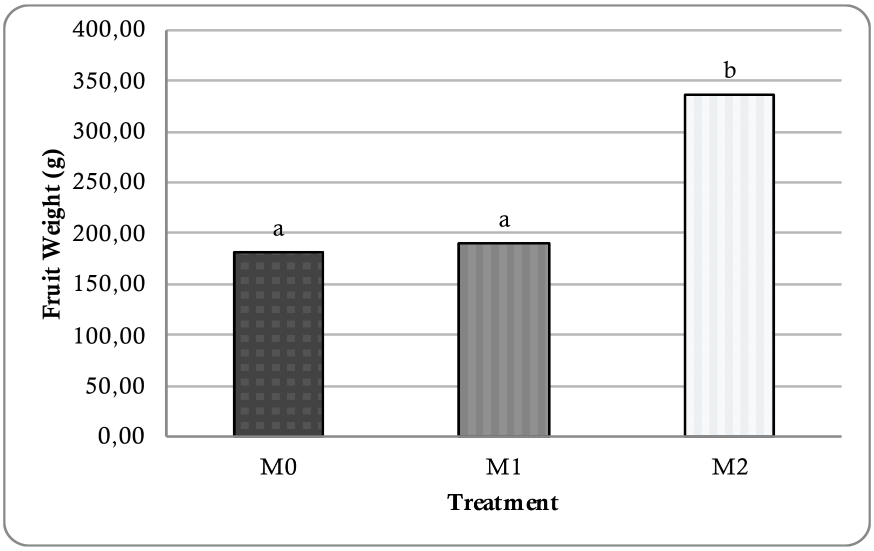

Figure 7. Average fruit weight of cucumber plants in the stale rice MOL treatment. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. M_0 (Control equivalent to 0 ml/liter of stale rice MOL water), M_1 (100 ml/liter of stale rice MOL water), M_2 (150 ml/liter of stale rice MOL water). Letters above the bars (a–b) indicate the results of a post hoc multiple comparison test at the 5% significance level.

A single treatment of water hyacinth bokashi has been shown to significantly effect on cucumber fruit weight (Syifa et al., 2020). This effect is closely related to improved nutrient availability, which stimulates protein synthesis and accelerates photosynthesis, ultimately enhancing carbohydrate production. These carbohydrates are then utilized in metabolic processes that support fruit formation. In addition, bokashi application improves soil physical and chemical properties, facilitating root development and increasing the uptake efficiency of essential nutrients such as nitrogen and potassium. These enhancements contribute to increased plant vigor and improved fruit productivity. In line with this, Sinaga et al., (2024) reported that the application of bokashi fertilizer significantly improved both the vegetative growth and fruit yield of cucumber plants, confirming its effectiveness as a sustainable organic input in vegetable cultivation.

