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Utilization of Different Organic Growing Media on Growth, Yield Performance, and Palatability of Hydroponically Grown Watermelon (Citrullus *Lanatus Var.* Sweet 16 F1)

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ABSTRACT

The selection of appropriate growing media is crucial in optimizing hydroponic crop production. The study investigated the effects of different organic substrates on the Growth, Yield Performance, and Palatability of hydroponically grown Watermelon (*Citrullus lanatus* var. Sweet 16 f1). Four (4) treatments were evaluated: T1 - Sawdust, T2 - Rabbit Manure, T3 - Carbonized Sawdust, and T4 - Carbonized Rabbit Manure. The experiment followed a Randomized Complete Block design (RCBD) and was replicated four (4) times. Growth parameters measured include the number of days from transplanting to 50% flowering, the number of days from 50% flowering to the first harvest, the number of days from transplant to first harvest, and plant vigor in 15, 30, and 45 days after transplant. At the same time, yield was assessed based on the number of fruits per plant, fruit weight in grams, fruit size, and fruit yields (t/ha). Palatability was evaluated through sensory analysis focusing on Color (flesh color), Taste (overall acceptability), Sweetness Index, and Texture (Firmness). Results revealed a significant difference among treatments, with T4 (Carbonized Rabbit Manure) producing the highest growth rate and yield. Additionally, T3 and T4 yielded fruits with superior palatability scores compared to other treatments. These findings suggest that Carbonized Rabbit Manure is a promising organic growing medium for enhancing the productivity and fruit quality of hydroponically grown watermelon.

INTRODUCTION

Watermelon (*Citrullus lanatus*) is a flowering plant species of the Cucurbitaceae family, and the name of its edible fruit. A scrambling and trailing wine-like plant, it is a highly cultivated fruit worldwide, with over 1,000 varieties. Watermelon is grown in tropical and temperate regions worldwide for its large edible fruit, which is a berry with a hard rind and no internal divisions, and it is botanically called pepo. The sweet, juicy flesh is usually deep red to pink, with many black seeds, although seedless varieties exist.

Based on Crop Statistics of the Philippines Statistics Authority data, the Philippines' production decreased to 135 metric tons of fresh watermelon in the year 2022, approximately mirroring the 2021 figure. Region VI (Western Visayas) has the highest production of 58 tons of fresh watermelon. However, the Ilocos Region ranked second among the regions in the country in terms of watermelon production in 2022. The region's production contributed 21.36 percent to the national production during the period.

Carbonization has been proposed as a management tool for agricultural and municipal wastes, producing fertilizer, renewable energy, and biochar. Carbonization is achieved through the pyrolysis of organic wastes at a temperature ranging between 300 to 500°C, eliminating the bad smell, and reducing organic waste's volume and weight (Popov, 2004). During carbonization, some amount of N is lost in the form of ammonia gas, but the resulting carbonized materials are high in valuable P by up to 5 times compared to the original waste (Shinogie *et al.*, 2003; Tagoe *et al.*, 2008). With increasing livestock populations, ever-increasing (large) amounts of manure are produced that can be useful resources if utilized properly. Pyrolysis is an alternative solution to the management of large amounts of manure, while simultaneously producing renewable and sustainable energy by converting biomass into high-value products such as bio-oil, syngas, biochar, and chemicals, in the absence of oxygen at high temperatures (300-800°C). The thermochemical conversion of manure into bio-energy and biochar ensures the destruction of pathogens, a dramatic reduction in waste volume, as well as a pathogen-free environment (Quambrani *et al.*, 2017). Accordingly, Roberts *et al.* (2010) suggest that carbonization could be an economically viable strategy for transforming waste biomass into value-added materials while suppressing energy costs and achieving a carbon offset. For energy saving and mitigating greenhouse gas emissions, carbonization should be performed. Livestock is one of the sources of income in rural areas, especially in the province of Misamis Oriental. Cattle and Goats are raised for meat. Also, Chickens are raised for meat and eggs. Their waste was left everywhere, as animal waste was one of the contributors to air pollution. Utilizing animal waste was one way to lessen the sources of pollution. Nowadays, pollution is one of the major problems in the community. Animal manure was one of the agricultural wastes that were dumped everywhere and contributed to toxic gases. Agriculture contributes almost 35-40% of methane gas in the environment, coming from animal

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waste. Also, animal manure contributes 9% of carbon dioxide emissions. Instead of dumping animal manure and producing toxic gases that cause global warming. Also, it can cause contamination in the environment. Converting animal waste into biochar will help to enhance soil properties and minimize pollution.

