CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Jack T. Adams

Project Number
S1901

Project Title
The Effects of Photosynthesis on Martian Atmospheric Composition in a Closed System

Abstract

Objectives/Goals
Martian habitability is a problem for NASA and other space agencies that will need to be solved before we can send people to Mars. This project consists of attempting to transform current Martian atmospheric composition into a composition in which humans could potentially inhabit within an enclosed environment. This could potentially solve the problem of the inhospitable Martian atmosphere.

Methods/Materials
Two airtight boxes were constructed using plexiglass and a strong adhesive, and Lepidium sativum (Garden Cress) was planted in regular potting soil in one box and planted in Martian soil simulant in the other. The container was flushed with 100% carbon dioxide and sealed, and the plants were allowed to grow for approximately 20 days. The resulting atmospheric composition was monitored over all of these days using carbon dioxide and oxygen gas sensors and recorded to a LabQuest device.

Results
The results of the experiment show that after 20 days, the oxygen and carbon dioxide levels returned to very near that of Earth. The experiment is affected, however, by the fact that the chambers could have been leaking, and other life might have been present in each box. Because of this, it cannot be concretely determined that the results were directly the result of the plant growth.

Conclusions/Discussion
Overall, the experiment worked considering the gas concentrations over the 20 days. If this is done on a larger scale, the same effect could be achieved on Mars. The results could have been skewed by leaking of the chambers of carbon dioxide, however. Another trial with re-secured chambers will be conducted within the time between the submitting of this application and state science fair.

Summary Statement
This project attempts to prove the viability of a certain system of oxygen production that could be used on Mars.

Help Received
Dr. Malhotra, my advisor, helped me to develop my methods, as well as Mr. Jeffery Lewis, He also helped me with making sure the chambers were airtight and flushing them with carbon dioxide, My dad also helped me with construction of the chambers.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anthony J. Castillo

Project Number
S1902

Project Title
Plant-Derived Smoke: The Effect of Karrikin on Water Stressed Yemeni Watermelon (Citrullus lanatus) Landrace Seeds

Abstract

Objectives/Goals
Drought is an environmental stress that affects the establishment, survival, and growth of plants. Researchers have discovered that karrikin, a compound found in smoke, accelerates seedling growth and resistance to stresses in many plants.

The objective of this experiment was to measure the effect of karrikin, a butenolide plant derivative, on germination, leaf length, and dry weights of plants, roots and shoots of Yemeni watermelon (Citrullus lanatus) landrace seeds exposed to a period of water stress.

Methods/Materials
Using a bee hive smoker and bee fuel pellets to create smoke fumigation, watermelon (Citrullus lanatus) landrace seeds from Yemen were subjected to karrikin exposure (50 seeds per length of time) for 2, 4, 8, 16 and 32 minutes. Fifty untreated seeds were used as a control group. The seeds were planted in trays, grown indoors, and observed for thirty days. On Days 1-14 seeds were given 5mL of reverse osmosis (RO) water every 12 hours. On Days 15-30, seeds were given 5 mL of RO water to establish a moisture level below 4.0, the wilting point for cucurbits. A digital moisture meter was used to measure daily moisture levels. Fresh and dry plant measurements were taken at the end of the 30 day trial. There were two trial periods.

Results
The seeds exposed to aerosol smoke karrikin treatments prior to planting had better plant growth during the period of water stress than the control group. The karrikin treated seeds produced seedlings with heavier dry plant, dry root, and dry shoot weights than control seeds. Karrikin treatment also resulted in seedlings with more leaves and greater leaf length than control.

Conclusions/Discussion
The results of the experiment suggest that pretreating Yemeni watermelon (Citrullus lanatus) landrace seeds with karrikin prior to planting is beneficial to the growth and development of seedlings during a period of water stress. The use of karrikin could possibly be a convenient low-cost way for traditional farmers to minimize watermelon plant sensitivity to water shortage.

Summary Statement
I used a beehive smoker to pretreat Yemeni watermelon landrace seeds with karrikin and studied the growth and development of the seeds after a period of water stress.

Help Received
I designed this experiment myself after speaking with Mohamed A. Al Jumai about traditional farming in Yemen and researching the practice of adding wood ashes to soil. Mr. Al Jumai provided the seeds for my project.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Suchitra Dara; Sumanth Dara

Project Number

S1903

Project Title

Antagonizing a Plant Pathogen with Beneficial Microbes to Promote Sustainable Agriculture

Abstract

Objectives/Goals

Evaluate the effect of the biopesticides based on a plant extract, beneficial bacteria, and entomopathogenic fungi, on cotton plants infected with the fungal plant pathogen, Fusarium oxysporum f.sp. vasinfectum (FOV). Plants# health ratings will be measured on a scale of 0 to 5. If the plants inoculated with the biopesticides in addition to the FOV pathogen have a higher rating than those inoculated only with the pathogen, using the beneficial fungi will improve the health of crops, thus providing additional incentive to use biopesticides.

