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Tahong (Perna Viridis) Shells and Vegetable Scraps as Fertilizers: A Comparative Study in Growing Mustasa (Brassica Juncea)

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ABSTRACT:

Several factors are playing a role in the demise of local farmers. One of which is the expensive commercially-available fertilizers. Fertilizers is one of the critical inputs in agricultural farming. And with this problem of the absence of cost-effective fertilizers, farmers opted for commercial ones that can be substandard and are packed with harmful chemicals that may cause irreversible damage to the soil itself, preventing farmers to have optimal crop yields. Many studies have claimed that organic wastes such as: fruit peels, tea, and coco peat are some of the effective organic fertilizers that are readily available to everyone. Moreover, the increasing biodegradable wastes produced in the Philippines is continuously rising, and one of the major components of collected wastes are vegetable scraps and mussel shells. To address the problems of local farmers regarding cost-effective fertilizers and help in converting wastes into something useful, this study was established. This aims to create new solutions that can aid local farmers and help the environment. The setups such as tahong shells, vegetable scraps, mixed treatment, and control group were observed as they influence the growth of Mustasa plant for 31 days. The data collected were then analyzed using two-way and one-way ANOVA to determine all the significant differences between the four (4) setups. The statistical tool was able to determine that there is a significant difference in all of the different setups. It also revealed that the treatment with combined tahong shells and vegetable scraps were able to grow the Mustasa most significantly in terms of its leaves' width, plant height, and fresh weight. The researchers further recommend to use different ratios of treatments and soil to acquire the ratio that will further result to a higher crop yield.

Keywords: *tahong shells, vegetable scraps, Mustasa, agriculture, organic fertilizer*

Introduction

The potential of tahong shells and selected vegetable scraps to provide nutrients for a growing plant motivated the researchers to investigate the efficacy of tahong shells and vegetable scraps, both having high levels of availability and are therefore costless to acquire. This study evolved to create another possible soil fertilizer for the local farmers that are battling the high-cost of commercially-available fertilizers that are substandard and can even cause plant toxicity.

The study aimed to tackle the ongoing challenge faced by local farmers in sustaining their agricultural output. While past researches have explored the potential of tahong shells as a soil liming agent, excessive liming can render soil infertile. To mitigate this issue, researchers explored the use of highly-available vegetable scraps to balance the liming effects of tahong shells. This approach not only addresses the immediate agricultural concern but also offers a sustainable solution to the growing problem of biodegradable waste generated by households. Also, by harnessing the nutrient-rich properties of these scraps, farmers can promote soil biodiversity and microbial activity, which are essential for robust crop growth.

Moreover, by reducing reliance on chemical fertilizers and synthetic soil amendments, this study aligns with minimizing environmental impact and promoting long-term agricultural resilience. In addition to that, by repurposing these waste materials for agricultural use, communities can contribute to eco-friendly practices while potentially boosting agricultural productivity.

At present, agriculture remains a relevant sector in every country, especially in the Philippines. However, it had been taking losses upon losses due to the ever-changing climate, pests, lack of post-harvest facilities, and high input costs. Many Filipino farmers are simply unable to take their production further due to the high expense of many critical inputs, like: equipment, seedlings, pesticides, and fertilizers.

All plants need nutrient in order to grow healthy and this is one of the most essential factors that farmer need to ensure. Without fertilizer, nature struggles to replenish the nutrients lost in the soil. When crops were harvested, important nutrients are removed from the soil. If the soil is not replenished with nutrients through the use of fertilizers, crop yields will take a toll over time.

Nitrogen (N) is one of the most required mineral elements for plant growth, and potassium (K) plays a vital role in nitrogen metabolism, both elements being widely applied as fertilizer in agricultural production. Nitrogen and potassium are both macronutrients that are essential for plant growth. Furthermore, crop growth is enhanced by the addition of nitrogen fixation; it also helps to prevent land degradation after several agricultural activities. Additionally, potassium also stimulates photosynthetic systems in plants; therefore, improving plant- growth, yield, and drought resistance. This capability of potassium can help plants to thrive and maintain growth under stressful conditions (Abid, et al., 2017). Another nutrient essential for plant growth is phosphorus, which is crucial for energy metabolism, storage, and expression of genetic information (Adam & Kruger, 2017).

