CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Adani Ahmad

Project Number

J1801

Project Title

Understanding Light Spectrum for Optimal Germination and Growth of Bean Sprouts

Abstract

Objectives

The purpose of this project is to figure out whether different colors of light would affect plant growth, and whether the seasonal changes in sunlight affect how a plant from the summer grows in the winter. How will imitating the color of light affect how a plant from the summer grows in the winter? The hypothesis concluded was - If red colored light that has the longest wavelength is used to grow plants, that will affect the plant to grow faster, taller/longer, and healthier.

Methods

In the procedure made for this project or experiment, the petri dishes and clear plastic cups had to be wrapped in colored (red, blue, green and yellow) and clear (as control) cellophane paper in order for it to work using different colors of light on germination and growth, respectively. For germination, the cotton balls were damped slightly using a syringe, with the same amount of water. 20 beans were then placed onto the wet cotton. The number of germinated beans were counted at 24, 36, and 54 hours. For sprout growth, the cups were 1/4 filled with cleaned beans and rinsed daily. The height of sprouts were measured in 12 days when one of them reach the top of cup. All experiments were duplicates and exposed to sunlight at the same location.

Results

The results at the end of the project proved that red was the color of light that will benefit a bean plant s germination, in which it has the most germinated beans in 24 hours compared to other colors. Actually, regular sunlight was, but if this color of light was excluded from the experiment, red would have been the most beneficial. For the growth of sprout, blue colored light had the tallest sprout in 12 days, even better than clear colored cellophane.

Conclusions

The conclusions to this project ended up supporting the hypothesis because the bean sprouts using the red colored light ended up germinating the healthiest compared to the other ones. However, blue colored light is needed to have the fastest growing sprout. By understanding light spectrum (e.g. color and wavelength) and how it affects plant biology, it is possible to manipulate plant growth by using different light colors to achieve optimal germination and growth. This means we will be able to grow plants out of their season and out of this world - for example to provide food to our astronaut in space.

Summary Statement

Different light colors (wavelengths) are needed for different stage of plant growth

Help Received

I conducted the research, literature review and plan experiment procedure, as learned from my previous science fair projects.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Daniel Bang; Thomas Kim

Project Number

J1802

Project Title

Dead Zones are Dead Jokes: Algal-Bloom Control by the Allelopathy of Aquatic Macrophytes

Abstract

Objectives

This project focused on the question, which aqueous plants could affect the growth of blue- green algae in lakes and ponds, preventing dead zones from forming and allowing a natural solution to stop this problem. The results that arise are important to the scientific community because instead of using non-eco-friendly and artificial solutions to solve this complication, nature s own specimen can provide a better option. Not only is it natural, but this method reduces a carbon footprint in the environment itself. Humans should care about these results because if this continues to occur, several ecosystems may not have the ability to thrive and support organisms anymore. The independent variable is the different species of aqueous based plants to fight off the blue-green algae, which are anacharis, amazon sword, and ludwigia. The dependent variable is the amount of blue-green algae, in grams, after one week with the aquatic plants. Constant variables include ?the pH of water, mass of blue-green algae before three weeks, mass of plants, amount of water, size of tanks, amount of given solid and liquid fertilizer, and more. The control variable would be the algal bloom without any effect of the plants. The hypothesis is that if we placed different types of aquatic based plants in a habitat with blue-green algae (water pH: 8.0), then the anacharis will have the least amount of algal growth, in grams.

Methods

Materials
36 gallons of pure water
3 10-gallon tanks
Electronic scale
Blue-green algae (Cyanophycota)
Measuring cup
Elodea canadensis (Anacharis)
Echinodorus grisebachii (Amazon Sword)
Ludwigia repens (Ludwigia)
10 lbs. Fertilizer (Nitrogen and Phosphorus Rich)
Liquid fertilizer

Procedure
Gather all materials

Summary Statement

The experiment conducted focuses on the negative effects of algal bloom and eutrophication to discover a natural method to fight this problem; Aquatic macrophytes.

Help Received

Mr. Lewis, Mrs. Dimonaco, Mr. and Mrs. Bang, and Mr. and Mrs. Kim.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Kian Chakamian

Project Number

J1803

Project Title

Predicting Implications of Olive Quick Decline Syndrome in San Diego County Olive Trees

Abstract

Objectives

Last year I tested olive trees in San Diego North County for a pathogenic disease, Olive Quick Decline Syndrome, which infects the trees and has implications for global olive oil production. I discovered a strong correlation between OQDS and the presence of the sharpshooter insect that transmits the disease. The purpose of my project this year was to develop a growth formula for the sharpshooter population to predict the impact of OQDS on olive trees countywide over time. I hypothesized that a formula could be developed based on an estimate of the San Diego North County olive tree population and an analysis of the change in magnitude of OQDS infections over a one-year period.

Methods

I first estimated the number of olive trees using satellite images in Google Maps. For five different areas in San Diego North County, I identified and marked locations of 345 individual trees that I predicted were olive trees by visually inspecting the satellite images for tree color, density and structure of foliage, patterns or symmetry of groupings. I validated this method through field inspections of all 345 trees to confirm whether the trees were correctly or incorrectly identified and to count additional, previously unidentified olive trees at each site. I then assessed and recorded the magnitude of OQDS infection in 100 sample olive trees. I created a growth formula for the sharpshooter population based on the number of sharpshooters I caught last year.

Results

My results revealed an estimated 26,576 olive trees in a 99 square mile test area (268.5 olive trees per square mile). I estimated approximately 186,600 sharpshooters in the test zone. This indicates a surge in sharpshooter activity, with an average of 7.02 sharpshooters per tree this year compared to 1.38 average per tree last year. Using this data, I created the formula: y(sharpshooter population) = 36798*5.07^[x(years after 2018)]. According to this formula the magnitude of infection, could be 100% in just two years time.

Conclusions

Sharpshooters carrying Xyllela fastidosa infect and kill not only olive trees but affect over 300 common plant species. These species include cherry, elm, mulberry, oak, orange and almond trees, as well as vineyards. Due to the potential environmental repercussions, further OQDS research is imperative.

Summary Statement

The purpose of my project was to assess olive tree damage and develop a growth formula for the sharpshooter population in San Diego County.

Help Received

Thanks to my parents who drove me to my sites over many hours. Thanks to Alfred Alyeshmerni, a scientist who researches OQDS, who has answered many of my questions about the disease. I would like to thank all the olive tree owners who allowed me to assess their trees. Thanks to my science teacher for

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Maya Chakraverty

Project Number

J1804

Project Title

Studying Effects of Increased CO_2 On Plant Biomass

Abstract

Objectives

Goal is to study the effects of increased carbon dioxide on the plant bio mass. Also, study from prior experiments what relation this may have due to increased CO_2 in the environment on quality of the plant and photosynthesis process.