Methods/Materials

Pima cotton seeds were planted into trays separated and labeled by treatment and regimen. Each treatment consisted of 16 plants and was replicated four times. Seeds planted in healthy and FOV4 infested potting mix represented negative and positive controls, respectively. Treatment solutions prepared based on the label rates for soil and foliar applications. Treatments were administered by adding 10 ml of the solution in respective treatments. Trays were placed in a greenhouse and watered every day for five minutes at noon. At 3, 4, and 5 weeks after planting, health of the plants was measured on a 0-5 scale.

Data were analyzed using the ANOVA model, and significant means were separated using the LSD test.

Results

In general, treatments helped reduce the severity of the disease. Plants in the negative control treatment displayed no signs of infection and maintained a very high health rating (approximately 4.8 out of 5). Plants in positive control (pathogen alone) demonstrated severe symptoms of disease # that included yellowing, necrosis, and wilting # throughout the observation period.

Conclusions/Discussion

The presence of FOV 4 significantly affected the plant health. Treating the potting mix with the beneficial fungi and biopesticides had a positive impact on reducing the severity of FOV 4 in cotton seedlings. Multiple applications or higher rates of treatments are more effective.

Entomopathogenic fungi-based BotaniGard, Pfr-97, and Met52 were among the best treatments antagonizing FOV 4.

Biopesticides are commonly perceived to be less effective than chemical pesticides, but by conducting studies like this, we can determine the proper application rate and frequency to improve their efficacy.

Summary Statement

We are using beneficial microbes to protect plants from disease.

Help Received

Neil Hudson, San Joaquin Valley Quality Cotton, Tim Anderson, Dow AgroSciences

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anita Garg

Project Number
S1904

Project Title
The Effect of Water Usage on Native Coastal Sage Scrub Plants

Abstract

Objectives/Goals
The goal of the experiment was to understand how best to preserve and restore the native coastal sage scrub community.

Methods/Materials
Materials: 48 Salvia apiana plants, over 150 samples of Artemisia californica, Eriogonum fasciculatum, and Sonchus oleraceus, 10 Encelia californica plants, 10 Isocoma menziesii plants, Decagon leaf porometer, scientific oven, scientific scale, meterstick. Methods: I first tested the effect of two different seeding styles on the growth of Salvia apiana. Next, I tested the effect the effect of slope aspect on Artemisia californica, Eriogonum fasciculatum, and Sonchus oleraceus. Finally, I simulated a drought to test the drought tolerance of Encelia californica and Isocoma menziesii.

Results
For the first part of the project on seeding styles, the average height of the shrubs only group was 31.9% greater than the average height of the mixed group. However, the average stomatal conductance of the mixed group was 27% greater than that of the shrubs-only group. For the second part of the project on slope aspect, the only plant that had a higher SLA on the north-facing slope was Eriogonum fasciculatum. A possible reason why could be because south-facing slopes in this hemisphere receive less sunlight than north-facing slopes, and therefore plants that consume more water such as Sonchus oleraceus and Artemesia californica grow better on south-facing slopes than on north-facing slopes. For the dry down experiment, Encelia californica had many more dead leaves than Isocoma menziesii did. This could be tied to the fact that Encelia californica consumed an average of 84.25 grams more water than Isocoma menziesii did, which means it depletes it water source more quickly and therefore is less drought tolerant.

Conclusions/Discussion
A species# rate of water consumption is partially dependent on its nature to consume water and partially dependent on its environment. A species with a natural disposition to consume less water and with a more hospitable environment tends to exhibit greater growth than a species that consumes more water or that is placed in a less hospitable environment.

Summary Statement
I created an action plan for future coastal sage scrub restoration projects based on the amount of water available.

Help Received
I conducted the experiment and collected all data by myself. I was able to borrow the UCI CEB's porometer to take stomatal conductance measurements.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Sagar Gupta

Project Number

S1905

Project Title

Investigation of Various Chemical Treatments for Root-Knot Nematodes

Abstract

Objectives/Goals

The objective of this project was to learn the effect of different nematode treatments, specifically Nimitz and Velum, on tomato plants grown in soil infested with root-knot nematodes. The hypothesis states that Nimitz will be most effective in resisting nematode activity and result in highest root-shoot ratio in tomato plants grown in treated soil.

