Mani Arango

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ENVL 2400 – Stoler

Final Project Report

Introduction

Fertilizer is widely used in the agricultural system to enhance nutrients already present in soil and allow plants to use those nutrients. The use of chemical and organic fertilizer is widely beneficial and leads to increased growth and yield in crops (*Olaniyi & Ojetayo, 2011*). An increase in the abundance of nutrients available for plant uptake positively correlates with an increase in biomass and crop yield (*Salt, et al, 1998*). Farmers, gardeners, and botanists share a common goal: a high crop yield. Regardless of what is growing; the desired outcome is a yield of healthy and plentiful crops. The use of fertilizer is becoming increasingly controversial, and more people are looking into sustainable alternatives in their home gardens. Farmers and gardeners are more limited each day in how they can care for their crops. Finding alternative fertilization methods for sustainable home gardening and organic farming can help increase soil nutrients without sacrificing ecological integrity. Despite the importance of this, we know very little about how plants can obtain those nutrients from alternatives other than treated soil.

The snap pea (*Pisum sativum*) is a legume that grows in temperate areas, high elevations, or during cool seasons in warm areas and grow best in light, well-drained soil (*Pavek, 2012*). They tolerate low temperatures but grow best at around 55 to 64°F, which is also around the average temperature in New Jersey during early spring. Peas are well known for their abilities of nitrogen fixation, but they benefit from added nitrogen from fertilizers in low fertility soils (*Pavek, 2012*). It has also been found that increasing nitrogen fixation can lead to an increase in crop productivity and less need for nitrogen fertilizer (*Abi-Ghanem, et al. 2011*). Peas and other types of legumes are often used in intercropping practices due to their ability for nitrogen fixation and high crop yield (*Ullah, et al, 2007*). Given the widespread use of peas in home gardening and the potential importance in sustainable farming, it is important to better understand more sustainable practices of growing them.

My study explores the effects of water nutrient levels on plant growth. Specifically, I hypothesize that water with grain extract promotes plant growth more than water without grain extract. Given my hypothesis, I predict that pea plants grown using water with rice extract will be taller than those grown using distilled or tap water. To test my hypothesis, I conducted a study that used pea plants and three water treatment types to determine how added nutrients in water affect plant growth.

Methods

My experimental designs consisted of three treatments, including rice water, distilled water, and tap water. I replicated each treatment three times for a total of nine experimental units. Each

pot held three (3) seeds for a potential total of 27 plants to grow by the end of the experiment. I set them up on a table in three rows in a randomized block design to make sure there was one replicate of each treatment in each row. I placed mesh netting around and above the pots to keep out birds and squirrels. As the plants grew, I placed a wire rack around them so the vines of the plant could grow straight. I exposed the pots uniformly to sunlight, rain, heat, cold, and other noncontrolled environmental factors.

I watered the plants weekly using 200 mL of water per treatment. I measured plant height after nine weeks of growth and recorded those values. Each week, I prepared rice water by rinsing two cups of rice with equal parts water and retaining that water. After watering the plants, I left the plants in a sunny place to drain any excess water, then placed them back on their table until the following week. I watered the plants weekly regardless of any rainfall that occurred on or before the predetermined watering day. At the end of my experiment, I recorded the final height of my plants and determined the average rate of growth for each water treatment to perform my statistical analysis.

Results

I used a one-way analysis of variance with a randomized block design in RStudio to determine significance within my treatments. The block factor in my design was pots because each pot held three seeds, so these treatments were not individual.

I did not find a significant effect of water treatment on plant growth ($F = 0.2365$, among $df = 2$, within $df = 1$, $P = 0.7912$).

