The Effects of Liquid Organic Fertilizer Treatments (Madre De Cacao, Sweet Potato, Alugbati) on the Growth of Pechay Plant (Brassica Rapa)

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ABSTACT

The growing demand for sustainable agricultural practices has led to increased interest in the use of organic fertilizers derived from natural plant sources. This study examined the effects of liquid organic fertilizers made from Madre de Cacao, Sweet Potato, and Alugbati on the growth of Pechay (Brassica rapa). A selective sampling method was used to select uniform plant sections for treatment application and observation. The study involved three organic treatments, with each group receiving one type of plant-based liquid fertilizer. Growth parameters such as plant height, number of leaves, length of leaves and width of leaves were measured at the beginning and end of the experimental period. Data analysis was performed using Repeated Measures ANOVA through Multivariate Statistics Pilla's Trace to determine differences across time and treatments. Significant differences were found in plant height and number of leaves among the treatments. The findings reveal that the Pechay plants in all treatment groups showed improvements in their growth, indicating the effectiveness of each fertilizer treatment in enhancing plant development. The results further showed that the plants subjected to Alugbati and Madre de Cacao treatments showed the most significant improvements. This study contributes to eco-friendly farming practices and supports the promotion of organic alternatives for vegetable production. It is recommended that farmers and gardeners consider using Alugbati and Madre de Cacao-based liquid fertilizers as sustainable and cost-effective alternatives for enhancing the growth of Pechay and possibly other leafy vegetables.

Keywords: Liquid Treatments, Pechay, Organic Fertilizer, Plant Growth,

INTRODUTION

Soil fertility increases with fertilization because this leads to better crop yields in agricultural practices. The price increase together with environmental concerns about chemical fertilizers makes them inaccessible and unsustainable for common farm operations. Natural fertilizers known as compost create a sustainable solution through their production from organic substances including plant extracts and animal manure. The researcher evaluates leaf extracts derived from Alugbati (Basella alba), Madre de Cacao (Gliricidia sepium), and Sweet Potato (Ipomoea batatas) for their capacity to function as liquid organic fertilizers in this study. This study evaluates the potential of Pechay (Brassica rapa) response to leaf extracts from Alugbati (Basella alba), Madre de Cacao (Gliricidia sepium), and Sweet Potato (Ipomoea batatas) to provide farmers with budget-friendly organic fertilizers which support sustainable farming practice.

Pechay (Brassica rapa), commonly known as Chinese cabbage, is one of the most widely consumed leafy vegetables in the Philippines. Known for its short growing period and adaptability to various climatic conditions, Pechay is a staple in Filipino diets and is often cultivated in backyard gardens and small-scale farms. Its nutritional benefits, which include high levels of vitamins A, C, and calcium, make it a popular crop among health-conscious consumers and subsistence farmers. Because of its high demand and short harvest cycle of about 30–45 days, Pechay is considered a practical crop for increasing food supply and income, especially in rural areas. The rising market costs of synthetic fertilizers exceed affordable limits for vegetable

farmers to purchase them. Research community members recognize the necessity to develop affordable local fertilizers as a replacement for existing alternatives.

Studies carried out recently indicate that there are benefits of organic fertilizers enhancing growth of plants. For example, in a study on the use of Gliricidia sepium as green manure, Garcia and Mendoza (2022) found that it significantly increased the vegetative development of leafy crops, including pechay. Similarly, Lopez et al (2023) observed that sweet potato leaves have been processed to a liquid fertilizer which acts to increase chlorophyll content and biomass in lettuce. In addition, Reyes and Santos (2023) found that Alugbati extract could function as organic fertilizer which improves plant vigor and root development. Such discoveries indicate that such organic materials have potential uses in sustainable vegetable farming.

This study aims to determine the effectiveness of fermented leaf extracts from three plant sources namely Alugbati (Malabar Spinach), Madre de Cacao (Gliricidia sepium), and Sweet Potato (Ipomoea batatas) in enhancing the productivity and growth of Pechay plants. Using fermented plant extracts as a replacement for inorganic substances will create greater yield capacities and foster environmental preservation benefits for upcoming generations. The research findings will help parents alongside future researchers and school administrators along with project/program coordinators and farmers and plant producers to reach positive outcomes through the implementation of their economical environmentally safe organic fertilizer.

