The Effect of Mango Peel on the Growth of Okra (*Abelmoschus esculentus*)

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Abstract: Fertilizers are substances containing nitrogen, phosphorus, and potassium. They supply nutrients to the soil to improve plant growth and plant productivity. While they may have helped the agriculture sector better their crops, recent studies suggest that common fertilizers adversely affect the environment and human health. Aside from common fertilizers, fruit peels, such as mango peels, also pollute the environment since their accumulation leads to waste disposal issues. To alleviate these issues, researchers proposed the utilization of fruit peels as fertilizers. In this study, mango peels were utilized as fertilizers to identify their effects on the growth of the okra plants by measuring the plant height and comparing the number of leaves. Five (5) pots with two okra seeds were assigned specified amounts of mango peels: 0 g, 1 g, 3 g, 5 g, and 7 g. Plant height and number of leaves were measured every two weeks for two months. The results suggest that varying amounts of applied mango peels affect the growth rate of okra, with 7 g yielding both the highest plant height and highest number of leaves. The results can be attributed to the nutrients of the mango peels, such as potassium and phosphorus, which are included in the three primary nutrients found in common fertilizers.

Key Words: mango peels; okra; fertilizer; plant height; number of leaves

1. INTRODUCTION

Fertilizers are organic or chemical products that supply the soil nutrients, primarily nitrogen, phosphorus, and potassium, to improve plant growth and plant productivity (Morari et al., 2011; Jariwala & Syed, 2016). For some time, organic fertilizers have been the primary source of nutrients for plants since these have helped the agriculture sector improve their soil and crop growth (Morari et al., 2011).

Despite its benefits for soil management and plant growth, studies have found significant adverse effects on the environment and human health, ranging from water or air pollution, crop contamination to food borne illnesses (Morari et al., 2011). In response, researchers have sought alternative sources of nutrients aside from the common fertilizers, one of them being the utilization of agro-wastes, such as fruit peels. Previous studies by Halpatrao et al. (2019) and Jariwala and Syed (2016) confirmed that fruit peel fertilizers are suitable as soil fertilizers after analyzing the peels' pH level and nutrients.

However, there is still a lack of study regarding the utilization of mango agro-waste as fertilizers. Mangoes are among the most globally advertised fruits, with their global production increasing to 50.65 million metric tons of mangoes in 2017 (Statista, 2020). Their wastes were found to be abundant in potassium, phosphorus, and calcium, with the first two being part of the three primary nutrients found in common fertilizers, implying the mango peels could potentially be utilized as fertilizers (Nijiru et al., 2014; The Fertilizer Institute, 2016).

This study focused on utilizing mango peels as fertilizer and an alternative to common fertilizers by determining whether it is effective on okra. Okra plants were used since they grow and germinate fast, making them suitable for observing the effects of fertilizer for a short time. Okra takes 6 to 18 days to germinate and 2 to 3 months for it to mature (Luttjohann, 2017; Masabini, n.d.; Seed Savers Exchange, n.d.). During the experiment, medium-sized chopped carabao mango peels were used and introduced onto the soil of the okra plants in specified amounts for each pot. The plant height and number of leaves of the plants were measured and counted, respectively, then evaluated whether varying amounts of mango peels affect the growth of the okra plants. The effects of mango peels and common fertilizers were not compared.

2. METHODOLOGY

2.1 Materials

The variant of mango used for the study was the Philippine mango, otherwise known as the

Carabao mango since it is the most produced mango variant in the Philippines (Philippine Statistics Authority, 2021). Next, the five pots used were approximately 12" in height and 12" in diameter. Okra (*Abelmoschus esculentus)* seeds were also used since okra can grow in season all year round (Bureau of Plant Industry, 2020).

2.2 Mango Peel Application

Two researchers were assigned to the experiment. Each researcher gathered all the needed materials for the first week: Five pots, okra seeds, and mango peels. Once the materials were complete, two okra seeds were planted in each pot. These seeds were given one to two weeks to germinate before proceeding to the mango peel application.

The researchers were assigned to plant two okra seeds and apply 0 g, 1 g, 3 g, 5 g, and 7 g of mango peels in each pot. The pots were labeled as follows in Table 1. The MPs in the code stand for mango peels, while the numbers stand for the number of mango peels applied in grams.

Table 1. *Labels for the number of mango peels applied to each pot*

Code	Amount of Mango Peels (g)
MP0	0
MP1	1
MP3	3
MP5	5
MP7	7

After the plant germinated, the mango peels were placed onto the soil of each plant according to the amount designated per pot every two weeks until the last data collection. The plant height was measured and recorded in centimeters to observe plant growth. Aside from plant height, the number of leaves attached to the plant was also recorded. The researchers also met every two weeks for two months to discuss and gather all the collected data until the last week of observation. Then, the data were analyzed and compared using various analysis strategies.

2.3 Research Design

An experimental type of research was conducted, which allowed the researchers to observe the effect of varying amounts of mango peels on the plant. The setup consisted of five pots, with each having two seeds of okra plants. Each pot was labeled as follows: MP0, MP1, MP3, MP5, and MP7. Furthermore, the researchers had 14 weeks to conduct the experiment, observe the plants, and collect primary data centered on plant height changes and the number of leaves. After gathering the data every two weeks for two months, the researchers set meetings to analyze the data that they have collected.