Methods

1) Two plants for intervention group that was given increased CO_2
2) Two plants for control group that did not received additional CO_2
3) Half gallon milk carton (containing yeast, warm water, sugar- to release CO_2)
4) Bottle of water (to show CO_2 production via bubbles in the water)
5) Flexible tubes
6) Measuring scale in ounces
7) Dropper for watering the plants
8) Old fish aquarium to store the intervention group plants

Results

The small scale field experiment I conducted showed the two plants kept in the excess CO_2 chamber to have an increase in their biomass, as compared to plants that were kept outside the CO_2 chamber. There was an impact on biomass and height of the intervention group plants.

Conclusions

Conclusion: There appears to be sufficient preliminary evidence of a non-zero effect on plants in an environment of higher CO_2. the small scale "chamber" experiment conducted over the past few weeks indicates that higher CO_2 levels on plants under certain conditions have a non-zero effect, in this case resulting in a greater biomass than the control group plants that continued in the typical setting with relatively less CO_2 (the chamber was provided/injected with excess CO_2 as an exhaust from a carbon rich fluid being broken down by active dry yeast, producing visible amounts of CO_2).

It is generally accepted scientific phenomena that plants produce "food" or "energy" from photosynthesis, among other methods. Photosynthesis happens mostly in the leaf biology where CO_2, sunlight and many other fluids within the plant result in generation of a form of glucose. With increased amounts of CO_2, the plant has more fuel for continued photosynthesis which can result in more "food" or "energy" production, that ultimately adds to the total biomass.

Summary Statement

Effects of increasing Carbon dioxide on plant life

Help Received

Benicia Middle School

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Brian Chen

Project Number

J1805

Project Title

Validating Novel Algorithm-Generated Crop Rotations: A Second Year Study

Abstract

Objectives

My research aims to validate the effectiveness of algorithm-generated crop rotations that I found last year.

Methods

Previously, I wrote an algorithm in C++ that found crop rotations based off of a self compiled database of nutrients crops consume and produce. I tested three algorithm-generated crop rotations against respective controls (the same crop planted four times consecutively). Each crop rotation or control has four, three-week stages, one for each crop in the rotation. I am able to compare the 4th stage of each crop rotation with the 4th stage in the respective control to see whether the crop rotation is successfully conserving nutrients in the soil. All other variables such as light and temperature were kept constant.

Results

The experiment shows a drastic decrease in height over time in both corn and cabbage controls. This data demonstrates the problem of nutrient depletion and the need for crop rotations.

Corn rotation 1 outperforms the control in all three measurements. In addition, Corn rotation 2 outperforms the control in two out of the three measurements. The p-value from a student T TEST on stage 1 heights and stage 4 heights continues to support my hypothesis.

For cabbage, data on average heights and germination success rates show that there is no significant difference between the control and the crop rotation. This hints that cabbage may not be affected by crop rotations and is not a significant producer or consumer of nutrients.

Conclusions

Both of my algorithm-generated corn crop rotations outperforms the control significantly which supports my hypothesis. Results for cabbage crop rotations did not show significant differences between the rotation and the control. However, because of the exemplary performance of both corn crop rotations, I conclude that my algorithm-generated crop rotations are able to solve for the problem of nutrient depletion and ultimately, the usage of chemical fertilizers. I was able to show the potency of my crop rotations. My research suggests that successful crop rotations can be generated using an algorithm.

Summary Statement

I showed that my algorithm-generated crop rotations can successfully conserve nutrients in the soil.

Help Received

My mentor Ms. Peng from The Harker School gave me tips on the structure of my experiment. An email exchange with Prof. Ehrhardt from Stanford University, Dr. Telenko, and Dr. Nielson from Purdue University provided insights on corn diseases and crop rotations.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Manav Desai

Project Number

J1806

Project Title

How Does Vitamin D Affect Root Plant Growth?

Abstract

Objectives

The objective is to demonstrate the impact of root growth in radish plants when seed germination was supplemented with different concentration of Vitamin D.

Methods

Planting Box 1-yard x 1-yard, 36 radish seeds, Topsoil, Mineral soil, 12 blue cups, 12 green cups, 12 purple cups, ZAHLER Vitamin D3 droplets (1000IU), 36 Popsicle Sticks, Pencil/Pen/Marker, Beaker

Results

Radish Seeds that received 2000 IU of Vitamin D supplement every alternate day for 7 weeks showed an average 50% increase in root length in plants than the plants where seeds did not receive any Vitamin D supplement. Suggesting that the Vitamin D supplement may impact root growth.

Conclusions

These results can help farmers and vegetable growers to formulate fertilizers for plants. Plants which received Vitamin D supplement grew longer and stronger roots. This data can help root vegetable growers to determine if Vitamin D supplement will help them grow longer root vegetables while using the same amount of water they would normally use. In the long run, this data can help mankind reduce their water usage.

Summary Statement

Through analyzation of my data, I found that the plants supplemented with 2 drops of Vitamin D droplets showed a 50% increase then the plant supplemented with no vitamin D

Help Received

The design and manufacturing process of the planting box was helped achieved by my dad. The statistical analysis and observations of data was done by me, and the formating of my poster was better made by my mother. My science teacher, Mrs. Gramajo gave me a lot of advice and helped me make sure that my

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

John Benedict Estrada

Project Number

J1807

Project Title

Predicting Broccoli Yield Utilizing a Remote Sensing Low Altitude Multispectral Camera: A Two-Season Trial

Abstract

Objectives

Constructing statistical models to predict crop yield involves difficult calculations and measurements to arrive at an accurate yield prediction. Measuring chlorophyll content using a SPAD meter is tedious and can spread disease. This study was done to assess the efficacy of vegetation indices obtained through multispectral imaging in predicting the chlorophyll content and yield in broccoli over two seasons.

Methods

A field experiment on different N-fertilizer rates on broccoli was used. A small unmanned aircraft system (UAS), or drone with a GPS-enabled multispectral camera was built and flown autonomously at an altitude of 100 feet. More than 100,000,000 light reflectance values were collected to calculate the vegetation indices, GNDVI and NDVI. Chlorophyll content was measured on the same day. The vegetation indices were compared to the head yield and SPAD measurements using regression analysis.

Results

The regression analysis for two seasons showed very strong positive linear relationships between NDVI and GNDVI, and the head yield. The coefficient of determination for the NDVI regression lines in seasons 2018 and 2019 showed R2 values of 0.93 and 0.92 respectively. GNDVI and head yield also showed a relatively high correlation for seasons 2018 and 2019 with R2 values of 0.8 and 0.81 respectively.

The chlorophyll content and the vegetation indices for both seasons were highly correlated with each other. GNDVI consistently demonstrated the highest correlation for 2018 and 2019, with R2 values of 0.92 and 0.93 respectively, compared to NDVI which had R2 values of 0.74 and 0.83 respectively.

Conclusions

Based on my 2 year data, I showed that vegetation indices NDVI and GNDVI obtained from a high-resolution multispectral camera can reliably estimate the head yield and chlorophyll content in broccoli plants. NDVI is a more precise index to use in predicting head yield in broccoli while GNDVI is better in estimating the chlorophyll content in broccoli.