LITERATURE REVIEW

Organic fertilizers made from plants have a number of benefits over synthetic ones, especially when it comes to encouraging balanced and healthy plant growth. The application of leaf-based LOFs to leafy vegetables was studied by Santos et al. (2022), who found that treatments increased root length, chlorophyll content, and overall biomass. The researchers stressed that LOFs derived from green leaves are ideal for crops that grow quickly, like Brassica rapa (Pechay), since they break down and release nutrients more quickly.

Research Method

This experimental research employed comparative analysis through testing variables affecting three different liquid organic fertilizers such as sweet potato leaves and Gliricidia Sepium (Madre de Cacao leaves) and Malabar Spinach leaves (Alugbati Leaves). The research assessed and compared the study variables through final measurements at the end of the experimental period. The experimental research design allowed the researchers to measure and compare the variables that included plant height alongside leaf length and number of leaves and leaf color and fresh weight.

The organic fertilizer development needed specific materials which received proper preparation and sourcing. The research started by acquiring 2 kilograms each of sweet potato leaves and Gliricidia sepium (Madre de Cacao leaves) and Malabar spinach leaves (Alugbati leaves) which underwent thorough cleaning. These leaves were chopped into smaller pieces to facilitate extraction by filtering into liquid.To aid in the fermentation process, molasses was prepared by diluting it with the leaf’s extraction in a 1:2 ratio. This mixture serves as a natural carbohydrate source to enhance microbial activity, promoting the breakdown of organic matter. The prepared plant materials were combined with the molasses solution and placed in a sealed container for fermentation for 3 to 5 days. The fermentation process was monitored over a specific period to ensure proper decomposition.

The study used a purposive sample technique for plant selection. As a result, the study could only use three buffer Pechay plants and ten (triplicates) for each treatment of liquid organic fertilizer. An expert from the Department of Agriculture and the coordinator of Gulayan sa Paaralan were invited to assist in conducting the experiment to collect data on the growth and yield performance of Pechay plants to ensure the validity of the study's findings.

An observation tool was utilized to examine the fresh plant weight, plant height, leaf length, number, and color of pechay plants applied with the three designed liquid organizers to assess their growth and yield performance.

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Before the study began, the superintendent of the school's division and the head of the school gave their approval for the experiment. This was followed by the experimental site's preparation. An expert from the Department of Agriculture, two TLE instructors, and the school's Gulayan sa Paaralan coordinator served as the inter-raters, which allowed the researcher to keep an eye on and verify the experiment's execution. To safeguard participants and researchers from any possible risks related to organic fertilizers and carrying out fieldwork, appropriate safety precautions were put in place. To make sure that the pechay plants cultivated with organic fertilizers are still safe to eat, the study complied with food safety regulations. Harvested plants were handled and cleaned properly to reduce the chance of contamination.

The following pechay planting protocols, which were modified from the Department of Agriculture (2019), were used for both the pilot test and the actual trial, which lasted for seven weeks or forty-five days.

The plant development and yield were verified and tracked every Monday at 4 PM by the researcher, the Department of Agriculture specialist, and the School Gulayan sa Paaralan. For forty-five days, the three liquid organic fertilizers were developed. Using a structured observation technique, the researcher documented the plants' height, leaf length, number, color, and fresh weight every week in order to assess their growth and yield performance.

RESULTS

The use of Alugbati and Madre de Cacao liquid organic fertilizers on Pechay plants resulted in significantly greater height compared to those treated with Sweet Potato extract. This finding aligns with Carandang (2020), who reported that leafy-based fertilizers like Alugbati enhance vegetative growth due to high iron and phytohormone content. Additionally, the statistical analysis confirmed significant differences in plant height among treatments, with Alugbati and Madre de Cacao leading in growth performance. These results support the study of De la Peña and Ramos (2022), who emphasized that nutrient-rich organic solutions derived from green biomass promote faster stem elongation and overall plant development.

