



## Effect of Different Amounts of Volcanic Ash from the Taal Volcano Eruption to the Growth of *Ocimum basilicum* (Basil)

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**Abstract:** Volcanic eruptions have a tremendous impact on an area that often leads to the destruction of the environment, human injuries, and even death. However, this research emphasizes one specific outcome unique to volcanic eruptions. The study aims to shed light upon the beneficial applications of volcanic ash to determine whether or not volcanic ash has advantageous botanical properties that could potentially enhance the growth of *Ocimum basilicum* (basil). In 8 weeks, four different concentrations (VA-0, VA-0.5, VA-1, and VA-2) of volcanic ash-loam soil composition were tested on basil plants. Three parameters were utilized to measure the plant's growth: plant height, leaf count, and leaf surface area. Pot VA-1 achieved the highest plant height and leaf count increase among the four concentrations. As for the leaf surface area, VA-1 and VA-2 both yielded the highest growth from week 1 to week 8. Results support a beneficial relationship between volcanic ash and acid-loving plants.

**Key Words:** volcanic ash; basil; concentration; growth; acid-loving plants

### 1. INTRODUCTION

Every so often, volcanic activity occurs. Mt. Pinatubo, known for its global scale effect, has affected and devastated thousands of humans and other species, such as plants. Volcanic eruptions have a tremendous impact on an area that often leads to the destruction of the environment, human injuries, and even death. However, this research emphasizes one specific outcome unique to volcanic eruptions. Ash clouds will cover the atmosphere, leading to an abundant amount of volcanic ash everywhere when a volcanic eruption occurs. Depending on the magnitude of the explosion, its range or eruption radius may vary drastically. However, volcanic ash is commonly depicted as a terrible substance for the environment. Since it is heavy and acts as a sun-resistant layer over plants, it strongly hinders photosynthetic activities and transpiration from commencing.

In the field of botany, ash could potentially have effects that could change the way people grow plants and vegetables. With a composition of high sulfur levels, integrating ash into the soil could prove beneficial to acid-loving plants. According to the Natural Resources Conservation Service (NRCS), acid-loving plants prefer pH soil levels of 6.5 and below. Due to the ash's elevated sulfur levels and low pH levels, non-acidic plants may not survive. In contrast, acid-loving plants may thrive from their low pH nature. Acid-loving fruits grow more efficiently on soils with a pH level of 4.0 to 5.0. In contrast, some acid-loving vegetables will prefer a pH soil level of 4.5 to 5.5. In addition to this, soils following a volcanic eruption yield the most fertile and productive soil

(Fiantis et al., 2019). Individual plants grown in such soils could thrive and develop into healthy, high-yield plants.

Along with a volcanic eruption comes the adverse effects such as the destruction of acres of land, bodies of water engulfed by ash, thousands of crops perishing, and hundreds of homes rendered uninhabitable, to name a few. The aftermath of such events led to stockpiles of ash left on the streets. The problem is that all that ash was rendered useless by disposing of it rather than looking for ways to make use of its unique composition. As of today, volcanic ash is an excellent material for the structural integrity of bricks compared to cement usage (Salamah & Maryudi, 2016). Volcanic ash could potentially open many doors to new developments in different areas. With the utilization of the excess volcanic ash, the growth of acid-loving plants could improve. As studies have shown, the composition of volcanic ash leads to its high acidic nature. This brings the research to its hypothesis: volcanic ash aids in making the soil acidic to benefit the growth of acidic-loving plants.

The primary goal of the study is to undergo a substantial experimentation process to prove that unfiltered volcanic ash has botanic advantages. This study focused on plant development through natural means; hypothesized results could pave the way for future researchers to perform their trials with variables unique to their experiment. To achieve the projected outcome of this research, the researchers' general objective in conducting this study is to determine the effect of utilizing volcanic ash on basil's growth.



The findings of the study can be used as supporting evidence towards volcanic ash's overall knowledge, a resource regarded as pollution. This will be benefiting the agricultural sector as this could be used as an excellent addition to loam soil when growing acid-loving plants. This innovative, costless, and inventive soil composition with volcanic ash could drastically reduce the expenses of those looking to grow acidic-loving plants when choosing an efficient soil composition. Furthermore, this provides a framework for further studies regarding volcanic ash's feasibility as soil, making this particular soil composition evidence-based. If the research is successful, the addition of volcanic ash will prove an effective way to maximize available resources, making volcanic ash a more sought-after product when growing acid-loving plants. The effects of the volcanic ash from the Taal Volcano eruption are to be tested. However, because of the method of gathering the volcanic ash, it may not be considered pure. The height difference was determined using an initial and final measurement for each setup containing different volcanic ash concentrations. It could signify a change in development in the plant. The researchers only used four different concentrations of volcanic ash which includes a blank setup that serves as the control (0% volcanic ash), a 25% volcanic ash concentration composition, a 50% volcanic ash concentration composition, and a pure (100%) volcanic ash composition. Each of the concentrations yielded a certain pH level that was attained through averaging all the readings from time 0 to week 8. The pH levels are the following: 8.0 for VA-0, 6.5 for VA-0.5, 6.1 for VA-1, and 6.0 for VA-2. To ensure a pure reaction between the loam-volcanic ash soil composition, the researchers chose to avoid using chemicals such as aftermarket fertilizers and pesticides.