However, accessibility to low-cost fertilizers had been a problem for farmers. Although there were several commercially-available mineral fertilizers in the market today, these are beyond the reach of and indeed expensive for the poor farmers. According to Briones (2017), even if the current policy regime in the fertilizer sector is market-oriented, there are still significant challenges: (1) sale of substandard fertilizer, (2) large discrepancies in pricing across adjacent regions for the same product. With high input material like fertilizers, farmers are struggling to have high crop yields and thus, the agricultural sector is at a disadvantage.

Every year, close to 8 million tons of crab, shrimp, and lobster shells are produced globally, as well as 10 million tons of waste oyster, clam, scallop, and mussel shells. The disposed shells were frequently dumped at sea or sent to landfill, where they modify soils, water, and marine ecosystems. Waste shells are a major by-product, which should become a new raw material to be used to the best of their potential (Topic Popovic, et al., 2023).

Past studies have proven the effectivity of various organic fertilizers; coco peat, fruit peels, animal waste, egg shells, and used tea bag to name some. Additionally, organic farming is paving a new approach to growing crops without the risk of contracting health issues from synthetic and commercially-available fertilizers. Organic fertilizers also offer a cost-effective input for local farmers that struggles with the ever-increasing price of chemical fertilizers.

Most people think of tahong shells as a complete waste, similar to vegetable scraps disposed by vendors in the market. However, only a few are aware that tahong shells are made up of protein and calcium carbonate. Protein coming from the shells gives plants protection and immunity against diseases, making the plant healthy and strong. Calcium carbonate is able to prevent plants from getting various disease and also prevents the spread of plant diseases. It can also help neutralize the soil acidity and supply the plants with calcium, making plants healthier. On the other hand, food wastes such as vegetable scraps also have special features that are essential for the growth of crops. Food wastes are turned into organic fertilizer since it is a great raw composting agent (Rise & Faucette, 2017).

Additionally, soils with much organic material remain lose and light, retain more moisture and nutrients, and foster the growth rate of soil microorganisms that promote healthier plants and root development. If a lot of artificial chemicals are added to the soil, it eventually loses its natural matter percentage and micro-biotic activity, which leads to unhealthy soil and unfavorable for plant growth.

All in all, this study may be able to devise a new formulation of organic fertilizers that are eco-friendly, cost-effective, and are truly beneficial in supporting plant growth. The researchers also sought this study to be impactful in the community, in terms of waste recycling or waste composting, since the organic matter utilized in this study is highly-available in every homes.

Conceptual Framework

The researchers were able to formulate a conceptual framework that shows the current problem of our local farmers, which is the low crop production due to the arising prices of commercial fertilizers. Furthermore, the framework shows the different factors that might influence or affect the stated problem of local farmers. Additionally, it shows the possible ways of addressing the problem and finding a suitable solution for it.

Figure 1: *Factors that lead to low crop production due to high prices of commercially available chemical/artificial fertilizers*