Table 1. Resuls of Frequency, Percentage and Mean Distribution of the Rate Growth Performance of Pechay Using Liquid Organic Treatments (Plant Height)

Treatment	Mean (B)	Mean (E)	Interpretation (B)	Interpretation (E)	SD (B)	SD (E)
Madre de Cacao	2.61	8.35	Poor	Fair	0.28	0.47
Sweet Potato	2.29	7.66	Poor	Fair	0.23	0.53
Alugbati	2.52	8.36	Poor	Fair	0.27	0.58

Table 1 presents the descriptive statistics for plant height from the start of the observation to the end, including frequency, percentage, averages, and standard deviation. According to the data, the plant pechay's initial height was assessed as "Poor" at the beginning of the observation.

Such an improvement in growth indicates that all the three organic fertilizers had a positive impact on plant height with Alugbati being just slightly better. The standard measure of plant height for healthy Pechay (Brassica rapa) plants under organic fertilizer treatment typically ranges between 7 to 10 centimeters (cm) by 25 to 30 days after transplanting . This range is considered the normal and acceptable vegetative growth height before the plant reaches full maturity at around 30 to 35 days. According to the Department of Agriculture (DA-BAR, 2022), Pechay responds well to organic fertilizers, which support gradual but sustained height development. In particular, during the early stages of growth (10–15 Days), Pechay plants usually measure around 4 to 6 cm, progressing to 7–10 cm as they near harvest.

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Table 2. Resuls of Frequency, Percentage and Mean Distribution of the Rate Growth Performance of Pechay Using Liquid Organic Treatments (Number of Leaves)

Treatment	Mean (B)	Mean (E)	Interpretation (B)	Interpretation (E)	SD (B)	SD (E)
Madre de Cacao	2.60	7.50	Poor	Moderate	0.52	0.71
Sweet Potato	2.50	7.30	Poor	Moderate	0.53	0.82
Alugbati	2.50	7.60	Poor	Moderate	0.53	0.52

Table 2 shows the descriptive statistics for the number of leaves from the start of the observation to the end, including frequency, percentage, averages, and standard deviation. According to the data, the initial leaf count in all treatments was primarily between "Poor" and "Fair," with 60% of plants that reclined Madre de Cacao treatments falling into the "Fair" category. Toward the end, all treatments reached the "Moderate" category with Sweet Potato treatments having an average of 7.3 leaves, Alugbati treatments 7.6, and Madre de Cacao treatments 7.5. This is a good impact of organic fertilizers inducing foliage growth. Alugbati may have led to a slightly higher number of leaves due to its high levels of bioavailable nutrients, particularly calcium and magnesium, which support robust leaf formation (Reyes & Domingo, 2022). These nutrients help in cell wall development and enzymatic functions essential for foliage growth. The consistency of leaf increase suggests that Alugbati's nutrient profile effectively stimulates vegetative performance in Pechay.

The standard number of leaves for a healthy Pechay plant at 4 weeks ranges from 6 to 8 leaves under favorable organic conditions (Lopez & Garcia, 2023). In this study, the greatest increase in leaf number was observed during the third and fourth weeks, where most of the foliage development occurred across all treatments, especially in Alugbati-treated plants.

Table 3. Resuls of Frequency, Percentage and Mean Distribution of the Rate Growth Performance of Pechay Using Liquid Organic Treatments (Width of Leaves)

Treatment	Mean (B)	Mean (E)	Interpretation (B)	Interpretation (E)	SD (B)	SD (E)
Madre de Cacao	1.19	2.72	Poor	Poor	0.14	0.33
Sweet Potato	1.11	2.52	Poor	Poor	0.12	0.18
Alugbati	1.13	2.63	Poor	Poor	0.11	0.19

Table 3 presents the descriptive statistics for leaf width from the start of the observation to the end, including frequency, percentage, averages, and deviation from mean. According to the data, pechay leaf width remained in the "Poor" range for all treatments, even as the trial ended. Madre de Cacao had the greatest mean increase from 1.19 cm to 2.72 cm, but none of them reached the "Fair" category. This means that while there was little improvement, the effect of the organic fertilizers on leaf width was insignificant throughout the study period.