## 2. METHODOLOGY

Table 1. Materials Used

Qty.	Item	Description	Price (P)
16	Pot	16 identical pots measuring D.11in, H.9in.	P960
16	Basil seedlings	X weeks old seedlings	P1,120
14 kg	Volcanic ash	Volcanic ash was harvested during the Taal eruption and different amounts (g) will be used in 2/4 setups.	P0
80 kg	Loam	Each member gets 10 kg of loam. Loam will be used because it is the most basic form of garden soil	P560
4	Jollic pH indicator	Each member will receive identical pH level indicators for measurement of soil acidity with their respective trials.	P976
1	Escali gram scale Model: Pana#V136	To be used for mass concentration calculations to be done by one member.	P0
4	Anti-pest plant netting	To minimize or eradicate pest infestations, net usage will protect the plant.	P766
4	Ruler	To measure the growth height of the plant in centimeters	P0
<b>Total:</b>			<b>P4,382</b>

The research design formulates three different parameters that manifest plant growth. With the gathered data from 8 weeks of experimentation, each trial in each parameter has changed between the initial and the preceding week. The increasing parameters may help the amount of sunlight the plants receive hence providing more glucose or food for the plant to grow. Each pot gaining varying results on different parameters shows that each parameter benefits from the volcanic ash concentration.

There are sixteen pots in total. Since there are four members in the group, each member received and tended to 4 pots throughout the experimentation period. The pot was filled up to a certain point with the soil used (loam) to determine how much soil the pot can hold in grams, and once filled, the soil's weight was recorded. Each pot contained a different volcanic ash and soil concentration, while similar basil plants were planted in each pot. To meet the optimal pH level that basil thrives in (5.5-6.5 pH), every member of the research group was tasked to measure the loam soil's pH level in all of the assigned pots, respectively. Weight per weight percentage allowed the researchers to express the concentration of the solution. As for how the measurements were taken for the three parameters, namely plant height, leaf count, and leaf surface area, tools such as a ruler and ImageJ software were utilized to gather the data needed over eight weeks effectively. However, only the plant height and leaf count were recorded for eight consecutive weeks. The data taken for the leaf surface area was only an initial and final measurement, time zero and week eight, respectively.

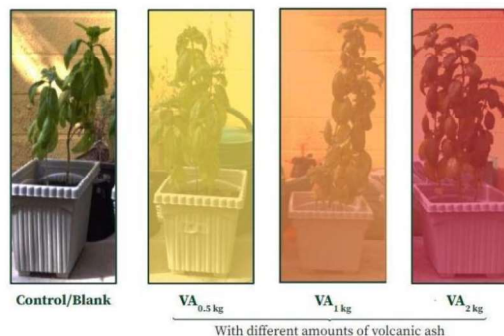


Figure 1. Research Design Showing Three Different Parameters per Trial

## 3. RESULTS AND DISCUSSION

As the researchers observed, the plant height had an average increase of 2 cm per week for VA-0, 1.9 cm per week for VA-0.5, 2.8 cm per week for VA-1, and 2.5 cm per week for VA-2. The average increase of the height of the plant was taken through finding the slope yielded by the trendline of each graph (Fig. 3.0-3.3). From this data that the members have gathered,



it can be concluded that VA-1 has the highest average increase which is 2.8cm per week. For leaf count (Fig. 5), it is shown in the graph that VA-0 has a continuous increase of leaves as weeks pass by. For VA-0.5 it reached its peak on week 5 and plateaued shortly after. VA-1 had a constant number of leaves within week 2 to week 5 and showed a sudden significant increase in number of leaves. Throughout eight weeks, the number of leaves of VA-2 shows an inconsistent increase and decrease in the number of leaves. The researchers took pictures of the basil leaves and used ImageJ to measure, analyze, and process the images to gain more accurate results. With this application, we were able to measure the area and compare the initial leaf area to week 8 area to know how much it has increased and to determine which pot has the highest area value. Starting from the pot which has the lowest average surface leaf area, VA-0.5 with 13.76 cm<sup>2</sup>, VA-0 with 17.95 cm<sup>2</sup>, VA-2 with an area of 22.71 cm<sup>2</sup>, and the pot with the highest leaf area, was VA-1 with an area of 24.93 cm<sup>2</sup>.