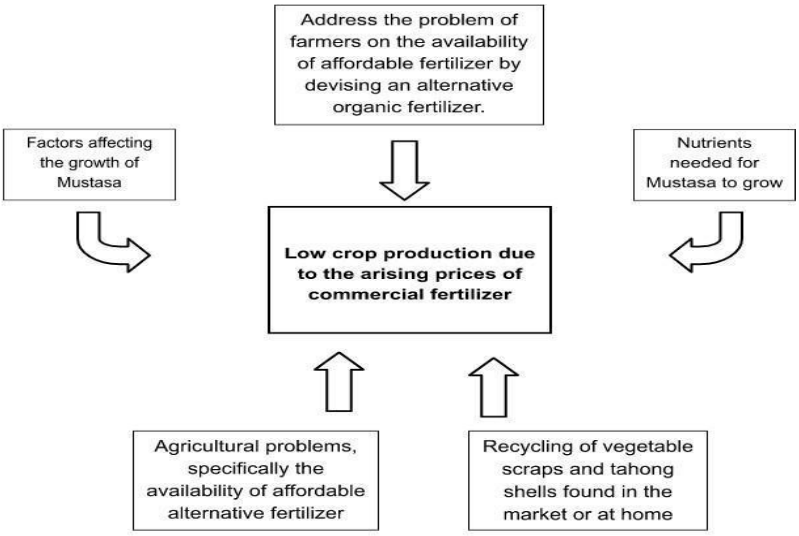
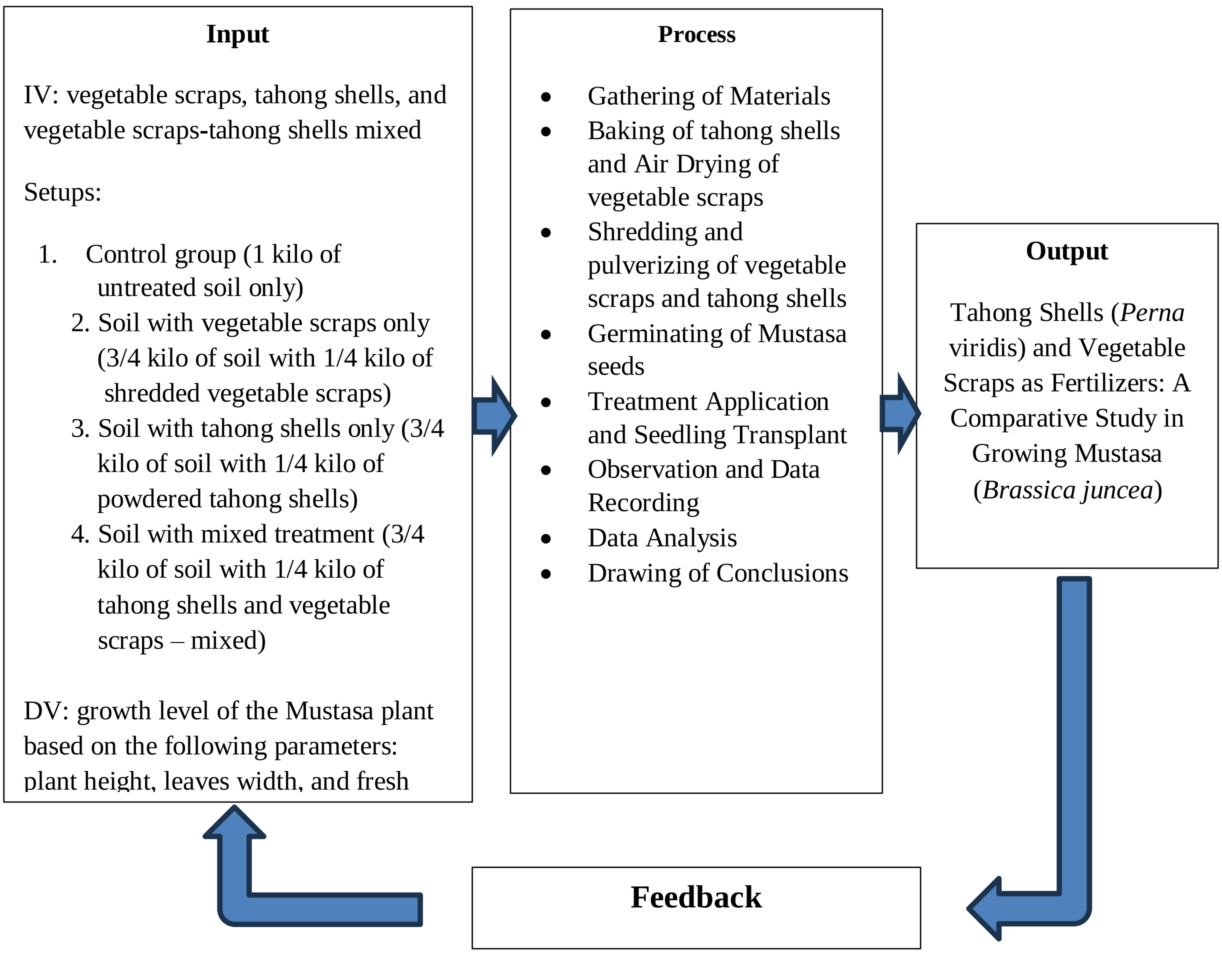


Figure 1 shows that there have been plenty of agricultural problems that arise due to the non-availability of cost-effective fertilizers. Local farmers are facing a big threat to their crop production. Fortunately, certain ways can be done to help farmers cultivate raw materials found in their homes and at the marketplace, enabling them to devise an affordable organic fertilizer. The availability of tahong shells and vegetable scraps, can be turned into something useful; this fueled the researchers to test the said tahong shells and vegetable scraps. The two variables are investigated on how it created a significant effect in growing Mustasa *(Brassica juncea*) and act as another organic fertilizer, an alternative to commercial fertilizer.