Replacing inorganic growing media with organic growing media was better, utilizing different organic growing media like carbonized animal manure (CAM), sawdust, and animal manure. It will help to minimize soil, air, and water pollution. Thus, this study will be conducted to evaluate the growth, yield performance, and palatability of watermelon applied with different organic growing media. The study's general objective is to determine the Growth, Yield Performance, and Palatability of the Watermelon var Sweet 16 F1 applied with different organic growing media. Specifically, the study will be conducted to determine the following;

a) To assess the impact of different organic growing media on the growth parameters of watermelon in terms of the number of days from transplanting to 50% flowering, the number of days from 50% flowering to first harvest, the number of days from transplant to first harvest, and plant vigor;

b) To compare the yield performance of watermelon in terms of the number of fruits per plant, fruit weight, fruit size, and yield (marketable - non-marketable yield);

c) To evaluate the palatability attributes in terms of Sweetness level/index (Brix level), texture, color, and taste of watermelon grown with different organic growing media in soilless conditions.

Statement of the Problem

This study will be conducted to determine the production performance of hydroponically grown watermelon in different organic growing media, specifically on the growth, yield performance, and palatability. This study aims to bridge these research gaps by investigating how different organic growing media affect the growth performance, yield, and palatability of watermelon grown in a hydroponic setup.

Significance of the Study

The study aims to find out the effects of different organic growing media on the growth, yield performance, and palatability of watermelon. Students, teachers, researchers, farmers, other agricultural sectors, and government agencies will benefit from the results of the study as baseline information to explore more regarding the use of different carbonized animal manure as growing media in hydroponic and soil conditioner for Watermelon production.

Scope and Limitations of the Study

The study will focus only on the evaluation of the growth, yield performance, and palatability of watermelon applied with different growing media under soilless conditions.

The study will be conducted in one cropping season only.

Time and Place of the Study

The study was conducted at Barangay Dinawihan, Gingoog City, Misamis Oriental, Philippines, from November 2024 to February 2025.

Operational Framework

Figure 1 shows the operational framework of the study. The independent variable was the different organic growing while the dependent variable was the growth, yield performance, and palatability of watermelon under the soilless conditions.

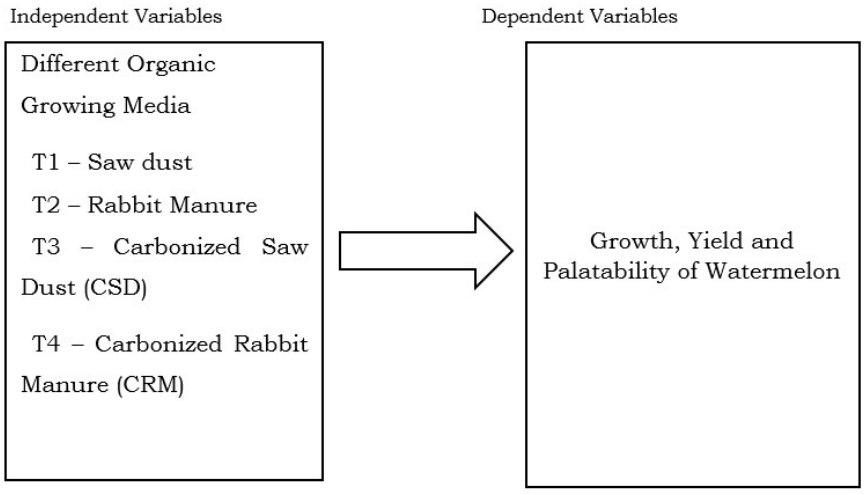

Figure 1: Schematic diagram showing the relationship between the dependent and independent variables of the study

MATERIALS AND METHODS

This part presents the materials, experimental design and treatment, experimental layout, cultural management practice, and statistical tools used in the study.