These results are consistent with the results of the study of Tayao (2017), which showed that leaf width is more sensitive to the nutrient ratio, particularly phosphorus and magnesium. As the tested organic fertilizers can be lacking in the correct balance of these nutrients, the development of width can have been restricted. Moreover, Luna (2019) said organic fertilizers alone cannot be enough in developing bigger leaf structures without longer periods of application.

Table 4. Resuls of Frequency, Percentage and Mean Distribution of the Rate Growth Performance of Pechay Using Liquid Organic Treatments (Length of Leaves)

Treatment	Mean (B)	Mean (E)	Interpretation (B)	Interpretation (E)	SD (B)	SD (E)
Madre de Cacao	2.30	4.94	Poor	Fair	0.22	0.28
Sweet Potato	2.13	5.19	Poor	Fair	0.19	0.28
Alugbati	2.18	5.37	Poor	Fair	0.19	0.32

Table 4 presents the descriptive statistics for the length of leaves from the start of the observation to the end, including the frequency, percentage, averages, and standard deviation. According to the data, all treatments started out with "Poor" leaf lengths but ended up reaching "Fair" levels at the end of the trial. The highest average leaf length was exhibited by Alugbati with 5.37 cm, then Sweet Potato at 5.19 cm, and followed by Madre de Cacao with 4.94 cm. This indicates that all three organic fertilizers exerted a beneficial influence towards the increase of pechay leaf length.

This improvement is consistent with a study by Carandang (2020), which found that organic treatments made from Alugbati increased leaf elongation because of their strong iron content and excellent water-holding capacity. The results of this investigation are further supported by Perez et al.'s (2021) validation that sweet potato fertilizers encourage the synthesis of chlorophyll and the growth of leaves. By the fourth week of growth, the average pechay leaf length under ideal organic fertilization is between 5 and 7 cm (Santiago and Beltran, 2023). In the third and fourth weeks, when nutrient intake and leaf development became more noticeable across all treatments, the greatest increase in leaf length was observed.

The results of this investigation are supported by recent studies. De la Peña and Ramos (2022) claim that because of their high phytonutrient content and natural growth hormones, organic fertilizers made from leafy greens like Alugbati greatly enhance leaf morphology and length. The use of sweet potato leaf extract also improves leaf development in leafy vegetables by increasing nitrogen availability, which is necessary for cell elongation, according to Bautista et al. (2023). Additionally, Madre de Cacao-based fertilizers, despite being somewhat less effective than other green manures, nonetheless favor vegetative features like leaf length because of their slow-release organic components, according to Navarro and Cruz (2021).

Table 5. Results Within-Subjects Effects of Organic Treatments on Plant Growth

Variable	Pillai's Trace	F	df	p	η^2_p
Plant Height (Beginning vs End)	0.36	7.45	1, 27	.010	.217
Number of Leaves (Beginning vs End)	0.07	2.10	1, 27	.159	.072
Width of Leaves (Beginning vs End)	0.12	3.62	1, 27	.068	.118
Length of Leaves (Beginning vs End)	0.80	109.47	1, 27	<.001	.802
Color (Beginning vs End)	0.16	5.14	1, 27	.032	.160

To ascertain the changes between treatments at the conclusion of the study period, a repeated measures ANOVA was performed. Treatment had a significant impact on plant height ($F(2, 27) = 7.63$, $p = .002$, $\eta^2_p = .276$) and leaf length ($F(2, 27) = 53.50$, $p < .001$, $\eta^2_p = .799$), according to the results. These show that the type

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of organic treatment used significantly affects plant height and leaf length. At the end of the treatment, there were no discernible variations in the number, width, or color of leaves between treatments.