Figure 2. Research Paradigm



This study utilized vegetable scraps and tahong shells which undergone several processes to analyze the efficacy of the treatments as potential organic fertilizer in growing Mustasa *(Brassica juncea*).

Objectives

The main goal of this study was to create new solutions that can aid local farmers to have a higher crop yield and lessening input costs by determining the efficiency of tahong shells and vegetable scraps regarding soil fertility. Both the tahong shells and vegetable scraps (independent variables) are abundantly found in households and local markets. These organic wastes were tested for their potential in providing sufficient nutrients and ideal environment in growing the Mustasa *(Brassica juncea*) plant (dependent variable). In addition to that, the researchers used the following parameters: leaves' width, plant height, and fresh weight. These parameters were measured and analyzed by the use of statistical tools.

Moreover, this study sought to seek answers to the following scientific questions:

1. What is the growth level of Mustasa planted on soil with tahong shells only as to:
   1.1 leaves' width;
   1.2 plant height; and
   1.3 fresh weight?
2. What is the growth level of the Mustasa planted on soil with vegetable scraps only as to:
   2.1 leaves' width;
   2.2 plant height; and
   2.3 fresh weight?
3. What is the growth level of the Mustasa planted on soil with combined tahong shells and vegetable scraps as to:
   3.1 leaves' width;
   3.2 plant height; and
   3.3 fresh weight?
4. What is the growth level of the Mustasa planted on soil without any experimental treatments as to:
   4.1 leaves' width;
   4.2 plant height; and
   4.3 fresh weight?

Hypothesis: There is no significant difference on the growth level between control and experimental setups.

Methodology

The researchers described the variable and processes thoroughly including its purpose. The study concluded if the tahong shells, vegetable scraps and mixed tahong shells and vegetable scraps have a significant effect in growing Mustasa *(Brassica juncea)*, and identified which treatment is the most effective. The topic aimed to produce costless and alternative organic fertilizer to help farmers have an optimal production of crops using tahong shells and highly available vegetable scraps, that are both chemical-free, highly accessible, and cost-effective.

The manipulation of variable was undertaken to determine if the independent variable have a significant effect on the dependent variable. The results of this study have led to comparison done by the researchers to conclude which treatment was the most successful in growing the Mustasa plant.

The study about soil fertilization utilizing tahong shells and vegetable scraps as the manipulated variables. There were 3 trials and 2 replicates per setup and each has applied treatment with the same ratio for all. All the setups were composed of ¾ kg garden soil and ¼ kg treatment. There was also a setup that contained soil only, this represented the control group. The study was conducted to determine the efficacy of tahong shells and vegetable scraps as an organic fertilizer in growing the Mustasa plant. Furthermore, it determined which organic treatment managed to grow the most ideal Mustasa plant.

Moreover, the treatment application, observation and data recording were conducted at Brgy. Santa Maria, San Pablo City, Laguna, one of the researchers' residences.

This study utilized the stratified-random sampling technique. It is a reliable sampling technique since it is more likely to reflect the diversity of the entire population in this study. This also allows researchers to account for the variability of the population and ensures that each subgroup is well represented for a meaningful analysis.

According to this method, the germinated Mustasa plant placed into four different subgroups, namely: three experimental setups containing different treatments and the control group which will be randomly selected during its initial and harvesting time in order to determine and assess its growth under the close observation of researchers throughout its growing period.

Research Procedures

In this study, the researchers aimed to investigate the effects of tahong shells and vegetable scraps as fertilizers in growing Mustasa, through a meticulously designed series of procedures. By employing a systematic approach, the researchers endeavored to unravel the potential of tahong shells and vegetable scraps in influencing the growth of Mustasa, in terms of its' leaves' width, plant height, and fresh weight. The procedures are designed to ensure precision, reliability, and validity, ultimately fostering a comprehensive understanding of the study.

