CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Alec T. Balabanis

Project Number
J1901

Project Title
Household Filtered Water and Plant Growth

Abstract

Objectives/Goals
To find out if using two types of filtered water (potassium softened water or reverse osmosis water) has an affect on seedling growth (height and weight) compared to city water.

Methods/Materials
3 groups of 31 pole bean seeds planted in the same organic soil and containers were watered with different water: potassium conditioned or softened water, reverse osmosis water and city tap water. Plant height measured at week 1 and week 2; wet weight measured at end (2 1/2) weeks. Average height and weight were taken for each group and compared.

Results
The results did not conclusively show that the filtered water had a significant affect on the growth. There was so much variability within the samples that the differences that appear to be there are not likely significant.

Conclusions/Discussion
While I thought that the filtered water might cause a the plants to have a lower average height and weight, it appears they did not. I thought using filtered water might be bad for plants, but these results show that at least for at least these 2 weeks, the plants will grow just fine with filtered water. However, to conclude this with more certainty that they would grow well over a period of time, I would need to make some experimental design changes and retest

Summary Statement
Measured Seedling height and weight (from 3 groups of 30 seeds each) when watered with potassium filtered water, reverse osmosis water compared to city tap and found no significant difference at end of 2 weeks.

Help Received
Belmont Nursery for help with seeds, soil and pots. Help from my parents with initial planting, daily plant care, and computer data analysis.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Rebecca D. Barnett

Project Number
J1902

Project Title
Aquaponics vs. Traditional Soil Farming

Abstract

Objectives/Goals
The main objective of this experiment was to compare the growth of lettuce and basil plants in an aquaponics system versus traditional soil based farming, without the use of any additional nutrients, fertilizers or supplements. Additionally, water usage was recorded to see which growing method would use the least amount of water.

Methods/Materials
An aquaponics growing system was constructed utilizing a 20 gallon plastic tub to contain the fish and a 56 quart plastic tray to grow the plants along with various pieces of pvc pipe, an aquarium pump, clay balls for a growing medium and water. The soil system was created with a 56 quart plastic tray with drain holes added and potting soil. Over a six week period I recorded the growth of 25 lettuce plants and 27 basil plants and recorded water usage within both the aquaponics and soil based growing systems.

Results
There was 960% more lettuce growth in the aquaponics system than in the traditional soil system. The aquaponics system produced 518 grams of lettuce compared to only 54 grams from the soil. The aquaponics system used on average 2.88 more cups of water per week. The aquaponics system used a total of 92.25 cups of water during the six weeks of testing. The soil tray used 75 cups of water. The basil did not have any significant growth in either tray and was not weighed.

Conclusions/Discussion
The first two sections of my hypothesis were correct since the lettuce in the aquaponics system clearly outgrew the lettuce in the soil and the lettuce significantly outgrew the basil in the aquaponics system. The aquaponics system produced almost 10 times more lettuce than did the traditional soil based system. I believe this large difference in growth is directly attributed to a greater amount of available nitrogen produced in the aquaponics system than that in soil. Basil growth was limited in both systems and I believe this was because the ambient air temperature in my garage averaged around 52 degrees. From my research I found that basil requires warmer temperatures than lettuce. The last part of my hypothesis did not turn out to be correct since the aquaponics system used more water than the soil system. I think this was due to the water being used up by the lettuce plants. During my research I found that lettuce is made up of almost 95% water. Plus the lettuce leaves in the aquaponics system were much bigger and would cause greater evaporation to take place.

Summary Statement
I compared the growth rates of plants grown in an aquaponics system versus a soil based system without using harmful fertilizers or chemical additives, and determined the aquaponics system was much more effective in producing plant growth.

Help Received

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Alexa G. Brent

Project Number
J1903

Project Title
A Comparison of Arugula Growth between Aquaponics and Soil

Abstract

Objectives/Goals
The objective of this study is to compare the difference in height between arugula grown using a traditional soil system and an aquaponic system.

Methods/Materials
2 plastic containers, potting soil, aquarium gravel, fish tank, 3 Comet Goldfish, water pump/appropriate tubing, arugula seeds. Used the water pump,gravel, fish tank, and one plastic container to create an aquaponic system employing a draining and pumping method. Used one plastic container and potting soil, watered regularly, to create a traditional soil system.

Results
The arugula grown in the soil system grew taller than the arugula in the aquaponic system. When plants in both systems had sprouted and surpassed 5 centimeters in height, the plants in the aquaponic system were 0.2 centimeters taller, but the tallest plant of the soil system then grew to be at most 0.5 centimeters taller.

Conclusions/Discussion
Although certain environmental factors could have impacted the results of the experiment unfavorably, the plants did grow taller in the soil system as opposed to the aquaponic system.This means commercial farmers would supposedly produce larger crops by using their current soil method.

Summary Statement
I found that a traditional soil method produces taller arugula plants than an aquaponics system.

Help Received
None. I designed the systems, built them,and took measurements for the project myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kian Chakamian

Project Number
J1904

Project Title
Correlating Olive Quick Decline Syndrome Infections to the Presence of Sharpshooters

Abstract

Objectives/Goals
The idea for this project came when my parents, who own an olive tree business, were discussing a disease affecting their olive trees. I decided to test whether there was a correlation between the number of sharpshooter insects near an olive tree and how infected an olive tree might be with a disease called "Olive Quick Decline Syndrome". I attempted to find patterns of where concentrations of sharpshooters are located in San Diego North County. I predicted the correlation between the presence of sharpshooters and the magnitude of infection in an olive tree would be a log relationship. I also believed there would be greater numbers of sharpshooters in an area with more olive trees.

Methods/Materials
I used a ladder and traps to catch sharpshooters. I monitored 23 trees in North County San Diego. My methods included hanging traps at mid-height in the olive trees, recording locations of the olive trees, the magnitude of the infection (if any) on each tree, and counting how many sharpshooters I caught.

Results
In my experiment I performed two trials. The first trials encompassed 16 trees (Trees 1-16) and was of a duration of 4 weeks. Due to weather conditions, some traps were destroyed or damaged. I then began a second trial, adding 7 more trees for a total of 23 trees for the duration of Trial Two. The following results are from the 23 trees in Trial Two. According to my Grid Assessment, 35% of the test olive trees were fully healthy. Another 22% of the test olive trees were 13% infected. 4% of the olive trees were 25% infected while 22% of the test trees were 38% infected. Approximately 13% of the olive trees were 50% infected with Olive Quick Decline Syndrome.

Conclusions/Discussion
The results showed a strong correlation between the tree infection and the number of sharpshooters. The line of best fit appeared to be quadratic rather than a logarithmic function. There was a concentration of sharpshooters found on both costal and inland area olive trees, but not between the two regions. The results did not show that elevation or number of nearby olive trees correlated to concentrations of sharpshooters. This project suggests that using traps may help reduce the numbers of sharpshooters and possibly help combat the spread of Olive Quick Decline Syndrome. I am continuing to test trees and increase my sample size to try and strengthen my project.