Methods/Materials

Two chemical treatments were used, Nimitz and Velum. Two control treatments were used, Miracle Gro soil and nematode-infested soil. Each treatment had five plants. The plants were germinated, then grown in a greenhouse for four weeks. Following this, they were assessed by measuring fresh and dry weights of root and shoot. The fresh and dry root-to-shoot ratios were calculated.

Results

The tomato plants grown in the Nimitz treatment resulted in the highest root-to-shoot ratio, at 0.67. The plants grown in normal soil had root-to-shoot ratio greater than the plants grown in nematode-infested soil, at 0.36 and 0.21, respectively. The plants grown in Velum treatment had average root-to-shoot ratio at 0.34. An ANOVA analysis of root-to-shoot ratio of dry plants showed that the two treatments were statistically indifferent.

Conclusions/Discussion

My hypothesis was partially correct. The plants grown in the Nimitz did have the highest root-to-shoot ratio numerically, but based on ANOVA testing, there is no significant difference between Nimitz and Velum treatment. The Nimitz did prevent against root galling. Although nematode-resistant tomato varieties exist, the nematodes eventually evolve to kill the plants. The Nimitz and Velum treatments provides a permanent solution to the root-knot nematode problem.

Summary Statement

Two different treatments were used, Velum and Nimitz, in nematode-infested soil containing tomato plants to determine which treatment produces plants with the highest root-to-shoot ratio and prevents root galling from root-knot nematodes.

Help Received

Mr. Joe Nunez of the UC Cooperative Extension Kern County provide the nematode soil and general guidance for the project. Ms. Tamera Tomaschow allowed me to use the greenhouse.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Desiree Ho

Project Number

S1906

Project Title

Cloning African Violets through Autotrophic Tissue Culture

Abstract

Objectives/Goals

Traditionally, tissue cultured plantlets use sugar provided in the medium for energy because the jars in which they are housed are sealed. My objective was to test if sections of African violet tissue would grow at an accelerated pace and have a decreased chance of contamination when provided a sugarless gas-permeable environment.

Methods/Materials

Materials include CO(2) testing solution to determine gas permeability of various plastics, heat sealer to make small plastic bags, 60 glass vials, pressure cooker to sterilize, 4 g Murashige and Skoog medium, 1-Naphthaleneacetic acid (synthetic auxin hormone), 6-Benzylaminopurine (synthetic cytokinin), and coconut water (natural cytokinin).

The CO(2) system is constructed from a bottle with yeast, sugar, and water attached to a bubble counter to gauge gas production, connected by airline tubing to the growth chamber. Ninety sterilized plant sections were housed individually in glass vials covered with gas-permeable Ziploc bag plastic (Autotrophic 1, or A1), small bags made from Ziploc plastic (Autotrophic 2, or A2), and vials sealed by the original screw cap with added sugar (Mixotrophic, or M).

Results

Overall, the explants in A1 and A2 had contamination rates 4 times lower and survival rates 2 times higher than those of M. However, the explants in the M experimental group haddeveloped calli (undifferentiated tissue, the precursor to shoots and roots) with larger biomasses. On the other hand, regardless of the original hormone supplement provided, 83% of the calli in autotrophic conditions differentiated into green shoots with the potential of maturing into adult plants, while 67% of the M group produced roots, which are more difficult to work with and have less potential.

Conclusions/Discussion

I developed a new method of plant propagation through the use of Ziploc bags and CO(2) generated from materials adapted from the fishkeeping hobby. My original hypothesis was partially supported; A1 was the most successful because of its structural stability, while A2 was similar but secondary in success and the M group was least productive. This unique, cost-effective technique may be applied to the cultivation of plant medicines, production of economically significant crops, propagation of fragile or sterile plants, and conservation of endangered species.

Summary Statement

This project investigates the effect of varying levels of gas permeability and carbon sources on the growth and differentiation of cloned African violet plantlets.

Help Received

I designed and performed the experiment at home by adapting information from previous publications focused on different plants and procedures.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Kim T. Johnson

Project Number
S1907

Project Title
The Response of Pea Plants to Different Photoperiods

Abstract

Objectives/Goals
The objective of this study is to see the responses of Pea Plants' when altering their photoperiods by measuring their height in centimeters and their flowering rates.