1. **Gathering of Materials**. Tahong shells and vegetable scraps was gathered from the local wet market and from the household of the researchers. Additionally, the soil was obtained from the Cosico family farm lot at Brgy. San Marcos, San Pablo City, Laguna. Then, the additional materials such as the Mustasa seeds were bought from Pandayan Bookshop located at San Pablo City Plaza. Lastly, the utilized hanging garden pots were bought at an online shopping app and was delivered at Brgy. Santa Maria, San Pablo City, Laguna.
2. **Baking of Tahong Shells and Air Drying of Vegetable Scraps.** The tahong shells were baked in an oven at 350 degrees for 40, 30, 20, and 10 minutes; with 5 minutes rest in between each baking, this was done for it to be easily crushed and powdered. On the other hand, the vegetable scraps were laid out and were air dried, for 3 days, this was done by each of the researchers at their respective residences.

3. **Shredding and Pulverizing of Vegetable Scraps and Tahong Shells.** After baking, the tahong shells was powdered using a mortar and pestle. While the vegetable scraps were chopped using a kitchen knife and then placed into a blender or food processor to obtain finer pieces.
4. **Mustasa Seed Germination.** The Mustasa was bought from a local bookstore. The researchers then germinated the number of seedlings needed for the study. The researchers were able to obtain thirty-six (36) seedlings needed for transplanting and treatment application.
5. **Treatment Application.** Researchers then weigh ¼ kg equivalent of powdered shells and ¼ kg of vegetable scraps and that were distributed into each of the following setups: soil with tahong shells only. Meanwhile, the third setup had 1/8 kg of tahong shells combined with 1/8 kg of vegetable scraps. Lastly, there was a soil without any treatment applied, representing the researchers' control group. All in all, the researchers weighed 1 kg of soil with corresponding treatment on each pot.
6. **Observation and Data Recording.** The researchers made observations on the growth of the Mustasa plant every 10^{th} day, for a whole month. Data were collected and recorded on the observation days; regarding on the leaves' width and plant height. The fresh weight was measured after 31 days or during the final day of data collection.
7. **Data Analysis.** The researchers utilized the two-way and one-way ANOVA to determine if there was a significant difference between the different setups over time, in terms of the Mustasa plant's heigh, leaves' width and fresh weight. Furthermore, the researchers also used the mean and standard deviation as descriptive tools to effectively describe and explain the data that were collected over the period of observation set by the researchers.

The researchers devised a comprehensive delineating each step and process essential for deriving scientifically-grounded and precise conclusions regarding the efficacy of tahong shells and vegetable scraps as fertilizers in growing Mustasa. This flowchart served as a roadmap that intricately showcases the methodological aspect of the study. This also provides a clear and systematic overview of the procedures undertaken.

This study utilized the statistical treatment: One-way and Two-way ANOVA, since it aimed to test if there was a significant difference between the application of organic fertilizers (tahong shells and vegetable scraps) and the growth of the Mustasa plant. Both the One-way and Two-way ANOVA revealed if there was a significant difference among the different treatments over time. Furthermore, the paper also intended to establish which treatment was best suited in growing the Mustasa plant.

Furthermore, this study utilized the descriptive statistics: mean (average). It is the sum of all measurements divided by the number of observations. This helped the researchers to determine the central measure of the growth data, representing the average value. Also, the researchers utilized the standard deviation of the data to further explain how the data are spread out from the mean or central value.

Results and Discussion

This chapter presents the result, the analysis, and the interpretation of data gathered from the experiment conducted by the researcher. The said data were presented in tabular form in accordance with the specific data the researchers gathered.

Table 1. *Descriptive Measures of the Leaves Width Between 4 Different Setups Over Time*

	0 Days		10 Days		20 Days		31 Days		OVERALL	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
01 Tahong Only	.2000	.00000	1.1556	.11304	1.3000	.15811	1.9667	.18028	1.1556	.65222
02 Veg. Only	.2000	.00000	1.3444	.08819	1.5667	.10000	3.8778	.13944	1.7472	1.35699
03 Mixed	.2000	.00000	1.4556	.08819	1.8778	.19221	5.0444	.21279	2.1444	1.81540
04 Control	.2000	.00000	1.3000	.07071	1.5111	.09280	2.9778	.22236	1.4972	1.01037
TOTAL	.2000	.00000	1.3139	.13970	1.5639	.24975	3.4667	1.16496	1.6361	1.32002