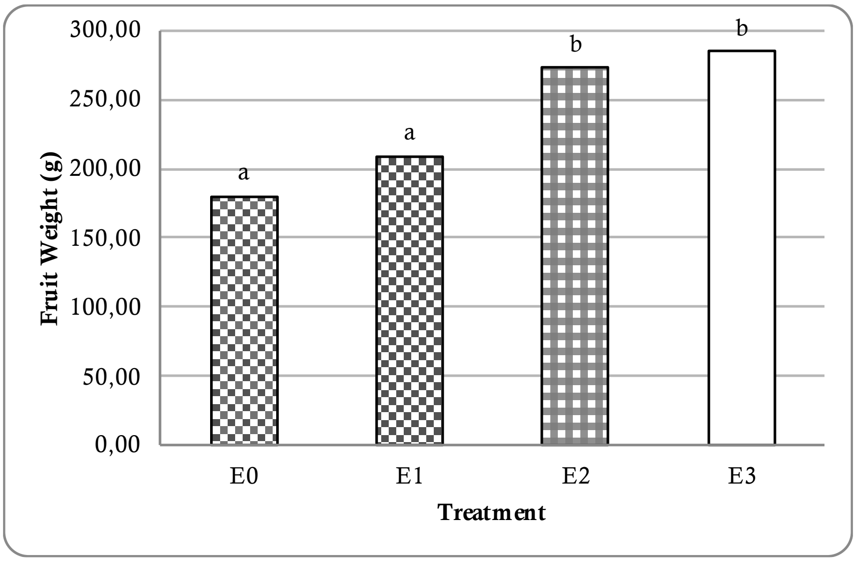

Figure 8. Average fruit weight of cucumber plants in water hyacinth bokashi treatment. **Description** : Numbers marked with the same letter in the same column indicate the same effect or have values that are not significantly different at the 95% confidence level. E_0 (Control equivalent to 0 g/polybag bokashi), E_1 (80 g/polybag bokashi), E_2 (130 g/polybag bokashi), E_3 (180 g/polybag bokashi). Letters above the bars (a–b) indicate the results of a post hoc multiple comparison test at the 5% significance level.

A single treatment of water hyacinth bokashi has been shown to significantly affect on cucumber fruit weight (Syifa et al., 2020). This effect is closely associated with enhanced nutrient availability, which promotes protein synthesis and accelerates photosynthesis, ultimately increasing carbohydrate production. These carbohydrates are then utilized in metabolic processes that support fruit formation. Furthermore, bokashi improves the physical and chemical characteristics of soil, thereby facilitating root development and enabling access to nutrients, including nitrogen (N) derived from urea fertilisation. These improvements contribute to increased plant vigor and fruit productivity. Supporting this, Sinaga et al., (2024) reported that bokashi fertilizer at a dose of 600 g/plant improved vegetative parameters such as plant height, leaf number, and stem diameter, and also resulted in the highest fruit weight, highlighting its potential as an effective organic input in cucumber cultivation.

Treatment with stale rice MOL has been shown to have a very significant effect on the fruit weight of cucumber plants. Stale rice MOL serves as a source of nutrients that support productivity and accelerate plant growth, especially in the initiation phase of fruit formation. According to A'yun et al., (2022) stale rice MOL contains beneficial microorganisms, including *Rhizobium* sp., *Azospirillum* sp., *Azotobacter* sp., *Pseudomonas* sp., *Bacillus* sp., and phosphate-solubilizing bacteria. These microorganisms play a role in increasing the availability of nutrients in the soil, improving soil quality, and increasing the efficiency of nutrient absorption by plants. Phosphate-solubilizing bacteria, classified as decomposer microorganisms, facilitate soil fertility enhancement through the process of phosphate dissolution, a process executed by the expression of specific organic acids of a certain molecular weight. Notably, *Rhizobium* sp. possesses the capacity to assimilate free nitrogen from the atmosphere, converting it into a form that is subsequently utilized by plants. In a similar manner, *Azotobacter* sp. functions to stimulate plant growth by increasing the availability of nitrogen, which is subsequently absorbed by plants.

CONCLUSION

The application of water hyacinth bokashi combined with stale rice MOL had a significant effect on cucumber plant height at 30 days after planting (DAP). The highest average plant height was recorded in the M_3E_3 treatment (150 ml/L stale rice MOL + 180 g/polybag bokashi), reaching 84.47 cm, which was significantly higher than the control (M_0E_0) with an average height of 48.33 cm. This demonstrates an increase of more than 74% compared to untreated plants. This optimal combination enhanced nutrient availability, especially nitrogen and phosphorus, and improved soil structure, which collectively supported vigorous vegetative growth. The scientific contribution of this study lies in demonstrating the synergistic effect of locally sourced organic inputs (bokashi from water hyacinth and MOL from stale rice) on improving cucumber growth performance. This provides a sustainable and cost-effective alternative to chemical fertilizers, while simultaneously promoting the utilization of agricultural and household waste for improving soil fertility in vegetable crop production systems.

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