Summary Statement
I tested olive trees for a pathogenic disease infecting olive trees and cutting global olive oil productions for a correlation between the disease and the presence of an insect which transmits the disease.

Help Received
Thanks to my parents who drove me to my sites over many hours. Thanks to Alfred Alyeshmerni answered many questions I had on the project. I would like to thank all the olive tree owners who allowed me to hang traps in their trees. Thanks to my science teacher for her guidance.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Ella Giguere

Project Number
J1905

Project Title
How Does Water Availability Affect Plant Health?

Abstract

Objectives/Goals
The goal of this project was to understand how changes in climate affect plant growth and health. Climate change influences the water cycle and water availability to grow plants. Water is an essential ingredient required for plant growth and development. Changes in water availability due to drought or prolonged rainfall has resulted in poor growth of tomato plants in my garden. It is unclear if water availability or biotic stress (exposure to pathogens) or both are the critical factors affecting the health of my tomato plants each season. This project used a controlled environment (greenhouse) to examine the impact of water and pathogens on plant health. Two questions were asked: 1) What are the optimal water conditions to grow tomato plants in a greenhouse? 2) How does water availability impact the susceptibility of tomato leaves to a common bacterial pathogen, Xanthomonas euvesicatoria? My hypothesis was: If tomato plants are grown in a saturated water environment, then they will grow the largest, but be more susceptible to bacterial infection.

Methods/Materials
To test this, tomato plants were grown in a greenhouse from seed in soil pots using three different watering conditions (dry, moist, and saturated). After six weeks, leaves were sprayed with a bacterial suspension and then leaf symptoms and bacterial titer were measured for ten days.

Results
Plants grown in saturated water conditions grew the tallest and had the largest leaves. After ten days of infection, two of the leaves from plants grown in saturated water conditions harbored high titers of bacteria; however, these data were not statistically significant when accounting for all leaves tested. Notably, leaf disease symptoms did not correlate with the number of bacteria in the leaves.

Conclusions/Discussion
These data indicate that tomato plants require a continuous supply of water under controlled temperature conditions for maximal plant growth. They also suggest that leaf symptom development depends on water availability and not bacterial titer, which was unexpected. Future experiments will investigate the plant factors that cause leaf symptoms and how water may influence them.

Summary Statement
I studied how water and bacterial infection affect tomato plant growth and development in a greenhouse environment.

Help Received
I designed and performed the experiments by myself. I received help for the bacterial growth assay from Dr. Jung-Gun Kim, my project mentor. He also reviewed my data calculations and discussed my findings. The project was done in Dr. Mudgett's laboratory in the Biology Department at Stanford University.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Nuria Alexandra S. Gordon

Project Number
J1906

Project Title
Does Aspirin Help Plants Grow?

Abstract

Objectives/Goals

Many gardeners dissolve Aspirin in the water they use to water their plants and are convinced it helps them grow. The reasoning is that plant produce small amounts of salicylic acid when stressed by insect attacks, plant disease or lack of water. The active ingredient in Aspirin is acetylsalicylic acid, originally made from salicylic acid, which reduces pain, fever and swelling. In plants, just like in mammals, salicylic acid helps them cope with stress and disease. By adding Aspirin to the water, gardeners are hoping to help their plants cope with problems and grow faster and stronger.

In this project, I tested the notion that putting aspirin in plant's water helps them to grow, and cope with disease and stress.

Methods/Materials

Materials:Flower pots (6 total), soil, seeds (radishes), Aspirin, water
Radishes were planted with the same materials under the same conditions (same pots, same kind of soil, same amount of soil, same seeds, same amount of seeds, same location). they were watered with the same amount of water each time; for three of the pots, the water contained Aspirin.
I started with 2 pots that were watered with plain water and two pots that were watered with Aspirin (2 Tablets/250 ml water). Later, I added, 2 more pots (one watered with plain water, one watered with Aspirin (1 tablet/250 ml). I recorded germination dates and growth.

Results

I made a batch of plants in which the radishes that had aspirin in them grew poorly, and far worse than the plants that were watered with plain water. I made a second batch, this time with half the aspirin in the aspirin water. This plant still grew worse than the plants watered with plain water, but there was a marked improvement with only half of the aspirin.

Conclusions/Discussion

I found out that aspirin harmed my plants. I did more research, and found out that the reason that the radishes did poorly with aspirin added to their water was because they produce more acetyl salicylic acid than most plants do, so giving them extra aspirin was like overdosing them.

Summary Statement

Aspirin does not help radishes, a plant that already has a high natural content of acetyl salicylic acid, which is Aspirin's active ingredient.

Help Received

I performed the experiment myself, but had help from my parents with setting it up. My advisor and my school science fair judges helped me review my presentation.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Ailish Kissane; Victoria LaFrance

Project Number
J1907

Project Title
Soapy Situation

Abstract

Objectives/Goals
The objective of this project is to use our experiment to show the possible effects that the pH, phosphate, and nitrate level in soaps may have in plants as soapy water is one of the largest forms of used water washed out into the bay. The goal is to raise awareness and have people understand why checking the ingredients in even soap is vital to ecosystem lives.

Methods/Materials
Pitcher, Measuring cups, Plastic cups, Soaps: Ajax, Generation, Gain Meyers, Palmolive, Dawn, Soil, Pea seeds, Ruler, Water.
Put 1 cup of dirt into a plastic container. Place a seed into the hole in the container. Divide containers into 6 groups of 12. Water each group of plants ¼ cup of water. Take one dish soap, water, pitcher, first set of plants ½ teaspoon and ¼ cup, measure ½ teaspoon of the first dish soap, and pour it into the pitcher with ¼ tablespoons of water. Water the plants. Measure the height of each plant in each set of twelve plants. Find average height.

Results
The plants watered with the Dawn dish soap grew the highest, with an average height of 30.58 cm. per month, although it did not do well appearance-wise, with shriveling
The plants watered with the Ajax dish soap had the most growth, with an average growth 8.2 cm. per month, doing the best appearance wise.
The plants watered with the Palmolive dish soap were the shortest, with an average height of 24.52 cm. per month. They also grew the least, with an average growth of -0.8 cm, due to shriveling.
The plants watered with the Gain dish soap were the only plants that didn't shrivel at any time during this experiment, with an average length of 24.5 cm. per month, and since the plants did not shrivel, only increased in growth.

Conclusions/Discussion
In the end, the plants watered with the Dawn dish soap grew the highest, meaning that positive results were achieved from this experiment, but others such as the plants watered with the Palmolive dish soap, were the shortest and had the least amount of total growth, which are negative attributes. This may be due to the ingredients in the soap, which inhibited the plant growth, or the fact that the Palmolive dish soap has a pH of about 9.4, which is too basic.

Summary Statement
This experiment observes the effects different soaps may have on plants based on phosphate, nitrate and pH levels to reflect possible effects on the environment.