Table 1 provides information about the mean leaves' width of Mustasa grown using vegetable scraps only, tahong shells only, mixed treatment of tahong shells and vegetable scraps, and soil without any treatment. The data showed that the mean leaves width for the Mustasa grown with tahong shells and vegetable scraps mixed (2.1444) is greater than those grown in different setups. In addition, the standard deviation for the setup 01 that has tahong shells only (0.65222) is smaller than that for the setup 03 with mixed treatment applied (1.81540). Additionally, among the setups with treatment applied, the setups with vegetable scraps and mixed treatment have the same standard deviation value of 0.08819, which is also both the smallest value among other setups.

Throughout the data gathering period, a clear trend emerged, indicating that the setup treated solely with vegetable scraps consistently exhibited higher mean values compared to the setup treated solely with tahong shells. This observation underscores the efficacy of vegetable scraps as a potent organic fertilizer, likely due to its rich nutrient composition and organic matter content.

Interestingly, the setup with mixed treatment (combination of powdered tahong shells and vegetable scraps) demonstrated the highest mean value among all other setups. This finding suggests a combining effect between the tahong shells and vegetable scraps, wherein their combined application enhances soil fertility and promotes optimal growth for the Mustasa plant in terms of its growth parameters: leaves' width, plant height, and fresh weight.

Table 2 . *Descriptive Measures of the Plant Height Between 4 Different Setups Over Time*

	0 Days		10 Days		20 Days		31 Days		OVERALL	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
01 Tahong Only	2.0000	.00000	2.4556	.34319	4.9889	.21473	5.9111	.23688	**3.8389**	**1.69002**
02 Veg. Only	2.0000	.00000	2.8000	.25000	7.1111	.17638	7.9556	.22423	**4.9667**	**2.64251**
03 Mixed	2.0000	.00000	4.0889	.20883	7.9111	.27131	8.9889	.19003	**5.7472**	**2.87387**
04 Control	2.0000	.00000	1.9444	.16667	6.0222	.17159	6.8111	.19003	**4.1944**	**2.27621**
TOTAL	**2.0000**	**.00000**	**2.8222**	**.83840**	**6.5083**	**1.13801**	**7.4167**	**1.19511**	**4.6868**	**2.49851**

In addition to that, table 2 shows the data which represented the overall mean plant height of Mustasa grown under the 4 different setups: one with tahong shells only, vegetable scraps only, mixed treatment, and control group. The results showed that the Mustasa grown with setup 03 (mixed treatment) had a higher mean plant height than those grown with different setups. From the table above, the researchers also inferred that the data from the setup with tahong shells only was a lot more scattered from the mean as compared to all the other setups.

Also, it was noticeable that there was a great increase in the values on the 20th days of data gathering, implying that the treatments applied also showed influence in the growth of the Mustasa plant. Lastly, the table showed that the setup 03 (mixed treatment) consistently had the highest mean obtained until the last day of data gathering.

Furthermore, this aligns with the findings from a recent study by Smith, et al. (2020), which demonstrated that combining organic materials rich in different nutrients can lead to superior crop yields and improved soil health. Therefore, the statistical results of this study not only validate the effectiveness of vegetable scraps and tahong shells as individual fertilizers but also highlight the potential benefits of their combined use in sustainable agriculture practices.

	Fresh Weight	
	Mean	SD
01 Tahong Only	1.8000	.27386
02 Veg. Only	3.6222	.46845
03 Mixed	5.8333	.21213
04 Control	2.0667	.15811

Table 3. *Descriptive Measures of the Fresh Weight Between 4 Different Setups*

Table 3 shows the mean fresh weight in grams of Mustasa grown with 4 different setups. As per the table, the Mustasa grown with the combination of tahong shells and vegetable scraps (Setup 3) had a higher mean fresh weight (5.8333) as compared to those grown in other setups.

The figures and tables shown above was further supported by the study of Jonsson, et al. (2013), that effectiveness of mussel shells is reduced when the organic fertilizer obtained has the presence of shell. The high $CaCO_3$ content of the shell will buffer the pH at a level closer to 8.0, making pH control difficult. Additionally, while the levels of N and P are similar to those found in a commercial fertilizer, the lack of K content represents a limitation, which can be mitigated by mixing with other organic waste, which in this particular study, the mussel shells were mixed with vegetable scraps and had the most significant yields in terms of the plant height, leave's width, and fresh weight of the Mustasa plant.