### 3.1 Plant Height

For the first week, there was a sudden increase in height for all trials with a  $\Delta T$  range of 6-8 cm. It was hypothesized that the sudden increase might be natural plant growth since the initial height (time 0) was based on seedlings, or newly germinated seeds. Pot VA-1 averaged 2.8 cm of growth per week. Being the highest out of all four concentrations, pot VA-2 came in second with an average growth per week of 2.5 cm. The experimentation period ended at week 8 with pot VA-1 being the tallest plant with an average height of 31.7 cm; which may prove the presence of a snowball effect on the height of the basil. The second tallest plant is VA-2; which could prove that a more concentrated amount of volcanic ash is potentially beneficial to the height of acidic plants. Adding to this, pot VA-0.5 resulted in having the lowest height with a total average height of 23.7 cm.

Table 3.3. Summary table of plant height

No	Sample	Linear Equation	R <sup>2</sup>	Growth Rate
1	VA-0	$y = 2.0050x + 11.496$	0.8120	2.0050
2	VA-0.5	$y = 1.9877x + 10.108$	0.8488	1.9877
3	VA-1	$y = 2.8562x + 10.302$	0.9113	2.8562
4	VA-2	$y = 02.5825x + 9.9958$	0.9477	2.5825

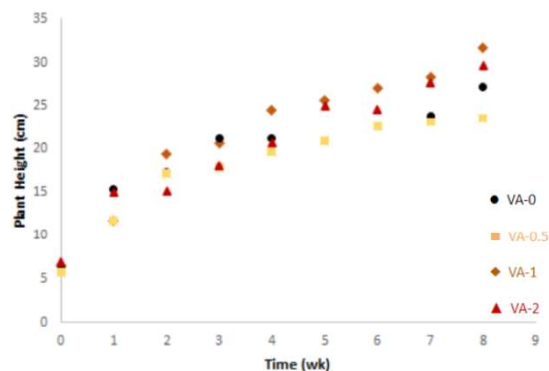
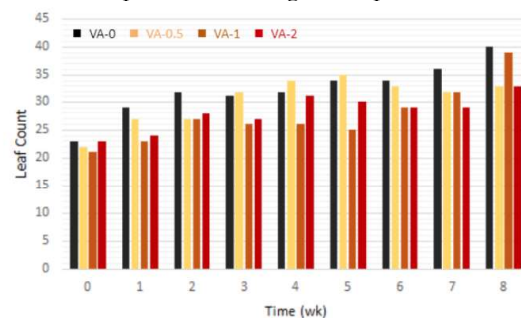


Figure 4.0. Combined Height of Basil Plants in a Span of Eight Weeks

### 3.2 Leaf Count

The basis behind including basil leaf count in the parameters is the concept of “more leaves means more sites for glucose production”. The pot that ended with the highest leaf count is VA-0 ; which had 40 leaves in average of all three trials. From week 0 to week 8, there was an increase of 17 leaves. The second plant with the highest leaf count is VA-1. It had 39 leaves in average of all three trials and had an increase of ~18 leaves from week 0 to week 8. Though VA-0 ended with the highest number of leaves, it had a lower increase of leaves from initial to final as compared to VA-1. As observed, VA-1 has the highest increase of leaf count with 18 leaves, with VA-0 being second to that. The researchers hypothesized that since VA-1 is the tallest, its height had an effect on the number of leaves increased since a higher plant height equates to more exposure to sunlight. This proves that leaf count is directly related to the plant height or the amount of exposure to sunlight the plant receives.



### 3.3 Leaf Surface Area

Similar to the leaf count, the size of the leaf plays a role in how much glucose could actually be produced by the plant; for the main goal of this research was to prove volcanic ash’s positive effects on basil’s growth. At time 0, VA-1 had the highest initial leaf surface area. It was able to maintain its lead ending with a highest final leaf surface area of 24.932 cm<sup>2</sup>. VA-1 also had the highest change in leaf surface



area out of all the pots. There is a small difference between the increase in surface area from week 0 to week 8 of VA-1 and VA-2 with both numbers rounding up to 16.5 cm<sup>2</sup>. With this, we are able to say that a higher concentration of volcanic ash in the soil composition will lead to a high leaf surface area increase as compared to VA-0 and VA-0.5.

#### 4. CONCLUSIONS

This research had the aim to shed light upon the beneficial applications of volcanic ash; which is determining whether or not volcanic ash has advantageous botanical properties that could potentially enhance the growth of *Ocimum basilicum* (basil). VA-1 benefitted the most from its concentration in terms of growth, the highest slope in leaf count increase, the highest plant height, and the biggest leaf surface area. With this, having a pH level of 6.1, VA-1 yields the best overall results. The results of this study indicate a positive relationship between a volcanic ash soil composition and the growth of acidic-loving plants. Specifically, 1kg of volcanic ash in loam soil has the biggest effect on the growth rate of *Ocimum basilicum* (Basil). Further studies can make use of different acidic-loving plants. This gives the research more space to justify the benefits of a volcanic ash composition on acidic-loving plants. Furthermore, a particular location to experiment in will benefit the results by providing uniform treatment to the plants. The gathering of ash could also be improved to achieve accurate conclusions about the correlation between acid-loving plants and the effects of volcanic ash.

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