Methods/Materials
Dried up seeds of Pisum Sativum, water, twelve cups/pots (four for each of the three groups), potting soil, three low-watt Fluorescent Light Bulbs with low color temperature, Plant Chamber which I crafted myself using cardboard, three trays for the three different groups of plants, a ruler that measures centimeters to measure plants everyday.

Results
The plants with a shorter photoperiod did, indeed, grow significantly faster in height, as well as flowering at a significantly faster rate. The control group came in with the second highest growth rate, and the plants with the longer photoperiods grew at the slowest rate. For the flowering rates, the plants with the shorter photoperiod had the highest flowering rates. The plants with the longest photoperiod had the lowest flowering rate (they also had a larger biomass, which was observed, not measured), and the control group was roughly in the middle.

Conclusions/Discussion
Altering the photoperiods of Pea plants has definitely affected their growth in height and flowering rates when comparing them to the control group, which had a normal spring season photoperiod (14 hours of light 10 hours of dark). This expands our knowledge of circadian rhythms and their entrainment to different environments, and how it may affect agricultural businesses.

Summary Statement
When altering Pea Plants' photoperiods, I discovered that shorter photoperiods accelerate plant's growth in height and flowering.

Help Received
None. I designed, built, and performed the experiments myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Esther E. Koh

Project Number

S1908

Project Title

Sucrose and Proton Electrochemical Gradients Mediated by Transporters in Phloem Loading as Crucial Aids for B. tabaci

Abstract

Objectives/Goals

Bemisia tabaci is responsible for transmitting East African pandemics of cassava mosaic disease (CMD) and cassava brown streak disease (CBSD). Since the 1990s, there has been an unprecedented rise of cassava whitefly in the cassava-growing regions, increasing the spread of CMD and CBSD. However, expensive insecticides can cause insecticidal resistance and Hemipteran resistance genes are not common in plants.

1. By investigating whether B. tabaci reaches the phloem through the help of the sugar gradient secreted by SWEET sucrose transporter proteins, the proton electrochemical gradient generated by H+-ATPase plasma membrane proton pump, or SUC sucrose transporters, I hoped to gain understanding of the feeding strategies of whiteflies.
2. I needed to determine which sucrose transporter mutant whiteflies had the most difficulty on.
3. If the whiteflies on a mutant showed difficulty in reaching the phloem, I needed to analyze to what degree it deviated from expected data.
4. To obtain the most data, I had to design new cages and staining and clearing protocols.

Methods/Materials

I infested Col-0, atsweet11, atsweet12, atsut1,atsut2, and ataha3 with whiteflies. Whiteflies were then counted and removed, and leaves stained with McBride's to track stylet pathways. I documented the number of stylets, bifurcations, and its locations, and compared the results. I also developed a new whitefly cage and tested various parameters to improve staining and clearing protocols.

Results

After analyzing stylet destination, directionality, and individual successes of feeding in the mutants and Col-0 using linear regression and chi-square goodness-of-fit tests, I clearly determined that whiteflies on atsweet12 had the most difficulty and least success in reaching the phloem. Agar dish infestations cleared up data and clearing stained leaves in an oven at 90°C for 36 hours before mounting produced best results. The electrochemical gradient and SUC mutants are currently being tested.

Conclusions/Discussion

By inducing the gene expression of SWEET12 proteins, whiteflies had an extremely difficult time feeding. Signs of difficulty in the absence of SUC transporters and AHA3 may provide further evidence of phloem loading's role during whitefly feeding and indicate other gradients whiteflies exploit. This new knowledge of the feeding mechanisms of whiteflies is crucial to improving plant defenses. Publication is under way.

Summary Statement

I have determined that by directly suppressing SWEET12 and possibly SUC and H+-ATPase gene expression, successful whitefly feeding was greatly reduced.

Help Received

I give a tremendous amount of gratitude to Dr. Walling and Mr. Thomas for mentoring me through this project and allowing me to use UCR's whitefly colony and facilities. Mr. Thomas assisted me during the experiments and infestation, but the analysis and conclusions reached were conducted by myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Nathan J. Lewis

Project Number
S1909

Project Title
Salt Water for Plants?

Abstract

Objectives/Goals
This experiment attempts to determine if plants can thrive when supplied with water of higher salinity than fresh water.

Methods/Materials
Planted three sets of seeds of five different types of plants and used six different water types (18 containers for each type of plant). Every week for six weeks, watered each container with its corresponding water type, measured and recorded the plant height, and tracked how many days it took for the first plant in each container to sprout.