This method of estimating head yield in broccoli can easily and quickly obtain measurements over vast areas. It does not require complex calculations to develop a statistical crop yield model. By estimating the chlorophyll content and predicting the yield, farmers can judiciously apply fertilizer and save money as well as protect our environment by avoiding ground water contamination.

Summary Statement

This study showed that the vegetation indices NDVI and GNDVI obtained through a high-resolution multispectral camera mounted on a drone can reliably and accurately estimate the head yield and chlorophyll content in broccoli plants.

Help Received

The California State University - Fresno Agricultural Field was accessed in this study. I conceptualized, planned, conducted, and analyzed the project myself. I did not receive any mentorship from any faculty or staff from the university.

Name(s)

Pauline Victoria Estrada

Project Number

J1808

Project Title

Early Detection of Drought Stress in Bell Pepper (C. annuum) Using a Remotely Operated Vehicle with an Infrared Camera

Abstract

Objectives

Late detection of drought stress in plants could lead to irreversible damage and low yield. Older methods of monitoring plant water status are destructive and only detects plant drought stress late in the process. Inexpensive thermal imaging infrared (IR) thermography cameras have been developed that can be used for remote and non-destructive determination of the water status in plants. This is done by measuring the canopy temperature of plants and calculating the crop water stress index (CWSI). This study was conducted to determine if an ROV equipped with an infrared camera can effectively detect the early signs of stress caused by drought in bell pepper plants.

Methods

A field experiment on bell pepper with different irrigation levels was used in this study. An autonomous GPS enabled ROV with a 6-wheel drive chassis was built and mounted with an infrared camera. This allowed it to maneuver in the tight inter-rows of the crops, and at precise locations due to GPS, take images of bell pepper leaves using the infrared (IR) camera at a close distance to measure the temperature accurately. Soil moisture level for each plant was measured on the same day. The images were analyzed to determine the average canopy temperature and calculate the crop water stress index.

Results

The regression analysis showed that there is a very strong negative linear relationship between CWSI and soil moisture level. The coefficient of determination for the regression was 0.96 and future measurements can be closely predicted by the regression equation $y = -0.0052x + 0.465$. Also, the significant (p value = 0.02 < ?=0.05) result of ANOVA showed that the variations in soil moisture level do affect the CWSI and that the linear relationship does exist between CWSI and soil moisture level.

Conclusions

This study showed that canopy temperatures obtained from infrared thermal images can accurately predict the moisture level and early signs of drought stress in pepper plants. This can have a big impact in the way irrigation is being managed in the field. By knowing the CWSI, farmers will have an idea when it is necessary to irrigate. Unnecessary irrigation can be avoided which will help farmers conserve precious water. This is not only good for the environment, but it also allows farmers to save money and to maximize their yield.

Summary Statement

A remotely operated vehicle with an infrared thermography camera can accurately measure plant canopy temperatures to calculate the CWSI and detect early drought stress in bell pepper plants.

Help Received

The California State University - Fresno Agricultural Field was accessed in this study. I conceptualized, planned, conducted, and analyzed the project myself. I did not receive any mentorship from any faculty or staff from the university.

Name(s)

Ruby Evans

Project Number

J1809

Project Title

Do Plants Absorb Microplastics?

Abstract

Objectives

Microplastics are small pieces of plastic found in the environment and are harmful to animals. I wondered if microplastics could affect plants. The objective of this project was to determine if plants could absorb microplastics through their roots.

Methods

I used brightly colored plastic beads that could be seen under the microscope to model microplastics found in the environment. I ground up plastic beads and passed them through filters ranging from 150um to 1um. First, I planted cabbage and kale seedlings in planting soil and secondly, I planted them in plant tissue culture medium and then I added microplastics to the soil or medium. To measure if plants absorb microplastics, I either looked at the roots directly under the microscope or chopped them up and looked under the microscope.

Results

To determine if I could see microplastics on roots with my microscope, I added microplastics to the outside of intact roots or root cross sections or the chopped root preparations. The microplastics were clearly visible on each root preparation. Seedlings were grown for 7-14 days with microplastics, and then removed from the soil, washed, and mounted on microscope slides. I prepared samples from 5 seedlings for both the control and the treated groups. No microplastics were seen on the roots, cross sections, or mashed up roots. To see the roots more clearly in their growing environment, I set up a sterile plant tissue culture system. I grew seedlings in Murashige & Skoog plant media with agar. I repeated the method development with seedlings grown in tissue culture and proven that I could see the microplastics with my microscope. I looked at 5 plants after 7-14 days of exposure to microplastic and saw only some microplastic on the outside. I performed a dye test with food coloring in either water or in agar to show that plants do absorb dyes, and also to determine what molecular weight plants can absorb. Seedlings can absorb food coloring because they changed color on the outside as well as the inside. I demonstrated that kale and cabbage plants can absorb molecules with a molecular weight of about 1000 Daltons.

Conclusions

Test microplastics were not absorbed in either soil or tissue culture seedlings even though plants can absorb small dye molecules. Microplastics breakdown slowly in the soil and it is possible that these breakdown products could be absorbed.

Summary Statement

Plants do not absorb microplastics between 1-150 microns in size even though small dye molecules can be absorbed by roots.

Help Received

James Evans, Scientist at Revolution Medicines

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Brooklynn Filstrup

Project Number

J1810

Project Title

Will The Direction of Gravity Affect the Way Plants Roots Grow?

Abstract

Objectives

The goal of my project was to see the direction that the plants roots will grow if i changed the direction of gravity . I wondered what went on underneath the surface. I wanted to know why the roots of a plant sometimes grew in different direction other than down. I wanted to research and discover if gravity truly does affect the way that a plants roots grow. In the end, if I change the center of gravity, then the roots of the plant will grow in that direction because the statocytes can sense which way gravity is pulling.

Methods

My materials included, CD cases, radish seeds, paper, a pipette, thread, a ruler and water. I acomplished my project by putting the paper in the Cd cases and marking it damp enough so that the radish seeds could stick to it. I let the seeds germinate and grow for about two days, I then turned the CD case on its side and then let that grow for about two days. Every day I would measure the length of the root using the thread and ruler. I also used some online. Websites to study plants roots more closely. I was able to hold the CD cases in the upright position in a tuplewear container.

Results

After letting the plants grow for a few days, I concluded that the direction that gravity is pulling does affect the way that a plants roots grow. This result was concluded after I compared the pictures from the first to the last day. Once I turned the Cd case on its side the statocytes were able to sense that the direction of gravity had changed. Then growing in that direction. Therefore proving that gravity does affect the way that a plants roots grow in

Conclusions

My project concluded that gravity does affect the way that a plants roots grow. This project showed an understanding of statocytes and what they do. They show that there is so much more going on with plants than what meets the eye. Many people do not know about why plants roots grow the way they do, many people don t even think about it. I know that I didn t even know why the grew the way that they did. With this project, I hoped to give people a greater understanding of why plants roots grow the way that they do.

Summary Statement

My project shows how plants roots grow if the direction of gravity is changed.