Help Received
We recieved aid in sourcing and buying all of the materials needed from family. We conducted the experiment completely ourselves, but we did receive help in plotting our data from our science teacher.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Cameryn M. Hoeft

Project Number
J1908

Project Title
How Does HydroGel Affect the Mortality and Yield of Plants?

Abstract

Objectives/Goals
The objective was to test the effects soil additives have on plants.

Methods/Materials
6 tomato plants, 6 pots, fertilizer, HydroGel, grow lights, controlled environment, soil saturation meter. Monitor the effects that soil additives had on moisture level, plant health, and crop yield on tomato plants.

Results
The results of the experiment proved that the plants with the HydroGel and fertilizer retained water and had the most growth in simulated drought conditions.

Conclusions/Discussion
My conclusion is that both HydroGel and fertilizer should be used when growing crops.

Summary Statement
If I include HydroGel into the soil of a plant, the moisture retention and plant yield will increase.

Help Received
Parents helped with providing equipment, Scott Mecom (manager of Creasorb Industries-Stockosorb HydroGel) for providing the HydroGel beads

Name(s)
Justin Hou; Tasha Lera

Project Number
J1909

Project Title
The Growth of Basil in a Controlled Environment with Modulated Lighting Conditions

Abstract

Objectives/Goals
Incubator farming is an effective way to consistently grow plants year round in a controlled environment. However, the cost of lighting in an incubator is a big factor in the cost efficiency of an incubator farm. One way of reducing energy needs is to modulate light that is used to grow the plants. The objective of this experiment is to find the optimal light modulation for the growth of basil. The hypothesis is that the plants exposed to the 50% duty cycle light would sustain similar or less growth to the 100% duty cycle and the 75% duty cycle, but would still be superior to the 25% duty cycle. Moreover, the frequency of modulated lights should have an impact on the growth rate of basil plants as well.

Methods/Materials
The main materials used were LED growth lights, basil plants, a Raspberry Pi, an incubator, and a temperature/humidity sensor. Basil was chosen for our experiment because it grows best at room temperature and because it is a good proxy for semi-fragile, arable herbs. The plants were grown in four different incubators with four plants in each. Each of the four groups had a different modulation cycle, 25%, 50%, 75% and 100%. In our further research, we tested modulations at four frequencies at 0 (control sample, no modulation), 0.2, 1, and 5 hertz, all of which are at a 50% duty cycle. They were grown over three weeks and 12 hours on a day. A Raspberry Pi was used to regulate the light modulations, and a sensor was attached to the Raspberry Pi to measure the humidity and temperature in the incubator.

Results
By measuring the delta in weights of the plants, the total growth of the plants over a three week period was calculated. After comparing results, it was found that 50% modulation is optimal for plant growth with a total growth of 1.35 grams. The 25% light modulation had a total growth of 0.2 grams, while the 75% and 100% both had a total growth of 0.875 grams. It was also found that modulation frequency has an impact on the growth rate of basil plants.

Conclusions/Discussion
The experiment showed evidently that the optimal duty cycle needed to grow basil was 50%, which was discordant with our hypothesis of 100%. Moreover, the results uncover a novel approach to reducing the energy required to grow plants in a vertical farm. Further investigations of the effect of LED lights on plants in general is needed.

Summary Statement
The experiment tested for the optimal light modulation for growing basil plants, and it was found that the 50% duty cycle produced more total growth than the 25%, 75% and 100% modulations.

Help Received
We received advice from the CEO of a vertical farm, who recommended we use basil plants as the test subjects for the experiment.

Name(s)
Emily M. Huitt

Project Number
J1910

Project Title
The Fungal Effect: Investigating the Effects of Endomycorrhizea Fungi vs. Cow Manure on the Growth of Tomato Plants

Abstract

Objectives/Goals
My objective is to determine what effect the inoculation of endomycorrhizae fungi on tomato seedlings at the time of planting vs. tomato seedlings grown in cow manure has on both groups with overall growth, taste, drought tolerance, and sustainability of fresh market tomatoes. A bigger tomato plant with a bigger rootmass should grow a stronger plant, able to keep and extract more water and nutrients ultimately leading to increased tomato production.

Methods/Materials
Endomycorrhizae fungi were inoculated on one-eight pound of tomato seeds and seedling roots were dipped before planting. Control group of cow manure seeds were planted into mixture of cow manure and soil. Seeds were planted in pots in greenhouse with their treatments then seedlings planted outside in 2 groups of 10 rows each 200 plants per row. At 30, 70, and 90 days I measured tomato rootstalks girth and rootballs. At 8 weeks I limited water on half the rows of each treatment to observe the effect of drought tolerance. When the crop matured overall growth and production was determinted for each treatment.

Results
The results of this experiment showed by adding endomycorrhizae fungi at the time of planting seeds and dipping tomato roots before planting had better growth, were disease resistant, had no transplant shock. A stronger compact tomato plant was raised with expanded root system which could absorb more water during a drought year to sustain the plant and fruit. Mature mycorrhizal plants grew an average of 4 1/2 feet tall and produced 30 pounds of fruit per plant verses 18 pounds of fruit from cow manure control group. Cow manure plants were spindly,weak,had many diseases and couldn't sustain the fruit. After limiting water from drought rows for 2 weeks, I observed the inoculated rows had continued to grow,mature, and produce.

Conclusions/Discussion
My original hypothesis was right in that inoculating tomato seeds and seedlings at the time of planting with endomycorrhizae fungi increased the overall size of the plant, significantly increased crop production and greatly enhanced the plants ability to withstand water deprivation during plant development. Mycorrhizal tomatoes were juicer,disease free,took longer to ripen the plants were loaded with fruit.They produced tomatoes for 80 days verses manure group at 35 days, which wilted and turned yellow. Cow manure had much nitrogen which made plants grow spindly,didn't preserve the moisture.

Summary Statement
I tested the effects of endomycorrhizae fungi verses cow manure on tomato plants to see if fresh market tomato production could be increased and become more drought tolerant.

Help Received
My mother provided me with equipment and land to grow my tomato plants on.

Name(s)
Sina S. Kassayan

Project Number
J1911

Project Title
Light Bite: An Optical Measurement Method and Device to Determine the Ripeness of Fruits

Abstract

Objectives/Goals
The purpose of this project was to answer following questions:
1. How does a fruit become ripe?
2. What biochemical and physiological changes happen when a fruit ripens?
3. Can optical properties of fruits be used to measure the ripeness?
4. How can I use optical properties to create a method to measure ripeness?

Methods/Materials
My test method is based on measuring the ratio of transmittance and reflectance for red and white LEDs and try to correlate these optical measurements with taste and color of the banana.
Fixture: my fixture comprised of two light sources (Red & white) and two photodiodes (PD) to measure transmittance and reflectance.
Method: The test started with 8 bunches of bananas. For 6 days, I recorded the optical measurements, color and average taste for one banana from each group.
I calculated the ratio of red to white light measured at top PD; this is the transmittance ratio. I also calculated the ratio of red light to white light measured at bottom PD; this is reflectance ratio. Then I studied the correlation between these two measurements, taste and color.