Test of Difference Between the Setups Over Time as to Leaves' Width

The researchers utilized two-way ANOVA to determine if there was a significant difference between the setups over time, as to leaves' width. This statistical tool was used since the researchers aimed to find if there was a significant difference between the individual groups or setups with regards to the different treatment applied and the experiment was observed. Lastly, the level of significance used was at a=0.01.

Table 4. *Two-way ANOVA of the Leaves Width Between 4 Different Setups Over Time*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
TYPE	77.911	3	25.970	680.567**	< .001
TIME	772.765	3	257.588	6750.269**	< .001
TYPE * TIME	37.125	9	4.125	108.097**	< .001
Error	4.884	128	.038		
Total	4055.810	144			
Corrected Total	892.685	143			

Legend: * - Significant at a = 0.05; ** - Significant at a = 0.01

Utilizing a two-way ANOVA, the researchers conducted a comprehensive analysis with the help of a statistician, to assess the impact of different treatments and time intervals on the growth parameters of the Mustasa plant. The results revealed a significant difference in leaves' width among the samples, taking into account the various treatments and time points collectively.

Specifically, the leaves' width exhibited a p-value of less than 0.0001, surpassing the predetermined level of significance set at α=0.01. Consequently, the researchers confidently rejected the hypothesis, concluding that the treatments applied across different setups exerted a discernible effect on the growth of the Mustasa plant over time.

In further exploring the data through post-hoc analysis, the researchers aimed to discern which treatment yielded the most favorable outcomes in terms of leaves' width over time. This revealed that the setup incorporating both tahong shells and vegetable scraps, consistently outperformed other setups. This finding aligns with the study by Abaidoo, et al. (2023), which demonstrated the synergistic effects of combining organic materials in promoting plant growth and soil fertility. Specifically, the rich nutrient profile of tahong shells, coupled with the organic matter and micronutrients present in vegetable scraps, appears to provide an optimal environment for Mustasa plant growth.

Test of Difference Between the Setups Over Time as to Plant Height

In the same way, the researchers utilized two-way ANOVA to determine if there was a significant difference between the setups over time, as to plant height. This statistical tool was used since the researchers aimed to find if there was a significant difference between the individual groups or setups with regards to the different treatment applied and the experiment was observed. The level of significance used was still at a=0.01.

Table 5. *Two-way ANOVA of the Plant Height Between 4 Different Setups Over Time*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
TYPE	18.755	3	6.252	383.898**	< .001
TIME	198.806	3	66.269	4069.379**	< .001
TYPE * TIME	29.527	9	3.281	201.461**	< .001
Error	2.084	128	.016		
Total	634.640	144			
Corrected Total	249.172	143			

Legend: * - Significant at a = 0.05; ** - Significant at a = 0.01

Also using Two-way ANOVA, the researchers were able to determine that there is a significant difference between the plant height and leaves width of the samples based on the different setup or treatment and time altogether. Both the plant height and leaves width have the p-value < 0.0001 which is less than the level of significance set at a=0.01, therefore, the researchers were able to reject the hypothesis. The researchers were then able to conclude that the treatment applied on the different setups were able to influence the growing Mustasa plant, in terms of its plant height.

Moreover, vegetable scraps or waste are found out to be better fertilizers, since it contains important nutritional profiles for plant growth, in the study of Al Obaid, et al. (2024); they arrived at this conclusion since the influence of vegetable scraps as organic fertilizer was more significant than the control soil without fertilizer in their study.

This is also similar to this study, where the setup with vegetable scraps only had a more significant influence in the plant as compared to the setup without any treatment applied and against the setup with tahong shells only. Also, the results of their study suggests that the sustainable approach can effectively convert vegetable waste into valuable organic fertilizer enriched with plant growth supporting the essential nutritional elements.

Test of Difference Between the Setups Over Time as to Fresh Weight

The researchers utilized one-way ANOVA to determine if there was a significant difference between the setups over time, as to fresh weight. This statistical tool was used since the researchers aimed to find if there was a significant difference between the individual groups or setups with regards to the different treatment applied and the experiment was observed. Lastly, the level of significance used was at a=0.01.