Help Received

Corrie Filstrup, John Filstrup, David Olvera

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Bhargavi Gulia

Project Number

J1811

Project Title

Shoot, It Sprouted! Effects of Turmeric and Hydrogen Peroxide on Sprouting of Moong Beans

Abstract

Objectives

The objective of my research was to test the efficacy of different treatments of turmeric and hydrogen peroxide on the sprouting of Moong Beans. Do turmeric and hydrogen peroxide improve the speed of emergence/sprouting, uniformity, vigor, quality and freshness of Moong Beans?

Methods

The materials I used for this experiment included Moong Bean seeds, water, turmeric, hydrogen peroxide, spray bottle, measuring cup, paper towels and Ziploc bags.

I prepared several solutions with different proportions of water, hydrogen peroxide and turmeric. I used Paper-Towel Method for sprouting the seeds. I soaked the seeds in their respective solutions and germinated them on wet paper towels at room temperature. The paper towels were enclosed in Ziploc bags. I recorded data after second, third and fourth days. I analyzed data using excel-sheet and its statistical tools.

Results

I conducted multiple replicated trials and compared their results. My data showed higher number of seed germination when treated with hydrogen peroxide than with water alone while the vigor and quality were recorded better with treatment of turmeric followed by the mixture of turmeric and hydrogen peroxide.

Conclusions

The testing of turmeric and hydrogen peroxide in different solutions showed positive impacts on the Moong Bean sprouts. Turmeric due to its nutritional, medicinal and bio-stimulating activities offers a great organic option for sprouting Moong Beans, while hydrogen peroxide provides a conventional solution to have quality sprouts.

To further my research, I am planning on testing the efficacy of curcumin, a compound found in turmeric, for reducing/removing of bacteria/diseases on various seeds.

Summary Statement

My experiment showed that solutions of turmeric and hydrogen peroxide have positive effects on the speed and quality of Moong Bean sprouts.

Help Received

During this project, I received help from my family and my teachers at school, Mr. Anderson and Ms. Brown.

Name(s)

Sarah Hansen

Project Number

J1812

Project Title

How Much Seed Do You Need?

Abstract

Objectives

The purpose of this study was to determine how much seed is needed to grow a viable plant and to try to induce the growth of true leaves which are indicators of viability. There are several key parts of a seed. The hypothesis is that any seed cut or otherwise treated will grow if it has an intact hull with intact radicle and plumule. A second hypothesis is that light influences the production of a plant s true leaf more strongly than plant size or time post germination.

Methods

Freshly harvested squash seeds were cut, planting each part as a condition. Seeds were cut in half horizontally, vertically, the top removed, the bottom removed, middle of the seed isolated, seed coat removed, seed coats roughed up by sanding, soaked in vinegar, and dried before planting. They were planted in soil at a controlled depth with controlled watering. Plants were measured daily to monitor growth. Time until true leaf appearance was recorded. During a second experiment plants were grown under different light conditions, ambient, dark, and light to test if light was a significant factor in inducing true leaf growth.

Results

Only seeds in which the top (point) was planted germinated. The shape of the embryonic leaves was determined by the shape of the cut seed; the top of the seed was oriented towards the stem of the plant. Seeds with the smallest fraction of seed removed generally grew to a greater height. The time-to-true-leaf was less variable (7% CV) than the height at which plants produced a true leaf (21% CV). The percentage of plants that grew a true leaf correlated with the percentage of seed planted with an exception being the dried seed conditions. After growing for 312 hours in different light environments, 100% of the plants in the light condition, 0% of plants in the dark, and 67% of plants in the ambient light had produced a true leaf.

Conclusions

Any seed that does not have a radicle and plumule will not germinate. If the seed is split vertically both halves will germinate, but only one will grow a true leaf and be viable. Time until appearance of a true leaf was less variable than plant height at which the true leaf appeared. Seeds planted later in the season with less daylight took longer to generate a true leaf. I hypothesized that light was a dominant factor in inducing true leaf growth. A controlled light experiment to test the effect of light on initiation of true leaf growth was performed. In the dark, no true leaves were observed after 312 hours, 67% of plants in the ambient light produced true leaves and 100% of plants in the lighted environment produced true leaves.

Summary Statement

I determined what fraction of a seed is needed to produce a viable plant and showed that light is a significant factor in inducing true leaf formation.

Help Received

Bob Dubrow acted as a science fair mentor. My parents helped with laying out my poster and watering plants with me.

Name(s)

Savannah Kampmann

Project Number

J1813

Project Title

Manure and Nutrients

Abstract

Objectives

My goal was to see which manure had the most nutrients in it. An additional analysis was performed on broccoli seeds for a visual comparison of which manure provided the best environment for growing broccoli.

Methods

I obtained four different manure samples from around my house and had them tested for a variety of nutrient levels. I also mixed each of the manure with with dirt and planted broccoli seeds to see which mixture grew the best.

Results

I found that pig manure was the highest in primary nutrients. However the broccoli seeds thrived the best in the goat manure mixture.

Conclusions

I learned that although the pig manure had the most primary nutrients, and the the goat manure was the best balance for growing broccoli seeds, the type of manure and mixture with the soil will depend on the crop you want to grow.

Summary Statement

Although pig manure was the highest in primary nutrients, it does not mean it is best for growing every crop.

Help Received

The Director of Ag Services at Fruit Growers Laboratory, Scott Bucy, and guidance from my parents.

Name(s)

Lucia Khuu

Project Number

J1814

Project Title

Plant Life on Mars?

Abstract

Objectives

The objective of this study is to measure the growth rates of broccoli plants in Mars Simulant soil with and without steer manure fertilizer as compared to broccoli plants grown in earth soil with and without steer manure fertilizer. All plants are given enough water.

Methods

Mojave Mars Simulant soil, earth roadside soil, steer manure fertilizer, broccoli seeds, portable greenhouse, plastic cups, ruler, camera. Compared the growth rates of broccoli plants grown in 4 types of soil (earth soil, earth soil with fertilizer, Mars Simulant soil, Mars Simulant soil with fertilizer) over a period of 27 days.

Results

As measured by plant height, broccoli plants grew best in earth soil with fertilizer, second best in Mars Simulant soil with fertilizer, third best in earth soil without fertilizer and barely grew (or not at all) in Mars Simulant soil without fertilizer.

Conclusions

Earth food plants (especially broccoli) may be able to grow in Martian Simulant soil if given enough manure fertilizer. If humans were to colonize Mars, they probably will not be able to grow enough food to eat because they will not be able to produce enough manure.

Summary Statement

I showed that food plants possibly can grow on Mars with enough manure fertilizer, but future human Mars colonists may not be able to produce enough manure to grow enough food to eat.

Help Received

None. I designed and conducted the experiment without help from any scientific professionals or institutions.

Name(s)

Kasey Lassen

Project Number

J1815

Project Title

The Positive Effects of Arbuscular Mycorrhizal Fungi on Sodium Stressed Plants

Abstract

Objectives

The objective of my experiment was to determine if using Arbuscualr Mycorrhizal Fungi (AMF) would positively benefit and sustain plants grown in sodium-stressed soil as compared to those grown in non-stressed soil.