Results
1. Very good correlation between the R/W transmittance ratio and the taste. (R = 0.803)
2. Good correlation between the red to white reflectance ratio and the taste. (R = 0.787)
3. Optical measurements changed over 6 days for all groups. This means that light interaction with banana changes as the fruit becomes ripper. The transmittance ratio of banana increases when it becomes ripper, which means ripe banana transmits more light.
4. Samples visually ripe but with poor taste were properly detected as not ripe by the optical method.

Conclusions/Discussion
In this project, it was hypothesized that a simplified optical method with the use of off-the-shelf visible light LED(s) and silicon photodiodes has the potential for optical, non-destructive evaluation of banana ripeness. After analyzing all the collected data, the results from using my very simple setup shows that it is possible to monitor the process of fruit ripening, in this case banana, using a non-destructive optical method. There was a clear correlation between the taste (sweetness) and optical measurements, which confirmed my hypothesis. This correlation was better than how color correlated with the taste.

Summary Statement
In this project I used fundamentals of optics and studied the interaction of visible light with fruits, to evaluate the ripeness of fruits.

Help Received
I conducted the experiment by myself. I got help in understanding the statistical analysis.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Benjamin M. Kiekhaefer

Project Number
J1912

Project Title
Does Coffee Affect Spinach Growth?

Abstract

Objectives/Goals
The objective of this study is to determine the effect of coffee on the growth of spinach.

Methods/Materials
Spinach seeds, planter pots, potting soil, plastic cover, graph paper, and a gram scale. Twenty spinach seeds were planted and half were watered with coffee and the other half with an equal quantity of tap water. Surface area and weight of each plant's leaves were measured and compared to an average of coffee and control groups after 55 days.

Results
The spinach plants fed coffee had no significant difference in size or weight on average ($p<0.05$)

Conclusions/Discussion
Coffee has no significant effect on spinach plant growth.

Summary Statement
Coffee does not have a significant effect on spinach plant growth.

Help Received
I designed the experiment myself, and my science teacher helped me to incorporate the scientific method into my project and my mentor teacher helped me edit my report.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Gianni T. Lombardi

Project Number
J1913

Project Title
Plants vs. Radiation

Abstract

Objectives/Goals
The objective of "Plants vs. Radiation', is to determine the effect of the suns's radiation on plant growth.

Methods/Materials
4 groups of 3 Basil Plants in 12 cardboard boxes measuring 27.94 cm x 38.10 cm. Group A acted as a control group, with white construction paper covering the inside of each control group box. Groups B and D were the Radiation affected groups (group B with black construction paper covering the inside of each B box and group D with a 6 watt solar panel on the back wall of the inside of each of the D boxes), and group C had aluminum foil covering the inside of each of the C boxes. I watered all the Basil plants equally 3 times a week for 3 weeks and measured the height of each plant on the same day every week. I also examined each Basil plant's leaves under a microscope. For the final portion of my experiment I measured the inside temperature of each Basil plant's box using a digital thermometer.

Results
My findings were that although Group A the control group grew to be the tallest, "38.83 cm" , Group B the black paper box had the most overall growth, "29.62 cm" , Group D the solar panel box grew moderately "28.78 cm" , and Group C the aluminum foil box became dehydrated and grew the least "27.74 cm"
Additionally after measuring each of the Basil Plant boxe's inside temperature, using a digital thermometer, Group A control group was the hottest followed by Group B the black paper box as the next hottest, followed by Group C the aluminum foil box as the 3rd hottest and lastley Group D the Solar panels box was the coolest.

Conclusions/Discussion
After exposing the Basil plants to the 4 conditions, (Group A White Control Group Box, Group B Black Paper Box, Group C Aluminum Foil Box, Group D Solar Panel Box) I have concluded that my hypothesis, that Group A would grow normally, that Group B and D would be unhealthy and Group C would be exposed to less radiation than usual, therefor prospering, was incorrect. As my results showed Group A, the control group grew the tallest, but Group B, the black paper box had the greatest growth increase over the 3 weeks, and the solar panels Group D were not an advantage. Interesting, Group A, the white control group box was the hottest. Therefor infrared radiation is not unhealthy for plants, and is in fact beneficial for faster growth.

Summary Statement
After measuring and viewing the height, leaf structure and infrared footprint of all 12 of my experimental Basil plants, I found that infrared radiation is beneficial to plant growth and overall heralth.

Help Received
my teacher was there to advise and answer questions as needed

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Anthony J. Matise

Project Number
J1914

Project Title
GMOs: Testing the Performance of GMO vs. Wild Type Soybean Seeds When Exposed to Various Levels of Weeds and RoundUp

Abstract

Objectives/Goals
The objective of my study is to determine if genetically modified (GMO) soybean seeds grow better than wild type seeds when exposed to various levels of weeds and RoundUp.

Methods/Materials
Soybean seeds (50 genetically modified and 50 wild type), grass/weed seeds, potting soil, 20 pots, 1 bottle of RoundUp, water. Created two sets of 10 environments with various levels of weeds and RoundUp, one for GMO seeds, the other for wild type. Observed and recorded the germination and stage of the seeds.

Results
In my experiment I tested GMO and wild type seeds and how well they grew when exposed to various levels of weeds and RoundUp. In the first round of experiments, 17.65% of the GMO seeds began to germinate, whereas 66.67% of the wild type seeds began to germinate. In the second round of experiments, 26.09% of the GMO seeds began to germinate, whereas 56.52% of the wild type seeds began to germinate.

Conclusions/Discussion
The wild type soybean seeds performed much better than the GMO seeds in my experiments. I believe this could be related to lower than optimal temperatures for the seeds to germinate. The experiment was conducted during the winter when overnight temperatures dropped below 60 degrees. In a future experiment, I would build a greenhouse that would constantly maintain the optimal temperature for germinating soybean seeds, 77 degrees.

Summary Statement
I discovered that wild type seeds can be more reliable than GMO seeds in certain environments and conditions.

Help Received
I designed, built and conducted the experiment by myself. My father observed the results with me and helped me understand the data.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Molly S. Menashe

Project Number
J1915

Project Title
Phototropism vs. Gravitropism

Abstract

Objectives/Goals
The objective of this experiment is to find which tropism will exhibit a more dominant effect on plants: Phototropism or Gravitropism. This information can be useful in developing more efficient methods of growing crops, which can be used to meet the rising demand on food and oxygen resources due to increasing world populations.

Methods/Materials
To set up the experiment, six basil plants were placed on their sides, with the stem perpendicular to and hanging off a shelf. The control group, three plants, had a light source above, (Group A), and the other three, (Group B), had the light source below. The plants' needs were tended to daily. Every day, recordings were taken of: the height of the plant, the length from base to bend, the length from bend to tip, the angle of the plant from the vertical plane, and the angle of the bend.