2.4 Data Analysis Strategy

First, the researchers observed the effects of the mango peels on plant growth by analyzing and comparing the plant height and number of leaves data per pot. The collected data from the experiment was organized and kept on a log to ensure ease in data classification and data analysis. The plant's growth was presented on a bar graph to show the differences between the height of the plants each time it was recorded every two weeks for two months. Lastly, error bars were used to identify the uncertainties and the variability of the data gathered.

3. RESULTS AND DISCUSSION

3.1 Number of Leaves

The number of leaves that were attached to the plant was counted, while those that were unhealthy or wilted but attached were not. The following bar graph shows the recorded average number of leaves per gram from January and March.

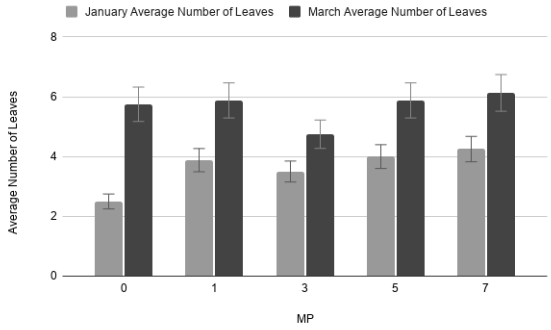

Figure 1 *Average Number of Leaves Per MP*

MP7 had the highest average number of leaves for both January and March, which is consistent with the study by Wazir et al. (2018), in which they observed from their research that the fruit peel fertilizer yielded the most significant number of pea leaves, with a mean average of 79.00, as compared to the controlled setup, which had a mean average of 55.00. On the other hand, MP0 yielded the lowest for January while MP3 for March. The results may be associated with the phosphorus and potassium content of mango peels. Both enhance plant growth by improving the photosynthesis rate through an increased adenosine triphosphate production in the plants (Conway et al., 2003; Kirschbaum, 2010; Kaisler & Rosen, 2021). According to the findings of Xu et al. (2020), using fertilizers with high

concentrations of nitrogen, phosphorus, and potassium yields the highest number of leaves per plant as compared to the other fertilizer treatment. This would explain why the setups with the least amount of mango peels applied yielded the least number of leaves since they had less to no added nutrients from the fertilizer to absorb and promote their plant growth. Aside from that, the aphid infestation during the first data gathering in March may have also contributed to the significantly low yield of MP3 in the same month. According to Sorensen (2009), aphids can hinder nutrient absorption by feeding on plant sap.

3.2 Plant height

The plant height measurement was used as an indicator of its growth rate. The recorded plant height from each MPs from both the researchers was averaged and plotted into a bar graph to observe the effect of different mango peel concentrations on the growth rate of the okra plants. Below is the bar graph for the average okra plant height with varying amounts of mango peel applied.

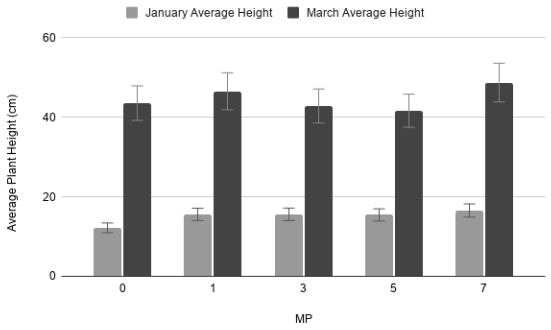

Figure 2. *Average Plant Height Per MP*

For both January and March, MP7 had the highest average height while MP0, the controlled variable, had the lowest for January and MP5 for March. For MP5, its short average plant height may have been caused by the aphid infestation that affected one of the MP3 and MP5 setups during the first data gathering in March. According to Sorensen (2009), aphids can remove plant nutrients, which may have caused a decrease in the growth rate of MP5. On the other hand, the high potassium and phosphorus content in mango peels may have contributed to the highest average height of MP7 for January and March (Nijiru et al., 2014; The Fertilizer Institute, 2016). Both potassium and phosphorus enhance the rate of photosynthesis by increasing the production of adenosine triphosphate within the plants, consequently improving their growth rate (Conway et al., 2003; Kirschbaum, 2010; Kaisler & Rosen, 2021). In addition, the results are also consistent with the findings of Mercy et al. (2014), in which the plant height of the fenugreek with fruit peel power applied to the soil was higher than the one without. Furthermore, Halpatrao et al. (2019) also support the result, as they have found that fruit peels increase the plant height and shoot length of the monggo plant.

4. CONCLUSIONS

The study results showed that varying amounts of mango peels affect the growth of the okra and that mango peels can be an effective alternative to common fertilizers for okra plants. In terms of the best amount of mango peel fertilizers to apply, the results suggest that MP7 is the most effective for the growth of the okra, seeing that MP7 was the only setup to yield the highest plant height and number of leaves consistently. The results can be attributed to the nutrients of the mango peels, such as the presence of potassium and phosphorus, which are included in the three primary nutrients of common fertilizers (Nijiru et al., 2014; The Fertilizer Institute, 2016). On the other hand, MP3 was with the lowest plant height and number of leaves, primarily due to the aphids damaging the plants and disrupting nutrient absorption.

Future researchers are recommended to analyze the leaf areas and to test the mango peel fertilizers on other plants for further studies. Additionally, it is also recommFuturement in one specific location so that the results would be precise.

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