Methods

I tested my question by inoculating 30 milkweed plants that I'd germinated from seed- half with positive AMF inoculum and half with negative. Then, I simulated a sodium-stressed environment in half of each of these plants by adding a salt solution. I then observed plant health and height. The materials I used were milkweed seeds, pots, trays, and AMF inoculum, all supplied by Dr. Ylva Lekberg. I also used a TDS meter, native soil, vermiculite, distilled water, and salt.

Results

I found that the plants with AMF in the sodium-stressed soil had the most change in growth; they averaged at 5 cm of total change. The other averages were much smaller; 3 cm of change for the AMF in non-stressed soil, 2.6 cm for the non-AMF in the non-stressed soil, and 2.4 cm of growth for the non-AMF plants in sodium-stressed soil.

Conclusions

My results apply to California today because as people use grey water irrigation to reduce water usage, they add sodium to their soil, which has negative impacts on plants and soil. AMF, I have found, increases these plants' health. By using AMF, you can positively benefit plant health and counteract the negative impacts of soil salinity. This fungus can potentially be useful in agriculture to increase the health of plants and soils that suffer from drought- and sodium-stressed environments.

Summary Statement

My project focuses on using Arbuscualr Mycorrhizal Fungi to combat the negative effects of sodium in plants and soil due to grey water irrigation.

Help Received

Through email, I consulted extensively with Dr. Ylva Lekberg, a professor at the University of Montana, and also borrowed equipment from her laboratory. Additionally, at the culmination of my experiment, I collected root samples from my plants and shipped them to Dr. Lekberg for analysis.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Eileen Ma; Sally Zhu

Project Number

J1816

Project Title

The Impact of Different Types of Bacteria on the Water Conservation and Growth of Lepidium sativum

Abstract

Objectives

Currently, hundreds of billions of gallons of water are used daily on agriculture across the nation. This project finds how bacteria can affect environmental conditions and promote growth. In natural environments, the bacteria B. subtilis, E. coli, and Serratia marcescens have various interactions with plants, such as through fertilizers and soil. However, there are no rigorous studies that show the effects of bacteria on the water consumption of plants. This project explores the different ways in which these three types of bacteria can impact the water usage of the plant, Lepidium sativum.

Methods

First, culture the three types of bacteria and make agar plates with the bacteria. Then, plant the Lepidium sativum seeds on the agar plates. After they germinate, count the number of seeds that have sprouted and record the data. After two weeks of consistent watering and controlled sunlight, measure the length of the sprouts and amount of water left in the agar plates.

Results

We discovered that the seeds with Serratia marcescens used the least amount of water, using around 60% of the amount the control did, then B. subtilis, which used around 30%, the control, and lastly E. coli, which used almost double the amount the control did. However, the germination rates and sprout lengths were not all that different, especially for the germination rates, yet the bacteria had a slightly positive impact on the growth of the plant because the germination rates were still higher than that of the control. Although for both of these aspects, B. subtilis had the highest germination rates and sprout lengths. The results were that overall, the seeds in the petri dish with B. subtilis had the highest growth, and although the dishes had almost identical growth rates, the seeds with Serratia marcescens used significantly less water.

Conclusions

Because the seeds in the Petri dishes with B. subtilis had the highest germination frequency, this means that those plant living conditions were the best, which could be due to more oxygen, water levels, or pH levels. The seeds in Serratia marcescens had the lowest water consumption levels, which increases productivity in farming by lowering the cost needed to take care of the plants. Moreover, this decreases the amount of fertilizer needed to be used for farmers. Some ways that bacteria promote plant growth are that they ensure that the plants receive all the necessary nutrients, they modulate plant hormones, and protect the plants from pathogens.

Summary Statement

This project tested which bacteria would be the most water conservative and promoted the most growth in Garden cress seeds.

Help Received

I used the lab equipment at The Harker School under the supervision of Ms. Peng and Dr. Engeszer. They explained the details of bacterial dilutions and growth.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Mariko McCabe

Project Number

J1817

Project Title

How Do the Shells and Spines of Red Sea Urchin Affect Plant Health?

Abstract

Objectives

To find a way to utilize the commonly wasted shells and spines of Red Sea Urchin that have potential to become a zero waste resource.

Methods

Mixed 340 grams of crushed Red Sea Urchin into soil. Filled four plastic 12 inch deep and 15 inch diameter pots with soil that has mixed in shells and spines. Filled four with untouched soil. Mixed in 700mL of water into each pot and poured 240mL on top. Planted three Lemon Queen Sunflower seeds about 127mm apart and 12.70mm into the soil. Watered everyday with 120mL of water in each pot. Took average height and observations each week.

Results

The sunflowers with the added calcium did not sprout as quickly, although the average height did end up surpassing the sunflowers without the shells and spines. The ending average height for the row with added calcium was 28.575mm and the ending average height for the row without the crushed shells and spines was 73.025mm.

Conclusions

This study shows that calcium is a very important component of soil and this nutrient is needed by plants. This study also shows that the shells and spines of Red Sean Urchin can be utilized and not wasted.

Summary Statement

My project is about finding a way to utilize the leftover shells and spines of Red Sea Urchins from my family's business by mixing them into soil, because plants benefit from added calcium.

Help Received

My mother, Millie Nagata; My uncles, Ryo and Kai Nagata; Mr.Dev; Ocean Queen; Armstrong Garden Center; Pasadena Library.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Jai Vir Mehta; Nicholas Wei

Project Number

J1818

Project Title

Shorter Days: The Effect of the Day/Night Cycle on the Growth of Plants

Abstract

Objectives

One of the most pervasive and destructive problems in the modern world is the lack of access to fresh, healthy food. Thus, the goal of our project is to find out whether time and intensity of light can be modeled in an artificial setting to accelerate plant growth and produce mature crops faster. Based on the observation that plants can detect when they receive light and usually grow in a day/night cycle of 12 hours of day and 12 hours of night, we postulated that giving plants short, intense light would be more effective than giving them prolonged, weak light.

Methods

Radishes were grown in an enclosed environment with regulated temperature and light, plus adequate ventilation. We designed two growth setups (ie., two plantings and two harvestings). In the first setup, we measured the effect of changing the duration of the light/dark cycles but keeping the total light received over 28 days equal. In the second experiment, we attempted to speed up growth by increasing the lighting intensity and commensurately decreasing the light/dark cycle to simulate shorter but more intense days. We measured the height of the plants periodically and measured the mass of the plants at the end of the experiments.

Results

In the first experiment, the 24 hour cycle plants grew significantly better than the 12 hour plants and 8 hour plants in terms of both mass and height, and the 12 hour plants grew better than the 8 hour plants. In the second experiment, the 24 hour cycle plants again did the best. However, when we allowed the experiment to continue so that all 3 tents grew their plants for 28 calendar days, the trend was reversed, with the 8 hour plants doing the best, followed by the 12 hour plants and the 24 hour plants. The more intense light had a significant positive impact on the mass of the plants even though they received shorter light/dark cycles.