Materials. The materials used in the study were the following: Styro cup, Tuna box, A and B solution, weighing scale, record book, seedling tray, watermelon seed, UV Film, Bamboo pole, Rabbit manure, Sawdust, and Carbonizing Pan.

Methods for carbonizing animal manure

1. Carbonize the sawdust and manure using a carbonizing pan.
2. Stir regularly to burn the manure evenly to prevent over-burning.
3. When manure and sawdust are charcoal, already remove it and let it cool before filling a sack.
4. Place it in a dry place and store it for 1 month to reduce the pH.

Experimental Design and Treatment

The study will be using a Randomized Complete Block design (RCBD). The study will be conducted with four (4) treatments and replicated four (4) times. The following are the treatments and consist of 64 sample plants;

T1- Saw Dust (SD)
T2- Rabbit Manure (RM)
T3- Carbonized Saw Dust (CSD)
T4- Carbonized Rabbit Manure (CRM)

Experimental Area and Experimental Layout of the Study

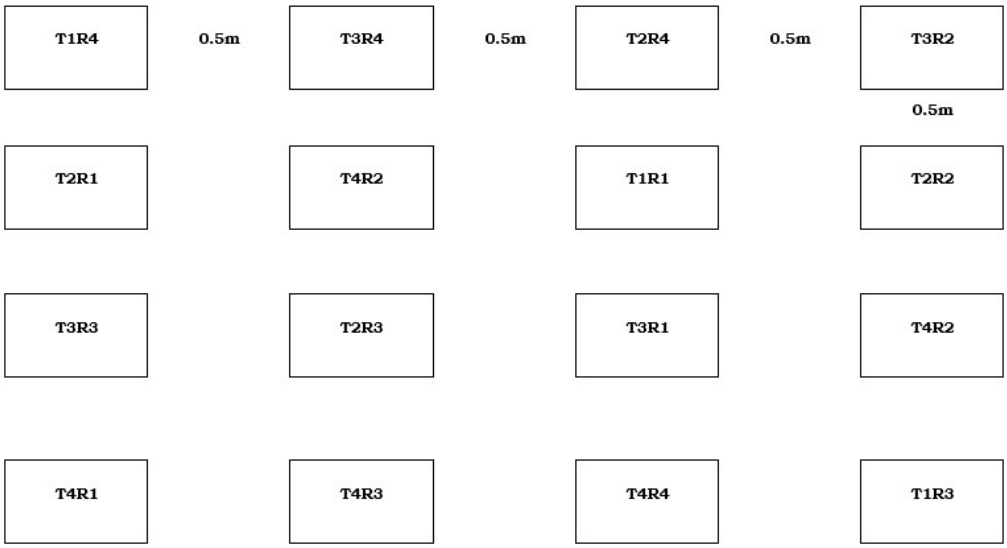

Figure 2: Experimental layout of the study

Cultural Management and Preparation

Treatment Sample Analysis

The treatment sample used in this experiment will be submitted to the Department of Agriculture Regional Office 10 for laboratory analysis before use.

Growing Media Preparation

A total of 16 boxes (0.6069 m x 0.6069 m x 0.1397 m) were used as the growing boxes for watermelon following the principle of the Kratky hydroponic system. The lower half of the growing box serves as a reservoir for water with nutrient solution. A total of 4 (four) holes were made for the lid or cover of the growing boxes using hot metal. The distance between boxes will be 50 cm, containing one plant per cup with 4 cups per box.

Pest Management

Pest control will be done before it causes high damage to crops (The pest will be controlled before it can reach the economic threshold level). However, when the researcher observed that pest infestation was high in 30 days after transplant and alarm on the pest activities, they needed to sprayed with botanical insecticide or synthetic insecticide, twice a week to reduce the pest population in the research area.