Results
The results show that Group A (light source above) had a percent change in growth of 4.496%, while Group B (light source below) had a percent change of 3.056%. Group A had an average angle from the vertical plane of 95.361º and an angle after the bend of 128.833º. Group B had an average of 134.722º from the vertical plane and 151.611º after the bend.

Conclusions/Discussion
Based upon the data, phototropism has a more dominant effect on plants than gravitropism because the plants grew both with and against gravity in order to grow towards the light.

Summary Statement
Phototropism exhibits a more dominant effect on plants than gravitropism.

Help Received
None

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Hayley N. Meyer

Project Number
J1916

Project Title
The Effect of Almond Byproducts on the Germination, Establishment, and Growth of Tall Fescue Grass Seed

Abstract

Objectives/Goals
My project's objective is to determine if almond byproducts can be used as an effective soil amendment. I studied the growth of tall fescue grass seed to determine if the addition of almond hulls, shells, and/or almond dust to the soil would improve the germination, establishment, and growth of the grass.

Methods/Materials
Three almond byproducts were used in my experiment: hulls, shells, and dust. For each growth sample, I planted the same amount of tall fescue grass seed into 3 cups of soil or 2 1/2 cup soil, 1/2 cup byproduct mixture. I conducted two separate trials of my experiment. The samples were placed under a grow light for 10 hours each day and watered the same amount at the same time. The germination date was recorded for each sample. Throughout the 8 week experiment, I measured and recorded the five tallest grass blades of each sample, as well as observed the overall health of each sample.
At the conclusion of my experiment, I wondered what would happen to the grass samples if I stopped watering them and removed them from the grow light. I began a supplemental experiment. On January 23rd I removed the grow light and stopped watering the growth samples. For the next 4 weeks, I observed the samples.

Results
The growth samples with the shells and dust had the fastest germination time of 5 days, compared to 6 days for the control sample. After 8 weeks of growth, the shell sample resulted in the greatest average growth with an average blade length of 18.37 centimeters. The second two almond byproduct samples also showed a greater average growth compared with the control sample. The hull sample's average blade length was 18.16 centimeters, and the dust sample's was 16.70 centimeters, while the control sample's average blade length was 16.56 centimeters at the end of the experiment.

Conclusions/Discussion
The use of almond byproducts as a soil amendment improved the germination, establishment, and growth of tall fescue grass. Compared to the control sample, the samples with almond byproducts resulted in a shorter germination period, increased grass blade length, and an overall healthier appearance.
For my supplemental experiment, after four weeks of no grow light or water, the samples with the hulls and dust showed impressive endurance, and were markedly healthier than the control sample. These byproduct samples were still thriving, whereas the control sample was almost completely dead.

Summary Statement
My project shows that the almond byproducts- hulls, shells, and dust- can be used as a soil amendment to improve the germination, establishment, and growth of tall fescue grass seed.

Help Received
My dad helped me obtain the almond byproduct samples, and my mom taught me how to use Excel for my result tables and graphs.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
David G. Mirrione

Project Number
J1917

Project Title
Artificial Light vs. Sunlight

Abstract

Objectives/Goals
Which light source will produce a healthier plant, the artificial LED light source or regular daylight?

Methods/Materials
I researched that for the days in February that I was growing my plants, that according to where I lived, I received 10 hours of daylight in Hollister, CA. So I programmed a timer to turn on my LED light source for 10 hours a day. I used catgrass and cilantro seeds to plant, because they would sprout in a weeks time. I placed both seeds in identical containers with identical amounts of seeds, identical growing mediums, watered them each 1/4 cup of water a day, at the same time of day, but placed one under the LED light source and one in a location that had access to full sun. I took pictures, and measured my plants everyday for 14 days, and recorded my findings into a Microsoft Excel spreadsheet.

Results
Surprisingly I discovered that the LED plants had a higher germination rate, and they grew taller, and faster than the plants grown in daylight.

Conclusions/Discussion
My hypothesis was wrong, I thought that the plants grown in sunlight would be reaching for the sunlight, and they would grow taller and faster. I discovered that the plants grown under the LED light grew taller and faster. I believe that possibly the weather, meaning cloudy weather, may have effected the plants grown in sunlight. I also noticed that the plants grown under the LED light did not suffer any effects of heat, because the LED light put out little to no heat. This is important because too much heat can damage a plant, and it can also evaporate the water that the plant should be absorbing.

Summary Statement
I found that plants grown under an LED light source produce a healthier plant, verses a plant grown in sunlight, as weather, excessive heat, and evaporation are not a factor in the LED grown plants.

Help Received
My science teacher approved my idea. I researched it, planted it, I did the experiment, typed it and put it together myself. I also created the Microsoft Excel spreadsheet myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Dovid M. Moskowitz

Project Number
J1918

Project Title
Red vs. Green Apples

Abstract

Objectives/Goals
The purpose of this project was to determine whether or not an unripened fruit can be ripened faster by apples when they are stored together. Another goal was to see if either green or red apples work best to ripen bananas.

Methods/Materials
Green and red apples, brown paper bags, grid, green bananas. In this test, green unripened bananas were stored in brown paper bags together with red or green apples. Also, there was another group where the bananas were not stored with anything. Percent of green, yellow and brown was measured over course of seven days.

Results
Green or red apples were stored with bananas and over a course of seven days the amounts of green, yellow and brown were counted. After 2 days, the bananas stored with green apples had twice as much yellow as the group stored with nothing, while the bananas stored with red apples had 1.5 times as much yellow as the group stored with nothing.

Conclusions/Discussion
After measuring the color of bananas after 0,2,5 and 7 days, the apples stored with green apples ripened the bananas double as fast as the control group, while the bananas with red apples ripened the banana 1.5 times as fast. It is concluded that apples have an effect on the ripening time of bananas and that green apples ripen fruit faster than red apples.

Summary Statement
After testing to see if apples have an effect on the ripening time of bananas, I found out that apples stored with bannas speed up the ripening process and green apples work best for this.

Help Received
Mr. Bessler helped editing the papers and coming up with the procedure, while I tested the fruit at home.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Shania S. Navarro

Project Number
J1919

Project Title
Which Method Is More Efficient for Plant Growth: Hydroponics or Soil?

Abstract

Objectives/Goals
The problem that is being addressed is that many people do not have the money to buy new vegetables every week, so by doing this project, it will help people know which method will be better to reproduce vegetables from table scraps. In addition, with droughts in different states, good soil can become dry and it will be hard to grow a plant in it. This project can help by figuring out which method is better to grow plants.

Methods/Materials
I used two main methods for my project, which was hydroponics and growing plants in soil. I also used five different vegetables, but I had to double the amount as I was using vegetables for both methods. Growing them in different methods would have affected how the plants turned out. I also put them outside for sunlight every day for a little photosynthesis to increase the growth of the plants. Recording their visual and physical appearance was also mandatory for my results as well as taking pictures of each plant every week.