Conclusions

Our results from the first experiment indicate that plant biochemical processes are more efficient over extended periods of time. Our results from the second experiment indicate that it is difficult to speed up plant growth by shortening light/dark cycles and intensifying light. However, we did find that when we allowed all plants to grow for 28 days in experiment two, the plants that received the greatest light intensity did best regardless of cycle time. This leads us to the conclusion that light intensity is an even greater determinant of plant growth than light cycle time.

Summary Statement

Our project was conducted to study the effects of both intensity and duration of light on plant growth.

Help Received

Our parents helped purchase some materials.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Cosette Monson

Project Number

J1819

Project Title

Water Uptake Rate of Drought Resistant Shrubs

Abstract

Objectives

The objective of this project is to determine which drought resistant shrub has the lowest water uptake rate out of boxwood, Russian sage, and rosemary.

Methods

I tested the water uptake rate of drought resistant shrubs using an H-type (bubble) potometer and a stopwatch. I used clippings from the three types of shrubs: boxwood, rosemary, and Russian sage.

Results

I recorded multiple trials for each type of shrub and found that Russian sage had the lowest water uptake rate. The Russian sage's average rate was 0.62 cm/s, boxwood's was 1.28 cm/s, and rosemary's was 0.49 cm/s.

Conclusions

Russian sage had the lowest average water uptake rate. Based on my results, Russian sage would be the best choice for a consumer as a drought resistant plant that conserves water out of the three shrubs.

Summary Statement

I compared water uptake rates of the drought resisant shrubs, rosemary, boxwood, and Russian sage.

Help Received

I recieved feedback and advice from my science fair mentor and my science teacher guided me through the scientific process.

Name(s)

Harsha Pillarisetti

Project Number

J1820

Project Title

Effect of Intelligent Watering Systems on Plant Growth and Water Consumption

Abstract

Objectives

To understand if a sensor-based watering system uses water more efficiently and also improves plant growth at the same time by optimizing the water required by the plants.

Methods

Grew beans, radish, sunflower seeds in different soil types using different watering patterns. A total of 54 samples were used and laid out in 9 potting trays and were subjected to different watering patterns over 11 days. Measured amount of water consumed and plant growth (leaf count, plant height) among all the samples. Could not measure surface area (warped leaves) or color (no access to chromatograph) but visually observed leaf health (color) and estimated surface area differences using a graph sheet. The watering system used a soil moisture sensor, a raspberry pi controller and a submersible pump in a tank. 3 trays were watered without sensor (control samples), 3 trays were watered at a fixed frequency using a sensor and remaining 3 trays were watered multiple times a day using a sensor.

Results

The 3 trays that were watered multiple times a day using a sensor showed lower water consumption (36%) than control samples in loamy soil, while potting mix soil showed higher water consumption (14%). However, plant growth (as measured by leaf count and plant height) did not show any significant change in loamy soil but was 49% higher for potting mix in these trays. The leaf health (color, surface area) was also observed to support this data.

Conclusions

Since loamy soils retain moisture, frequent sensor-based watering results in significant (36%) reduction in water consumption with no impact to plant growth in most plants. In non-succulent soils (peat soils like potting mix) frequent sensor-based watering marginally increases (average 14%) water use to keep the moisture in desired levels, but also significantly increases (average 49%) plant growth in all types of plants. These findings have a deep significance for our irrigation systems in future in a world with significant fresh water shortages.

Summary Statement

I found that frequent sensor-based watering not only makes efficient use of water but also improves plant growth since it reduces water stress in plants caused by overwatering or excessive dryness.

Help Received

I designed the watering system based on research and internet study and performed the experiments myself. I received help from my parents to install the pump.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Libby Sanders

Project Number

J1821

Project Title

Biotechnology and the Soybean Revolution: The Effects of GMO Soybean Meal on Plant Growth and Environmental Pollution

Abstract

Objectives

The purpose of my science fair project was to determine if the application of genetically modified soybean meal fertilizer would result in negative growth outcomes and environmental consequences. Nearly 94% of US soybean crops are modified to be resistant to glyphosate, the active ingredient in common herbicides. Research has linked the chemical to increased use of fertilizers due to poor soil health, resulting in contaminated food and water sources. My study compared plant growth outcomes in terms of weight, and negative environmental effects measured as residual nitrate and glyphosate concentration in runoff water.

Methods

Plastic planting troughs were altered with PVC pipe to collect runoff water, then 16 snow pea seeds were planted in each. I applied .8 oz. of glyphosate resistant (GMO) soybean fertilizer to one, .8 oz. of Non-GMO soybean meal to another, and left the third unfertilized to act as a control. After 72 days of cultivation, I collected water samples and extracted the plants and weighed them with and without the root base. Nitrate concentration was tested with an Ion Chromatograph, and glyphosate was tested using the Abraxis Glyphocheck kit.

Results

The average weight of plants fertilized with non-GMO soybean meal was greater than those fertilized with the GMO product and control plants. These also sprouted more quickly and appeared to grow more vigorously. Only 8 out of the 16 plants fertilized with GMO fertilizer sprouted, giving a poorer overall yield. The results from water samples resulted high concentrations of nitrates from both GMO and non-GMO soybean meal, compared to the control. Glyphosate levels were reported as "high" for all 3 samples, and controls with Nanopure and well water both resulted in "non-detectable."

Conclusions

My experiment proved my hypothesis in terms of plant growth. GMO fertilizer yielded a smaller number of plants and lower average weight. In regards to environmental pollution, the results were inconclusive. Both fertilizers were significantly higher than the control and the maximum contaminant level for nitrates, showing they both have the potential to be very polluting. The elevated glyphosate results revealed that the soil in all test troughs had been previously contaminated, obscuring the outcome. My project reveals the importance of limiting the use of herbicides and fertilizer to avoid accumulation of contaminants in soil and water.

Summary Statement

My analysis indicated the negative effects of (GMO) glyphosate resistant fertilizer on plant growth outcomes, however, environment pollution could not be determined.

Help Received

I was given assistance by my dad in altering the troughs with a drill. I was also guided by the laboratory supervisor in the use of the Acquion Ion Chromatograph.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Mackenzie Scott

Project Number

J1822

Project Title

Determining the Effect of Various Organic Solutions on Plant Growth

Abstract

Objectives

The objective was to learn what organic solutions would effect plants growth.

Methods

Scarlet globe radish seeds, planters, and soil, were purchased and organic materials were gathered(lemon, grapefruit, orange, potato, and onion). Organic solutions were made with one and one half cup of water with one fruit/vegetable worth of peels. The mixtures were blended until it became a solution, and this process was repeated for all the organic materials. Seeds were planted and watered with the organic solutions and water only was used for the control. Plants were watered with the solutions every three days. Plants were monitored and measured daily for growth.

Results

Some organic solutions effected the plants growth. The onion solution was the most successful in promoting the radish seeds growth. Potato solution was also successful. The fruit solutions were the least successful because they formed a gel on the top of the plants and prevented growth.

Conclusions

Using ten trials of each solution, the most successful solution was onion in promoting the radish seeds growth.

Summary Statement

The organic solution that was most effective in increasing radish seed growth was an onion solution.