Irrigation

Application of water during the critical growing period of the crop particularly during the dry season is required to increase yield. An adequate supply of water is necessary. Water must be monitored regularly and add water with A and B solution when water level was low.

Harvesting

Watermelon fruit will be harvested when it reaches maturity or tendrils will dry. Harvesting was done manually. To avoid weight loss, harvesting should be done early in the morning or during the cooler times of the day.

Post-Harvest Handling

Separate the marketable and non-marketable fruits. Marketable fruits are damage-free and pass the quality test. Non-marketable fruits are damaged fruit, over-ripped fruits, deformed, and didn't pass the quality test. Store fruits at 12-15°C for not more than 2 weeks at 90% relative humidity if cold storage facilities are available.

Data Gathered

The different data to be gathered were the following: Growth parameter, yield, palatability, and its components.

Growth Parameter

1. Number of days from transplanting to 50% flowering

This was obtained by counting the days from transplanting to 50% flowering.

2. Number of days from 50% flowering to the first harvest

This was obtained by counting the days from 50% flowering to the first harvest.

3. Number of days from transplant to first harvest

Maturity is the stage where the crop is fully developed, or the quality of maturity

This data was determined by counting the number of days from transplanting up to the times when 75-80% of the fruit was ripped from each treatment. The maturity of watermelon was determined by physiological maturity, not by economic maturity.

Plant Vigor

This was taken at 15, 30, and 45 DAT. The following was the rating used to determine the plant vigor of watermelon.

Table 1:

Rating	Description	Meaning
1	Most vigorous	Healthy and diseases free
2	Vigorous	Slightly infested with diseases
3	Moderate vigorous	Not stagnant but infested with diseases
4	Weak	Stagnant
5	Very week	Stagnant and diseased

Yield and Yield Components

The Plants used for parameters a-g:

Number of Fruits Per Plant

This was done by counting the number of fruits that reached maturity.

Fruit Weight

This was determined by weighing the fruits per treatment plant.

Fruit Size

Size is determined by the fruit's weight in grams. The following classification was used to determine the fruit size of the watermelon, as presented. (PNS-BAFPS 56-2007-Watermelon.com)

Table 2:

Sized classification	Average fruit weight (kg)
Small	<3
Medium	3.1-4.0
Large	4.1-7.0
Extra large	>7

Fruit yields (t/ha) - fruit harvested in each treatment from first to last harvest was weighed and classified into marketable and non-marketable.

Fruit Yield (t/ha) = Treatment yield/1,000 (kg/ha) X 10,000(m^2/ha)/harvested area

Palatability

Color

Color is determined by the percentage of fruits' flesh color. The following classification was used to determine the flesh color of the watermelon, as presented.

Table 3:

Color code	Classification
1	Red
2	Dark Red
3	Light Red

Taste

This will be attained by tasting per sample berries. The following classification was used to determine the sweetness of the strawberry as presented.

Table 4:

Classification	Description
Less sweet	Less sweet
Sweet	Sweet
Sour	Sour
Bitter	Bitter

Sweetness Index

The sugar content of watermelon will be measured using a Refractometer. The following data will be used in correlation to different treatments' sweetness and K content of treatment.

Texture

This was determined by an eating test. The following classification was used to determine the texture of the watermelon as presented.

Table 5:

Classification	Description
Crunchy	Crisp
Juicy	Crisp and Firm
Soft	Grainy or Mushy

Statistical Analysis

All the data gathered were analyzed using the Analysis of Variance (ANOVA) of Randomized Complete Block Design (RCBD). Any significant differences among treatment means were analyzed using Tukey's test.

RESULTS AND DISCUSSION

This chapter presents the results and interpretation of data at different parameters to understand the results of the study.

Table 1. Effect of different organic growing media on the number of days from transplanting to 50% flowering, the Number of days from 50% flowering to the first harvest, and the Number of days from transplant to first harvest.