Results
At the end of my 6 week timeline, I have concluded that neither method was superior to the other. Growing them hydroponically would cause them to grow faster and had greater plant growth, but they would deteriorate quicker due to overexposure to water. Growing them in soil would cause them to last longer, but they would not grow as quickly. Only when using both methods would you produce a fully efficient plant, able to reproduce.

Conclusions/Discussion
What I have concluded or accomplished is figuring out which methods of regrowing plants are more efficient for different plants. This will expand our knowledge of plants by what will happen when we use different methods with different plants. We can use new plants and methods to experiment a little more and help those who don't have the money or proper environment to grow or buy new vegetables every week. The importance of this project is to help those in need and learn new things along the way in science.

Summary Statement
My project is about testing which method of growing plants will produce a better plant of efficiency.

Help Received
I didn't receive any help from any labs, but I have received a lot of help from my teachers and parents. They have all improved my project to the greatest. My research I have learned has also helped me on this journey.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Kiera M. O'Callaghan

Project Number
J1920

Project Title
Cryopreservation: To Grow or Not to Grow?

Abstract

Objectives/Goals
This Science Project answered the question, "Does cryopreservation impact the rate at which seeds will germinate?" The objective of the project was to learn if a plant's growth rate would increase if it had been cryopreserved for a certain duration before it had been planted.

Methods/Materials
Materials: Marigold Seeds, 9 planter pots, soil, measuring spoons, and water. The 9 planter pots were supplied by a friend. Method: Froze seeds for varying durations of time and then planted them, observing which group of seeds sprouted first.

Results
A group of seeds frozen for 11 days, another for 6 days, and a group of marigold seeds not frozen at all were distributed to 9 pots, 3 pots per group. The number of days it took for each group to sprout was recorded. The findings were that the group of marigold seeds cryoperserved for 11 days (the longest amount of time) sprouted first in 4 days. The group of seeds that were not cryoperserved at all sprouted second, also on day 4 of growing. The group of seeds cryoperserved for 6 days sprouted last, many hours after the first two groups, also on the fourth day of growing. The growth of the seeds measured in centimeters were recorded until the ninth day of growing.

Conclusions/Discussion
The growth of 3 groups of seeds cryopreserved (frozen) for different durations of time (11 days, 6 days, and 0 days) revealed that seeds that have been cryopreserved may grow faster than seeds that have not been cryopreserved. It was concluded that the longer a seed is cryoperserved for, the faster it will grow compared to a seed that has not been cryoperserved.

Summary Statement
As measured by the time it took for the plants to sprout, I found that the longer a seed is cryoperserved for, the faster it will grow compared to a seed that has not been cryoperserved.

Help Received
None. I designed and tested the experiment myself.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Zachary J.T. Patton

Project Number
J1921

Project Title
Effects of Water pH on Fodder Growth

Abstract

Objectives/Goals
To compare the optimal growth (dry mass) of barley (Hordeum vulgare L.) in various water pH ranges. Usually a neutral pH (6.5-7.0) is best for all plant growth, but I wanted to test a variety of pHs to clarify which aids the most growth measured by dry mass.
To determine if adjusting the pH ranges of water used in a hydroponic system would prevent mold growth.

Methods/Materials
I built the hydroponic system using PVC pipes and fittings, seed trays, plastic bowls, water pump. Rinsed 2,267 grams of barley seed by soaking the seeds. Measured 453 grams of seed into each of the 10 bowls. Filled water reservoir and tested water pH (changed pH if needed using pH up or down). Automatic timer watered for 5 minutes, 3 times per day. Day 7 measured the weight of the wet mass and dry mass using gram scale. Put fodder samples in a convection oven to find dry mass (150 F° for 3 hours).
Independent Variables: Water pH ranges: 6.0 (acidic), 7.0 (neutral), 8.0 (alkaline), 10.0 (alkaline)
Dependent Variables: Fodder dry mass and mold growth
Controlled Variables: amount of seeds, room temperature, soaking time, watering time and frequency

Results
Average dry mass of pH levels: pH 6 was 48.5g, pH 7 was 72.4g, pH 8 was 101g, pH 10 was 52g. The average dry masses of the fodder samples were compared to the growth for a pH of 7 because pH 7 is neutral or just water. On average, the growth of the control (pH 7) was adequate compared to the other pH levels.
Percent Change in Average Growth: between a pH 7 and pH 8 was a 39.5% increase in growth; pH 6 had a 33.01% decrease in growth; pH 10 had a 28.18% decrease in growth.
Mold was present in pH levels of 6 and 10. There was no mold growth in pH levels of 7 and 8.

Conclusions/Discussion
Controlling the pH was found to be important to maximize growth and minimize mold. After completing the investigation on the optimal pH range for the growth of fodder, the original hypothesis was correct, a pH range of 7-8 was the overall best, but a pH of 8 is the most optimal for the growth of fodder. By adjusting the pH range from 7 (neutral) to 8 (alkaline) had a positive effect on fodder growth. Water levels that are too acidic (less than 7) or too alkaline (greater than 8) do not promote optimal fodder growth. The water pH range does affect mold presence.

Summary Statement
I investigated the effects of water pH on the growth of fodder to determine the optimal growing range.

Help Received
I built and conducted the project on my own.

Name(s)
Tosten N. Pearson

Project Number
J1922

Project Title
How Does Companion Planting with Nitrogen Fixing Crops Affect Plant Development?

Abstract

Objectives/Goals
The objective of this study is to measure the effects (defined as a difference in mass) between a solitary Swiss chard plant and a Swiss chard plant that is planted in close proximity to a nitrogen fixing legume (in the case of my experiment; either a bean or pea).

Methods/Materials
Three 0.46m by 0.3m by 1.07m planters, vegetable soil, potting soil, 24 Swiss chard seeds, eight bean seeds, eight pea seeds, available water. In my experiment, I filled all three planters with an equal amount and ratio of potting and vegetable soil. I then planted eight isolated Swiss chard in the first planter, paired up eight Swiss chard with eight beans in the second planter, and paired eight Swiss chard with eight peas in the second planter. After a 77-day growth period, I then carefully dug up each plant, isolated their roots from the surrounding soil, and measured their individual masses.

Results
From the data I collected in my experiment, I have found that on average, the solitary Swiss chard plants weighed 16.125 grams, while on average, a Swiss chard planted with a bean weighed 3.875 grams, and on average a Swiss chard planted with a pea weighed 6.375 grams. This displays that planting a Swiss chard in close to a legume (bean or pea) has a negative effect on plant growth. This data fulfills my objective by showing an effect in growth between the average solitary Swiss chard specimen, and the average Swiss chard specimen planted with a legume.