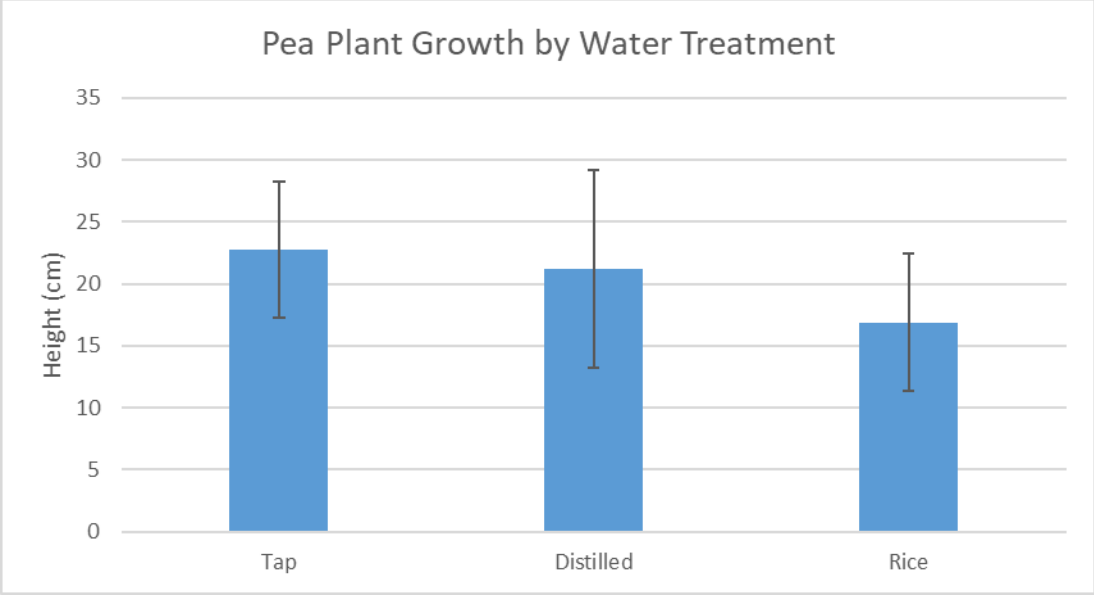

Figure 1: Average height (cm) of pea plants after a nine-week period by water treatment used. Error bars represent one standard error.

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Analysis of Variance Table

Response: Height
           Df Sum Sq Mean Sq F value Pr(>F)
Treatment   2  167.6   83.81  0.2365 0.7912
Pot         1   24.5   24.50  0.0691 0.7949
Residuals  23 8149.5  354.33
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Discussion

I did not find evidence to support my hypothesis that added nutrients in water significantly affect plant growth. My data fails to reject the null hypothesis that water treatment has no significant effect on plant growth. Pea plants grown using rice water grew less than plants treated with tap or distilled water. The greatest amount of growth after a nine-week period was recorded from the tap water treatment.

The results of this experiment could be explained by several factors. Although pea plants benefit from added nutrients in soil, too many nutrients might negatively affect pea pod growth (*Pavek, 2012*). Additionally, rice is typically known as a nutrient rich grain that acts as a staple in several countries and cultures. However, polished rice loses 75-90% of vitamins and micronutrients (*Steiger, et al, 2014*). As a result, commercially available rice does not contain as many micro and macro nutrients as unpolished rice. Therefore, it is entirely possible that the rice I used in my study did not have sufficient nutrients to provide a significant effect on plant growth.

Tap water also showed no significant difference compared to distilled water for plant growth. Neither of these water types were treated with any kind of nutrients so plants grown with them were expected to grow at about the same rate. An absence of added nutrients resulted in the absence of difference between tap and distilled water. I am interested in what would result from an experiment using water treated directly with minerals and nutrients. For instance, instead of using grain extract, I would like to see if other household extracts like beans, lentils, or eggshells could improve plant growth.

My results provide valuable information for farmers, gardeners, and botanists regarding finding ways to add more nutrients to their crops. Treating drinking water with grain extract does not add nutrients to soil and therefore cannot be used as a reliable source of nutrients for plants. Alternative methods of adding nutrients to soil must be sought including using fertilizer or implementing more sustainable farming practices that require fewer nutrient additions like intercropping. There is also the possibility that peas might not necessarily benefit from water-nutrients, but other crops will. An important aspect of sustainable fertilizing is ensuring that the nutrient to be used is compatible with the genetic and chemical makeup of a plant. If a species of crop is known to benefit greatly from calcium, adding eggshells to a fertilizer mix might increase the growth rate of the plant. Rotating crops every season and experimenting with different ways to add nutrients to the soil will end up promoting plant growth. Sustainability in farming and home gardening is a rising issue and requires attention. Alternatives to conventional fertilizer have become more common and important for communities as well as our ecosystem.

References

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