Table 6:

Treatment	Number of days from transplanting to 50% flowering	Number of days from 50% flowering to the first harvest	Number of days from transplant to first harvest
Treatment 1	40a	40a	80a
Treatment 2	35.5b	36.25b	73b
Treatment 3	33.25c	32.5c	68.25b
Treatment 4	28.5d	26.25d	54.75c
F-test	**	**	**
CV%	3.89	6.05	5.6

This means that the same letter is not significantly different

Table 6 shows the effect of organic growing media on the number of days from transplanting to 50% flowering, the number of days from 50% flowering to the first harvest, and the number of days from transplant to first harvest.
The number of days from transplanting to 50% flowering varied significantly among treatment. Treatment 4 (Carbonized Rabbit manure) had the shortest (28.5 days) which means it produces early, while Treatment 1 recorded the longest duration (40 days). The statistical analysis revealed highly significant differences among the treatment means.
Similarly, the number of days from 50% flowering to the first harvest was significantly influence by treatments. The treatment 4 again had the shortest duration (26.25 days), while Treatment 1 required the longest duration (40 days). The statistical analysis revealed highly significant differences among the treatment means.
Regarding the total number of days from transpalnting to the first harvest, treatment 1 recorded the highest number of days (80 days), whereas Treatment 4 reached harvest maturity much earlier at 54.75 days. The statistical analysis revealed highly significant differences among the treatment means.
Overall, Treatment 4 consistently promoted earlier flowering and harvesting across all growth stages, suggesting its potential for shortening crop cycles and improving production efficiency. The consistent significant differences across parameter highlight the robustness of the treatment effect.

Table 7: Effect of different organic growing media on Plant Vigor (15, 30, and 45 days after transplant

Treatment	15 DAT	30 DAT	45 DAT
Treatment 1	1.75a	2.06	2.69
Treatment 2	1.44b	2.06	2.56
Treatment 3	1.50ab	2.25	2.81
Treatment 4	1.25b	2.19	2.56
F-test	*	ns	ns
CV%	11.32	12.04	11.63

This means that the same letter is not significantly different

Table 7 shows the effect of organic growing media on the Plant Vigor in 15 DAT, 30 DAT, and 45 DAT.
Results revealed that T4 (Carbonized Rabbit Manure) was most vigorous 15 days after transplantation with a mean value of 1.25, while Treatment 1 (Saw dust) was the least vigorous among treatments 15 days after transplantation with a mean value of 1.70. The statistical analysis revealed significant differences among the treatment means.
At 30 days after the transplant treatment 3 showed the highest mean value (2.25), differences among treatment were not statistically significant. Similarly, at 45 DAT, Treatment 3 again recorded the highest mean (2.81), but treatments did not differ significantly.
The overall results indicate that treatments effect were more pronounced at the early growth stage (15 DAT) but tended to diminish as the plants matured. This could suggest that while early intervention can influence initial establishment, their long-term effects on the growth may level out under uniform environmental conditions.

Table 8: Effect of different organic growing media on Number of fruits per plant, Fruit weight, and Yield

Treatment	Number of fruits per plant	Fruit weight (g)	Yield (t/ha)	Fruit size
Treatment 1	1c	773c	2.10c	Small
Treatment 2	1.5ab	908c	2.47c	Small
Treatment 3	1.31bc	1474b	4b	Small

Treatment 4	1.69a	1717a	4.66a	Small
F-test	**	**	**	
CV%	16.20	11.62	11.62	

This means that the same letter is not significantly different

The influence of different treatments on fruit production parameters, including the number of fruits per plant, fruit weight, yield, and fruit size, is summarized in table 8.

Treatment 4 (Carbonized Rabbit Manure) recorded the highest number of fruits per plant (1.69) which was significantly different from Treatment 1 (1.0) and Treatment 3 (1.31), but not significantly different from Treatment 2 (1.5). Treatment 1 had the lowest fruit number, suggesting that Treatment 4 is more effective in promoting fruit production per plant.