Conclusions/Discussion
The results of my study could be implemented in many ways, but must notably in agriculture. A common issue in today's agricultural systems is the lack of fertilizer in developing countries. A common solution to this problem is the use of nitrogen fixing legumes to replenish nutrients in the soil. My study could be used to advise farmers not to plant a feeder (such as Swiss chard) and a legume (such as a bean or pea) during the same time period. If agriculturalists implemented the results of my project, they could better farm with low amounts of fertilizer.

Summary Statement
As measured by the mass of several Swiss chard plants, I've concluded that planting a Swiss chard plant in close priximity to a legume impairs overall grwoth.

Help Received
The only help I was given over the course of my project was advice from my mother regarding the contruction of my tri-fold board.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Pola V. Pietrzkowski

Project Number
J1923

Project Title
The Effect of Music, Noise, and Silence on the Germination of Seeds

Abstract

Objectives/Goals
The purpose of this project was to see if the germination of seeds could be affected by music differently than noise or silence.

Methods/Materials
Cucumber and radish seeds were used. The seeds were put in Petri dishes with germination paper soaked in water. These Petri dishes were put in one of three styrofoam boxes with a controlled temperature, humidity, light, and sound exposure. All the sounds that the seeds were exposed to had the same frequency, loudness, and length.

Results
24 seeds of each type were used for each group. After 72 hours, the number of radish seeds germinated in music was 16, noise was 13, and silence (control) was 12. In comparison, the number of cucumber seeds germinated was 8 in music, 18 in noise, and 20 in silence (control).

Conclusions/Discussion
In conclusion, this experiment showed that only some types of seeds are positively affected by music. These findings indicate that more research is needed to figure out what type of sound has a positive effect on different types of seeds.

Summary Statement
My project is about the effect of music, noise, and silence on seeds germinating.

Help Received
I designed the project myself, I received help in understanding the data from my science mentor - Ms. Afsaneh Miller.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Anna D. Sohn

Project Number
J1924

Project Title
The Effect of Heat on Bean Plant Growth

Abstract

Objectives/Goals
The objective of this experiment is to test the effect of heat on bean plant growth, in relation to climate change.

Methods/Materials
60 bean plant seeds in pots, 3 small greenhouses, 75W heat lamp, 150W heat lamp, moisture meter. Temperature measured 3 times daily. Moisture measured daily and watered accordingly. Height measured daily over 3 weeks.

Results
The hypothesis was proven false; the plants that grew tallest, an average of 15.3 centimeters, were in the 31 degree celsius greenhouse. The plants that were in the greenhouse measuring 28 degrees celsius grew an average of 14.1 centimeters. The control, which was 22 degrees celsius, grew an average of 10.7 centimeters.

Conclusions/Discussion
Measurements over 3 weeks showed that the warmer the greenhouse, the taller the bean plant grew. It was observed that the plants in the heated greenhouses were less healthy looking. This experiment concluded that heat makes bean plants grow taller, but not necessarily healthier. Future experiments, especially ones regarding climate change, can be built upon with this information.

Summary Statement
This experiment tests the effects of heat on bean plant growth, specifically in relation to climate change.

Help Received
I received basic assistance from my mom. She measured the temperature inside the greenhouses once a day, while I was at school.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Noa R. Wallock

Project Number
J1925

Project Title
Can Germinated Radish Seeds Grow in Different Gradients of Simulated Mars Soil, With or Without Fertilizer?

Abstract

Objectives/Goals
My objective was to see if Mars soil has enough nutrients to successfully grow and support plant life.

Methods/Materials
My experiment used 4 different types of Mars soil simulant: super fine, fine, course, and unsorted grade (purchased through a N.A.S.A sponsored website). Regular potting soil was my control group. I constructed 5 miniature greenhouses containing 10 germinated radish seeds in each. Some plants were watered with distilled water and some were watered with distilled water mixed with synthetic fertilizer.

Results
The results were based on both the average weight and singular mass of each radish plant after 4 weeks. The control group had the greatest average mass overall. However, plants also grew in the simulated Mars soil. The radishes in the very fine grade Mars soil simulant had the greatest average mass out of the soil simulants with and without the addition of fertilizer. Even though the regular potting soil had the greatest average mass after 4 weeks, some of the singular radish plants in the different gradients of simulated Mars soil outweighed the control group.

Conclusions/Discussion
Food is a prime resource our bodies need to function. By the 2030s, N.A.S.A predicts they will start sending people to Mars. For humans to survive on this distant planet, we will need a food supply. My experiment not only proved that Mars soil can support plants, but also which gradient of Mars soil would produce the best plants. I hypothesized that the fine grade Mars soil simulant would have the greatest mass after 4 weeks. However, my experiment concluded that the very fine Mars soil simulant had the greatest mass after the allotted time of 4 weeks. Therefore, my hypothesis was disproved.

Summary Statement
I demonstrated that plants can successfully grow in simulated Mars soil.

Help Received
I designed my experiment on my own. I had help with proofreading my work from my parents and a science teacher at my school, Ms. Joel. Another science teacher at my school, Ms. Carter oversaw my experiment to ensure my safety.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Maggie R. Watts

Project Number
J1926

Project Title
Aquaponics vs. Hydroponics: Replacing Commercial Fertilizers with Fish Waste

Abstract

Objectives/Goals
Last year I tested various methods of hydroponics, but this year I was curious about learning more about aquaponics, I wanted to investigate whether a natural fertilizer, such as fish waste, could be as effective as a commercial one.

Methods/Materials
The key materials used in my project were goldfish, a 10-gallon fish tank, Earth Juice plant food, lettuce seeds, and hydroponic coco coir. One set of plants was watered systemically with the fish waste, while the other set of plants was watered with the commercial fertilizer. I measured and documented plant growth on a regular basis, including the number of leaves and germinated plants.

Results
While documenting my plants, I found that the aquaponics portion of my testing had a higher germination rate. About 88% of the aquaponic plants germinated and 50% of the hydroponic plants germinated. However, the range of the number of leaves on the individual hydroponic plants ranged from 5 to 8 while on the aquaponic plants the number of leaves on the individual plants ranged only from 2 to 5. Also, the leaves growing on the hydroponic plants were larger and more robust.

Conclusions/Discussion
I learned that growing plants through aquaponics is a more sustainable process than ordinary hydroponics. However, hydroponics using commercial fertilizer is more effective in producing robust plants because they were fertilized with the right ratio of nutrients a plant needs to flourish. I also learned that nitrates are a crucial factor in growing healthy plants whether they are incorporated through fish waste or a commercial fertilizer. Overall the hydroponic method was far more successful than the aquaponic method. However, I also know that on a large scale, both Hydroponics and Aquaponics are extremely effective from my observations at Solution Farms. With time and practice, I believe that hydroponics and aquaponics will be the future for farming plants.

Summary Statement
The purpose of my project was to investigate whether a natural fertilizer, such as fish waste, could enrich plants as effectively as a commercial one.

Help Received
I designed and carried out this project on my own. I consulted with Solution Farms in Vista, California to learn more about aquaponics.