Recent research shows organic fertilizers improve plant growth effectively similar to the current study findings. Alugbati (Basella alba) extract contains phytonutrients that both enhance plant metabolism and leads to improved plant stature and leaf development according to Garcia et al. (2021). The high nitrogen and potassium content in Madre de Cacao (Gliricidia sepium) leaf solution according to Domingo and Arevalo (2020) leads to vertical growth through effective stimulation of shoot and root development. The decomposing process of Sweet Potato (Ipomoea batatas) leaf extract is slow because of its long-term soil enrichment capacity, which reduces its effectiveness for short-term vegetative traits according to Bacani (2020). According to Pagaduan et al. (2022) any organic fertilizer with rapid decomposition manifests better quick impacts on plants that grow rapidly including Pechay.

Table 6 Analysis of the Effects of Organic Treatments on Plant Growth

Variable	Treatment	M	SD	F(2, 27)	p	η^2_p
Plant Height (End)	Madre de Cacao	8.35	0.47	7.63	.002	.276
	Sweet Potato	7.66	0.53			
	Alugbati	8.36	0.58			
Number of Leaves (End)	Madre de Cacao	7.50	0.71	0.67	.520	.047
	Sweet Potato	7.30	0.82			
	Alugbati	7.60	0.52			
Width of Leaves (End)	Madre de Cacao	2.72	0.33	1.02	.373	.070
	Sweet Potato	2.52	0.18			
	Alugbati	2.63	0.19			
Length of Leaves (End)	Madre de Cacao	4.94	0.28	53.50	<.001	.799
	Sweet Potato	5.19	0.28			
	Alugbati	5.37	0.32			
Color (End)	Madre de Cacao	4.60	0.52	1.22	.310	.083
	Sweet Potato	4.10	1.28			
	Alugbati	4.70	0.48			

Note. Values represent post-treatment observations. F-values are based on between-subjects' effects from repeated measures ANOVA. η^2_p = partial eta squared.

Table 6 highlights the comparative effects of three organic liquid fertilizers Madre de Cacao, Sweet Potato, and Alugbati on the final growth parameters of Pechay plants. The analysis reveals statistically significant differences in plant height ($F(2, 27) = 7.63$, $p = .002$, $\eta^2_p = .276$) and leaf length ($F(2, 27) = 53.50$, $p < .001$, $\eta^2_p = .799$), suggesting that the type of organic fertilizer plays a critical role in enhancing these specific growth variables. Among the treatments, Alugbati-based fertilizer produced the tallest plants (8.36 cm) and longest

leaves (5.37 cm), slightly outperforming Madre de Cacao (8.35 cm height, 4.94 cm leaf length) and clearly surpassing Sweet Potato (7.66 cm height, 5.19 cm leaf length).

The higher performance of Alugbati can be attributed to its known phytochemical properties. According to Garcia et al. (2021), Basella alba contains ample natural nitrogen, iron, and other micronutrients that promote cell division and chlorophyll formation, directly influencing plant height and leaf development. Likewise, Domingo and Arevalo (2020) reported that Gliricidia sepium (Madre de Cacao) is a rich green manure that rapidly decomposes and releases nutrients, enhancing root establishment and shoot growth. On the other hand, Bacani (2020) suggested that Ipomoea batatas (Sweet Potato) leaves are slower to decompose, making their nutrients less bioavailable during short-term application, which may explain its relatively lower performance in this study.

CONCLUSION

The study verified that the application of liquid organic fertilizers—specifically Madre de Cacao, Sweet Potato, and Alugbati extracts—contributed to the growth and development of Pechay plants. Among the treatments, Madre de Cacao and Alugbati showed more significant positive effects on plant height, while leaf color remained statistically similar across all groups. These results demonstrate that plant-based organic fertilizers can effectively promote vegetative growth. This conclusion supports the Organic Farming Theory (Lombi, 2024; Palaniappan & Anadurai, 2022), which advocates the use of natural and renewable inputs to enhance soil fertility and plant health without compromising environmental safety. The observed outcomes also align with the Sustainable Agriculture Principles, emphasizing ecological balance, efficient use of local resources, and the long-term sustainability of farming systems. By using readily available plant materials to create organic fertilizers, this study illustrates a practical and eco-friendly alternative to synthetic inputs, contributing to healthier agro-ecosystems and more resilient agricultural practices.

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