Help Received

My science teacher helped me research information for my project.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Aniyah Shen

Project Number

J1823

Project Title

The Power of Soil Productivity

Abstract

Objectives

The purpose of this project was to find the major cause of the growth differences between the two lemon trees in my backyard.

Methods

I used the Carolina Physical and Chemical Properties of Soil kit to study the soil samples from the two lemon trees. I tested five factors that influence soil productivity: particle size, water-holding capacity, soil permeability, free ions (pH, N, P and K), and ion exchange capacity. I collected soil samples from 5 sites around the root spread of each tree and tested 3 repeats per sample for a total of 15 samples per tree and 30 samples total. My 3 controls were clay, sand, and humus. For particle size distribution, 30 jars were filled halfway with one sample per jar. Water was added to the brims and one drop of dish detergent was added to each jar. The jars were shaken and settled overnight. I measured the widths of the settled layers and used the Soil Analysis Triangle to determine soil type. Soil permeability was measured by timing how long it took 10 mL of water to pass through 33 dry and 33 wet soil sample columns. Water-holding capacity was measured by allowing 33 dry samples to absorb water overnight and calculating the weight of water that was absorbed. Chemical indicators were used in the analysis of free ions to determine pH, N, P and K levels. Ion exchange capacity was tested by washing Crystal Violet and Eosin Y through 33 sample columns per dye. The volume of water added, the color intensity of the filtered water, and the ion exchange chart were used to determine ion exchange capacity.

Results

My results show that the soil samples from the good lemon tree were silty loam and contained higher levels of clay and humus compared to the soil samples from the bad lemon tree, which were sandy clay loam. The higher level of humus in the good samples resulted in higher soil permeability and water-holding capacity. The higher level of clay in the good samples resulted in higher ion exchange capacity. All the soil samples have an ideal pH level and enough N, P, and K.

Conclusions

My results support my hypothesis that soil productivity is the major cause of the growth differences between the two lemon trees. The bad soil can be improved by adding a humus and clay mixture to increase soil permeability, water-holding capacity, and ion exchange capacity. The results of this study can benefit homeowners and farmers who are having trouble growing their plants.

Summary Statement

I investigated the cause of the growth differences between the two lemon trees by testing five factors that influence soil productivity.

Help Received

My science teacher, Mrs. O Brien, guided me through the entire process. Dr. Arthur Jia from UC Riverside assisted me with the statistical analysis.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Gary Shirikchian

Project Number

J1824

Project Title

Gary's Hydroponic Garden

Abstract

Objectives

Currently, parts of the world, such as Cape Town, South Africa, are running out of an essential part of human life, water; water is used to grow crops, cook food, and is used on a daily basis in numerous ways. To conserve water especially in one of the most water-consuming activities, agriculture, hydroponics could be used as an alternative. The objective of these experiments was to determine the ability to grow plants without soil, and avoid plants from pesticides, and most importantly to conserve water while still growing plants efficiently and faster.

With the completion of my research, I discovered that not only do hydroponic agricultural methods conserve a large amount of water compared to traditional agriculture, the methods also grow plants faster and larger because of the direct water and nutrient source. Due to this information, I hypothesized that the ebb and flow hydroponic system will work more efficiently than soil and aeroponics in both conserving water and growing plants larger and faster.

Methods

To the experiments that I conducted, there are two procedures. Procedure one begins with filling the reservoir with plants, water, and nutrients at the 12 mark which is at the six-inch mark. Once the plants are in regularly water the plants in the hydroponic systems twice a day seven days a week for one minute and regularly water the plants in soil three times a week until the water drips through the bottom hole of the planting cups. Throughout the weeks while watering the plants make sure to mark down the number of gallons used when watering plants. To find the amount of water lost in the hydroponic systems use the side ruler and the scale of 0.5 inch=1 gallons to measure the loss of water per week in units of gallons and percents.

The second procedure of my experiment is testing which method of irrigation is the most efficient when it comes to growing plants faster and larger organically. Once the plants are placed in the hydroponic system and in the soil water the plants at the necessary amount. Throughout the process of growing the plants mark the plants with a colorful tab for calibration purposes and measure the height of the plants. For every week that goes by measure the heights of the plants in units of inches and compare the results of each type of method to one another. If the mints outgrow the system trim the leaves of the mint but continue to add onto the past height of the plant as the plants grow. The apparatus itself was constructed by me with assistance with power tools such as a power saw from my father. The exterior is made mostly from tinted plexiglass and clear plexiglass, while the interior is made from plexiglass, mesh, PVC pipes, plastic cups,

Summary Statement

I showed that when using either hydroponic method, plants grow faster and larger and most of the water usin in the hydroponic methods were saved and reused, where they could not be in soil.

Help Received

I recieved help from my father with power tools suc as power saws and assistance from my father when bending the plexiglass with a heatgun.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

LeAnn Tai

Project Number

J1825

Project Title

Effect of Climatic Changes on Plant Growth: A Study of Their Adaptation Patterns

Abstract

Objectives

The aim of this research project was to analyze the effect of certain environmental changes on plant growth and their adaptation patterns for survival. This would help us understand how to prepare plants for the future. Our climate is fluctuating rapidly, which is affecting all aspects of our lives. Other than finding solutions to control our climate, we must also prepare to adapt to this crisis. It is important to protect plants from our changing environment.

Methods

This project was split into three main experiments. I constructed a homemade plant incubator. The plants Marigold, Cosmos, Zinnia, and Alyssum were used for their fast-growing nature. In Experiment 1, I grew the plants under various temperatures (95°F and 110°F, 80°F as control) to simulate the rise in global temperature. In Experiment 2, I watered the plants different amounts of water and at different frequencies to represent drought and flood conditions due to global warming and sea level rise. In Experiment 3, the plants were watered with slightly (3000 µS/cm) and moderately saline water (6000 µS/cm) made from water, NaCl, and CoCl(2) to show soil and water pollution. For all plants, at the end of two weeks, I measured morphological parameters: height, number of leaves, largest leaf area, root length, fresh weight. I performed four trials for each experiment, with around 1500 samples in total. I studied the taxonomic relationships between the plants.

Results

In Experiment 1, the plants had longer roots, more leaves at 95°F, and less leaves at 110°F. Plants grown in drought conditions had longer roots, however, different plants developed different adaptations in flood conditions: Cosmos grew taller while Zinnia produced thicker stems. In Experiment 3, many of the plants germinated but didn t survive for the two weeks.

Conclusions

In water shortages, the plants grew longer roots to reach deeper areas with more water. The plants grew more leaves for more evaporative cooling through stomata, but less leaves if evapotranspiration would dehydrate the plant. Cosmos grew taller to rise above the water level, possibly because of higher levels of auxin, while Zinnia exhibited more secondary growth to resist against water pressures and massive osmotic uptake of water. We can predict that increasing amino acids like proline and varying regulation of hormones like ABA can help plants survive salt stress. We saw that Cosmos and Zinnia plant were the most related out of the four plants. In general, the zinnia plant showed the best adaptive mechanisms.