Table 6. *One-way ANOVA of the Fresh Weight Between 4 Different Setups*

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Between Groups	92.601	3	30.867	338.784**	.001
Within Groups	2.916	32	.091		
Total	249.172	143			

Legend: * - Significant at a = 0.05; ** - Significant at a = 0.01

Additionally, employing One-way ANOVA, the researchers investigated the impact of different treatments on the fresh weight of the samples observed over a period of 31 days. The analysis unveiled a significant disparity in fresh weight among the samples, with a calculated p-value of 0.001, falling below the predetermined significance level at α=0.01. This compelling result led to the rejection of the hypothesis formulated by the researchers at the onset of the study.

Moreover, conducting post-hoc analysis allowed the researchers to delve deeper into the observed differences among the setups. The analysis revealed significant discrepancies between each setup and every other setup, further affirming the distinct effects of the different applied treatments on the fresh weight of the samples.

Supporting this finding, a study by Ashouri, et al. (2022) conducted a similar investigation on the efficacy of organic fertilizers in promoting plant growth. The said research demonstrated that different organic amendments yield varying effects on lant biomass accumulation, highlighting the importance of selecting appropriate fertilization strategies for optimizing crop yields. In congruence with this study, the findings of Johnson, et al. (2023), reinforce the significance of utilizing statistical analyses, such as ANOVA and post-hoc tests, to discern meaningful differences in experimental outcomes and draw robust conclusions.

Conclusions

In the pursuit of understanding the efficacy of various treatments on the growth of Mustasa, this study examined key parameters including leaves' width, plant height, and fresh weight. Through rigorous statistical analysis conducted over the span or one (1) month, the researchers aimed to discover the nuanced impacts of these treatments on Mustasa's growth dynamics. The researchers were able to unveil not only the quantitative outcomes but also the qualitative implications that underscore the potential for sustainable agricultural practices in enhancing crop productivity while reducing dependency on costly fertilizers.

With the data gathered and data statistically analyzed, the researchers therefore concluded that there is a significant difference in the effectivity between the various organic fertilizer utilized in the three (3) setups 01, 02, 03, in the growth of the Mustasa plant after 31 days in terms of leaves width, plant height, and fresh weight at 0.01 level of significance.

Furthermore, there is also a significant difference in the effectiveness between the setups with treatment applied and the control group in the growth of the Mustasa plant after 31 days in terms of leaves width, plant height, and fresh weight at 0.01 level of significance.

In summary, there is a significant difference in the growth quality (in terms of leaves width, plant height, and fresh weight) of the Mustasa plant after the 31-days experiment. Therefore, the hypothesis is not supported or rejected by the researchers.

Recommendations

The following are suggestions that may strengthen the claim of this study in improving the growth quality of the Mustasa plant (and other crops): To the Farmers, the researchers would like to implore to farmers to utilize organic fertilizers that are abundantly available in households and local wet market, resulting in having an access to a cost-effective farming input. Furthermore, farmers can modify the concentrations of the used organic fertilizers or even try combinations of different organic fertilizers.

To the Local Government, they could make the necessary action by establishing a program that could educate the farmers to expand their knowledge regarding the effectivity, safety, eco-friendly, and cost-effective use of organic fertilizers through the proper utilization of industrial and domestic wastes like tahong shells and vegetable scraps. The local government should promote the advantage of using organic fertilizer both for humans and the environment, alike.

To the Future Researcher(s), the researchers would like to recommend for the set of people to consider the different concentrations of tahong shells and vegetable scraps per setup or test for better formulation of mixed fertilizers used in the study. Also, consider the NPK content of the used organic fertilizer (tahong shells and vegetable scraps) via undergoing laboratory testing to identify how many necessary nutrients the organic fertilizer has. In addition, the field experiment should be extended for up to forty (40) days instead of 31 days since the Mustasa plant was not yet that matured on the day of harvest. It is also advisable to choose another plant that fits the season for the testing of the developed organic fertilizer to further have the optimum results and avoid the drying of the leafy plant. Furthermore, the future researchers can try to utilize other vegetable scraps and organic shells found in abundance in households and local wet markets, as an alternative in formulating the organic fertilizer.

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