Name(s)
Ayana R. Wilmot

Project Number
J1927

Project Title
Factors Affecting the Rate of Photosynthesis of California Lichens: A Suitability Study into Producing Oxygen on Mars

Abstract

Objectives/Goals
The purpose is to see if lichen can photosynthesize in more Mars-like conditions than on Earth and identify which lichen species is best suited for producing Oxygen for humans to breathe on Mars.

Methods/Materials
Materials: 4 different lichen species (Ramalina farinacea, Hypogymnia physodes, Flavopunctelia flaventior, and Xanthoparmelia taractica), LabQuest 2 data collection device, biochambers, Vernier O(2), CO(2) and pressure probes, Full Spectrum, Blue Enriched and Red Enriched LED light fixtures, digital balance, bell jar, light meter, thermometer and humidity detector.

Light stands were built. Lichen samples were collected and massed. Data was obtained by placing lichen in biochambers and recording ppm CO(2) produced or utilized per hour per gram for each species in the following light conditions: None, Natural, Full Spectrum LED, Red Enriched LED, Blue Enriched LED. Light Intensity, Humidity, Pressure and Temperature were recorded. The rate of respiration (CO(2) production in the dark), rate of photosynthesis (rate of respiration minus rate of CO(2) production in a specific light condition), and net O(2) production (rate of CO(2) utilization in a specific light condition) were calculated. Control experiments were done with empty chambers.

Results
All species photosynthesized in all four light conditions including low natural light (4,061 lux) with F. flaventior exhibiting the highest rate. It was also the only species that was consistently a net producer of oxygen under all experimental light conditions and under lower pressures. Photosynthesis was greatest with the Red and Blue Enriched LED lights. Photosynthetic rate was positively correlated with humidity (decreasing significantly from 66 ppm O(2)/h/g at 90% to 25 ppm O(2)/h/g at 67% to 2 ppm O(2)/h/g) and negatively correlated with time after collection.

Conclusions/Discussion
Lichen can photosynthesize well in low and red-light conditions. F.flaventior or a similar species could produce Oxygen on Mars in suitable habitats to control temperature, humidity and pressure.

Summary Statement
I found a lichen species (F. flaventior) that is a good net producer of Oxygen in low light, reddish light and low pressure but it needs a high level (>50%) of humidity.

Help Received
My dad showed me how to use the LabQuest 2 device and probes.

Name(s)
Bryce M. Wong

Project Number
J1928

Project Title
Used Coffea Arabica Grinds as Soil Substitute to Mitigate Waste and Environmental Pollution

Abstract

Objectives/Goals
Used coffee grinds (UCG) are increasingly becoming a huge waste problem. To mitigate this problem my experiment is about reusing UCG as soil to grow plants. Research shows UCG is beneficial in composting. However, I wanted to take this further by growing plants in UCG with some organic substances. Using UCG will reduce trash in the landfills.

Methods/Materials
To test my hypothesis, I planted fava beans, radish and lettuce seeds in used arabica coffee grinds (UCG) with different additives. I made three experimental groups: One group of plants is UCG with crushed eggshells and home prepared Lactic Acid Bacteria (LAB). Another group is UCG with alfalfa sprouts and the third group is UCG with fertilizer. I also planted same type of seeds in 100 percent potting soil as my control group. For 36 days, I watered, measured the height of the plants, recorded, and took photos every other day.

Results
Among my experimental groups, the fava bean grew the tallest in UCG with eggshells and Lactic Acid Bacteria. Its height was 32 centimeters. Radish and lettuce grew also in this group however, radish and lettuce grew the tallest in UCG with alfalfa sprout. Radish was 6.5 cm tall and lettuce was 3.0 cm tall. Radish and lettuce grew poorly in UCG with fertilizer. The fertilizer might have altered the PH causing the growth to be hindered.

Conclusions/Discussion
My hypothesis was supported by the results that UCG with eggshells and Lactic Acid Bacteria (LAB) could be used as soil. The combination of these two additives addresses the concerns of stunted growth of the plants and the lack of micronutrients of used coffee grinds. Eggshells add calcium that helps in the creation of plants' cell walls and provides aeration. The bacteria in the LAB solution break down minerals in the soil making nutrients available to the plants and also, prevents fungi growth. Planting in UCG can be very beneficial to our environment. It will help reduce cost of waste disposal and in the future, may become a viable substitute for soil when agricultural land becomes scarce.

Summary Statement
Due to increasing coffee consumption, UCG as soil subsitute in planting could pave the way to improve our state's environmental health and lessen cost of waste disposal.

Help Received
Ms. Mergeson is my mentor, Coffee Bean store in Torrance provided free UCG, and Janeline Wong for scientific discussion.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)
Eric Yang

Project Number
J1929

Project Title
Investigating Salt Tolerance of Western Plant Species

Abstract

Objectives/Goals
Global warming is posing risks to many shrubs and plants at the world's lagoons and salt marshes. The purpose of this project was to investigate which native plants might be most impacted by rising saltwater during the process of germination. I wanted to discover how seeds of various native plants would react to increasing levels of salinity and which native plants might be most vulnerable to harm.

Methods/Materials
I experimented with more than 600 seeds from Western native plants ranging from California to Colorado, including Purshia tridentata, Penstemon strictus, Atriplex lentiformis, and Fragaria chiloensis. I carried out seed germination tests, including more than ten levels of salinity ranging from 0.5% salinity to 5.0% salinity. I attempted to germinate seeds that I collected from local native plants, but none of those seeds germinated. I then obtained a mix of native California seeds to use in my second experiment.

Results
My tests showed that Purshia tridentata (Antelope Bitterbrush) was incapable of germinating in a 3.5% salinity concentration. The highest level of salinity the Purshia (Antelope Bitterbrush) could tolerate was 2.0% salinity. The Penstemon strictus (Rocky Mountain Penstemon), Atriplex lentiformis (Saltbush), and Fragaria chiloensis (Beach Strawberry) were all able to germinate in a 3.5% salt concentration. In fact Atriplex, the Saltbush, was even able to tolerate a 4.5% salt concentration and the Fragaria survived up to 4.25% concentration. The Penstemon germinated until the salinity concentration reached 4.0%. Approximately 70% of the mix of California native seeds I tested tolerated concentrations of up to 3.25%.

Conclusions/Discussion
Surprisingly, many seeds were able to germinate in saline water conditions. Fragaria and Atriplex tolerated the highest salinity levels and are plants living near ocean water or on the margins of wetlands and sink communities where ocean water may fill in and salt spray may reach them. According to my results approximately 50% of the California native seeds I tested were able germinate even at a 3.5% salinity. It seems that plants that normally endure a life exposed to coastal salinity might survive germination, but if salt accumulates in the soil, this may compromise any further growth. Soil salinity issues are an important topic for future studies.

Summary Statement
Investigating Salt tolerance levels of plant species ranging from Colorado to the Pacific Coast.

Help Received
Professor Ren Hou and my science teacher for guiding me through my project and supplying all necessary material. My parents for project support and guidance.