Summary Statement

This project aimed towards investigating how plants respond and adapt to environmental stresses, including temperature, precipitation, and salinity stress.

Help Received

I prepared the salinity solutions at school under my science teacher, Mr. Nguyen s supervision. Dr. Kanika Sharma Mittra was there to answer my questions when I had confusions.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ashlyn Vincent

Project Number

J1826

Project Title

Invisible Forces: Magnetic Effects on Plant Germination and Growth

Abstract

Objectives

The objective of this study is to identify if exposing plants to strong magnetic fields affect plant germination and or growth.

Methods

Tests were performed using 24 bean plant seedlings in total, twelve within Ziploc baggies, twelve within test-tube environments. Within each group, subsets of three were then subjected to varying degrees of magnetic force, observing and measuring findings daily. Differing strengths of neodymium magnets were used to produce strong magnetic fields, employing the influence over the fourteen day test period.

Results

Ziploc Test Environment - Ziploc test environments containing applied magnetic fields showed magnetic influence concerning germination, having sprouted two days earlier than control specimens without. Subset Beta experienced a catastrophic neodymium magnet failure after six days, resulting in an unexpected finding, having all plants within that given subset grow at a rate of double as compared to all others.
Test-Tube Environment - Cumulative results viewed through the average mean in test-tube environments showed fewer positive signs for magnetic field effects in relation to plant germination and growth. Overall, the control group outperformed all other subsets, yet nothing discerning from the performance of others.

Conclusions

In conclusion, magnetic fields do appear to have the potential to alter plant germination and growth. Expedited germination was noted as compared to the control subset viewed in the Ziploc baggy environment, sprouting a full two days early. In optimum test-tube soil environments, effects were less notable when comparing mean averages obtained from sample sets. However, the most notable effect observed occurred through pure chance and test failure. Sample set Ziploc Beta experienced a catastrophic magnetic field failure, resulting in only a 6-day magnetic field exposure. The results obtained from this entire subset outperformed all other subsets by nearly double, showing a potential breakthrough for magnetics in plant biology, not just for expedited germination, but for enhanced growth as well. The initial hypothesis was not supported by data obtained.
Upon further testing, if magnetic field exposure truly does expedite germination and growth with relative frequency, crops may potentially be harvested earlier, planted in shorter season cycles, require less water consumption, and may yield more value in crop production.

Summary Statement

Tested the effects of strong magnetics fields on plant germination and growth, measuring any and all influences observed.

Help Received

Aided by Derrick McCain (Step Dad) in project setup, material handling, and customized magnet/ test-tube holder apparatus build-out.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Pranav Walimbe

Project Number

J1827

Project Title

More Sugar, Please!

Abstract

Objectives

Ethylene is a plant hormone gas that is released in the ripening of fruits. It tells fruit to produce certain enzymes that facilitate the ripening process. I wondered whether the presence of ethylene during storage will cause fruits to produce more fructose (fruit sugar) than they would ve if stored on their own; so, I designed an experiment that would test said concept. My question was how does ethylene affect the fructose quantities in fruit. I hypothesized that if unripe fruits are stored with ripe fruits then they will produce more fructose than they would ve if stored on their own because of ethylene presented by the ripe fruit. My experiment included fruit stored in paper bags, as paper bags trap the ethylene while allowing oxygen to circulate. I chose bananas and avocados as the ethylene producers because they are the most efficient fruits in creating it. I selected mangoes and pear because they contain juice that can be be easily extracted for testing fructose testing with a refractometer. The independent variable was the presence of ethylene presented by the ripe fruit. The dependant variable was the amount of fructose in the unripe fruits.The experimental groups were the bags containing unripe fruit and ripe fruit. The control groups were those with only unripe fruits. The control groups would determine the fructose levels under normal, unaffected circumstances possible, while the experimental groups would show how the fructose levels varied with the addition of the presence of ethylene. After four days of storage in the paper bags, the fruits were ready for their fructose levels to be tested. My measuring method was with a refractometer, which finds the concentrations of a solution based on the solution s optical density, or how it bends light. The solution it tested was a given sample of the unripe fruit juice. In the end, the fruits stored in the presence of ethylene on average posted greater Brix percentages (unit of sugar measurement in solutions) on the refractometer, indicating more fructose. The results were consistent with my hypothesis, supporting the idea that ethylene induces more fructose.

Methods

Materials
Refractometer
20 unripe mangoes
10 ripe bananas
20 unripe pears
10 ripe avocados
40 paper bags

Summary Statement

Fruits release ethylene during ripening; will this gas influence fruits to produce more fructose(fruit sugar) than if not kept in ethylene's presence.

Help Received

My father bought the refractometer for me. All remaining work was completed by me at home.

CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Christina Walley

Project Number

J1828

Project Title

Nutrient Density of Plants: Aquaponics or Soil?

Abstract

Objectives

The goal of my project was to determine whether aquaponics grown plants will grow larger and more nutrient dense than soil grown plants watered with water from the aquaponic system.

Methods

Aquarium: Set up an aquarium and run the pumps and filters continuously to start cycling the tank. Check water chemistry for ammonia, nitrite, and nitrate levels every few days. After the water chemistry stabilizes, acclimate and add the tilapia to the tank. Monitor tank parameters very closely and feed the fish daily. Plants: Purchase 24 chard plants. Gently brush off the dirt from the roots and dip the root ball in water to take off leftover soil. This way all plants are placed in the same condition in their growing media. Divide and place the plants into two groups of 12 plants each. Place the plants in their respective pots, and cover the root ball with the growing media. Place the 12 aquaponics plants in the grow bed. The 12 potted plants should be next to them. Water all plants with water from the fish tank as needed. Test: Do the data collection as soon as possible after harvest. Use a tape measure to record the length of the tallest leaf and the width of the widest leaf per plant. Count the number of leaves per plant. Pick a leaf from each plant, extract juice from it, and place a drop of juice on the daylight plate of the refractometer. Look for the color change on the scale. Take the reading, and record the data.

Results

The aquaponics plants had 14% (1.16cm) taller leaves, 30% (2.17) more leaves, and 13% greater sugar content present in the juice.

Conclusions

Swiss chard grown in an aquaponic systems grew larger and are more nutrient dense. The results of my experiment support my hypothesis because the plants in the aquaponics system, were on average 1.16 cm taller, the leaves were 1.38 cm wider, had 2 more leaves and had Brix readings on average 13% higher. I started with 12 plants in each group, but I did lose 6 of my soil plants as well as 4 aquaponics plants to heat and insects. The 6 soil plants left were healthy, so to be fair, I selected 6 from the aquaponics system to test instead of testing all 8. I would have done a few things better, mainly starting earlier, and having replacement plants of the same age,and I would have built a greenhouse to protect the plants.

Summary Statement

The results of my project were that the aquaponics grown plants were bigger, and had a higher sugar content than the soil plants; higher sugar readings can correspond to higher nutrient density.

Help Received

My Dad taught me about fish and aquariums, he helped me design and build the aquaponics system. My teacher reviewed my project and gave me lots of guidance.