In terms of fruit weight Treatment 4 produced the heaviest fruit (1717g), followed by Treatment 3 (1474g). Treatment 1 and 2 had significantly lower fruit weights, 773 g and 908g, respectively. These results suggest that treatment 4 substantially improved fruit development compared to other treatments.

Regarding yield per hectare, Treatment 4 achieved the highest yield (4.66 t/ha, followed by Treatment 3 (4.00 t/ha). treatment 2 and 1 recorded lower yields of 2.47 t/ha and 2.10 t/ha, respectively. This pattern reflects the combined effects of both higher fruit weight and increase fruit number observed in Treatment 4.

Interestingly, fruit size was recorded as small across all treatments, suggesting that despite improvements in fruit weight and yield, the overall size classification did not changes. This may indicate that size grading was based on weight alone rather than external dimensions.

Overall, Treatment 4 consistently outperformed other treatments in enhancing fruit number, fruit weight, and yield, demonstrating its potential for optimizing crop production under the experimental conditions.

Table 9: Effect of organic growing media on Palatability such as Color, Taste, Sweetness Index, and Texture

Treatment	**Color**	**Taste**	**Sweetness Index**	**Texture**
Treatment 1	Light Red	Less sweet	8.97b	Crunchy
Treatment 2	Light Red	Sweet	10b	Crunchy
Treatment 3	Light Red	Sweet	10.5b	Crunchy
Treatment 4	Light Red	Sweet	14.38a	Juicy
F-test			**	
CV%			8.98	

This means that the same letter is not significantly different

The influence of different treatments on Color, Taste, Sweetness Index and Texture, is summarized in table 9.

All treatments produced fruits with a light red color; however, difference in taste and texture were noted. Treatment 1 exhibited a less sweet taste and lower sweetness index of 8.97, while Treatment 2, 3, and 4 were categorized as sweet with higher sweetness index of 10, 10.5, and 14.38, respectively. Biochar application increased the soluble solids content of watermelon fruits, leading to a sweeter taste than those from plants grown without biochar (Villocino & Quevedo, 2015).

The texture varied among the treatments, where Treatment 1, 2, and 3 exhibited a crunchy texture, whereas Treatment 4 demonstrated a juicy texture. This change in texture, alongside the elevated sweetness index, suggests that the treatment applied to Treatment 4 not only enhance sugar accumulation but also improved the overall juiciness of fruit. Biochar derived from manure typically has a high potassium level compared to plant base (Bilias *et al*., 2023) that will enhance the sweetness of the fruit.

The findings imply that the treatment corresponding to Treatment 4 was the most effective in enhancing fruit quality attributes, particularly sweetness and texture. This highlights the potential of such treatment in producing fruits with superior palatability and consumer appeal.

CONCLUSION

Based on the findings of the study, the following were drawn:

a. Based on the growth parameters, there was a high significance on the number of days from transplant to 50% flowering, the number of days from 50% flowering to the first harvest, and the number of days from transplant to first harvest. Also, there was a significant difference in the 15 days after transplanting (DAT).

b. Among the yield and yield components, there was a high significance on fruit weight in grams, yield, and number of fruits per plant.

c. In palatability parameters, there was a high significance in the sweetness index.

The application of different organic growing media under hydroponic conditions significantly influenced the growth, yield, and palatability of Watermelon (Citrullus lanatus var. Sweet 16 F1). Carbonized rabbit manure consistently enhanced plants performance, resulting in

earlier flowering and harvesting, greater fruit weight, higher yield, and improved sweetness. These results demonstrated that organic media, particularly carbonized rabbit manure, can effectively improve hydroponic watermelon production

Recommendations

Based on the findings and conclusion of the study, the following recommendation is forwarded:

1. The potential of different organic growing media in hydroponics must undergo further research to verify their potential in different growing seasons to elicit substantial conclusions.

2. A verification trial should also be conducted during the dry and wet seasons to determine which of the following growing media is best for the different growing seasons of the year.

3. The different organic growing media must be tested in other fruits and vegetable crops grown in hydroponics to determine if it alters the palatability and;

4. Conduct the same research in other locations with different elevations in Misamis Oriental.

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