Results
Plants supplied with distilled water grew best. The higher the water salinity content, the less the plant grew. No plant growth occurred when supplied with ocean water across all plant types.

Conclusions/Discussion
After six weeks of growth, the plants grew mostly in accordance with my hypothesis. It was true that the plants grew less when supplied with higher salinity water. However, growth did occur in some plants up to 35,000 ppm showing that plants can grow even without pure, fresh water.

Summary Statement
I found that, although plants that were supplied with different levels of saline water did not grow as well, they are able to grow despite the fact that it was not fresh water.

Help Received
My biology teacher helped me learn how to use the refractometer to measure water salinity

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Grady Morrissey; Matt Son

Project Number

S1910

Project Title

A Study of Macromolecule Absorbtion by Plants in a Hydroponics System

Abstract

Objectives/Goals

With concerns about food safety and the exact contents of each bite of produce, it is important to see how plants absorb nutrients. This study examined macromolecule absorption by basil plants in a hydroponics system. Using hydroponics for the scientific model has the advantage of allowing complete control of extraneous variables of interest.

Methods/Materials

The hydroponics system, a deep water culture, consisted of five bins filled with nutrient reservoir with lids containing plants growing roots down to the reservoir for sustenance. Two of the five bins were filled with plain nutrient solution as controls, while the other three experimental bins were supplemented with either glucose, starch, or lipids.

This study used macromolecule indicators in a semi-quantitative test, which was used to determine the relative concentration of a macromolecule in different solutions. By pairing control plants with experimental plants at the same dilution, the relative amount of the macromolecule could be found using indicators. After about two months of allowing the plants to grow and absorb the macromolecules, testing began.

Results

The pairs were tested for the macromolecule fed to the experimental plant in order to find how plants absorb different macromolecules depending on their availability. As expected, the plants fed glucose and starch had higher macromolecule concentrations than their control counterparts, while the plants fed lipids did not absorb more than the controls.

Conclusions/Discussion

These results are explained by plant nutrient uptake through osmosis, as only water-soluble nutrients are able to pass into plants through water.

Summary Statement

Our study used biological indicators to prove that macromolecule absorption by plants in a hydroponics system is a function of water-solubility.

Help Received

We designed, built, and tested with the help of internet research as well as learning the techniques for the biological indicators from our Biology teacher, Ms. Kaufman.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Sofia Perez; Janet Reyes-Zamora

Project Number
S1911

Project Title
The Effects of Air Pressure on Pisum sativum Germination

Abstract

Objectives/Goals
Our objective was to investigate how changes in air pressure might affect seed germination in pea plants.

Methods/Materials
potting soil, spray water bottle, pea seeds (Pisum sativum), small containers for planting seeds, air compressor, Culligan water filtration chamber, Vacuum chamber and motor, boxes for normal atmospheric pressure, and a ruler.

Results
Pea seeds were grown under three different types of air pressure: high pressure (50psi), low pressure (-12.3psi), and atmospheric pressure (14.7psi). Seeds germinated under these conditions for a week. Sprout lengths were measured to determine the effects of the different air pressure types. Based on our data, increased air pressure had a negative effect on seed germination.

Conclusions/Discussion
The results in this experiment showed that the seeds that were germinated under normal atmospheric and decreased air pressure had longer sprout lengths than seeds that were germinated under increased air pressure. Seeds germinated under increased pressure had shorter sprout lengths.

Summary Statement
We determined that increased air presure had a negative effect on seed germination.

Help Received
Our science teacher Mrs. Manabe

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Cole R. Rabano

Project Number
S1912

Project Title
Polyphosphates in Mustard Algae Pool Pest Could Bolster Growth of Backyard Vegetable Plants

Abstract

Objectives/Goals
Observed the efficacy of polyphosphate-rich mustard algae on kale plant growth to determine its organic fertilizer potential, transforming a prevalent swimming pool pest into a vegetable garden growth enhancer.

Methods/Materials
Extracted mustard algae from swimming pool. Deposited into buckets and cultivated supply. Planted ten kale plants evenly divided into two 27" x 9" clay deck boxes; five labeled Experimental and five labeled Control. Kale individually labeled and planted 3" deep/5.5-7" apart. Fed experimental group 200ml mustard algae water/control group 200ml garden hose water every 2-3 days. Measured and documented soil moisture daily. Tested soil pH and phosphate levels 1x/wk. Collected data on plant height and leaf count.

Results
Control group gained in growth with average height of 21cm, while experimental group lagged behind slightly, yet gained in average # leaves. Similarly, while control group average height rapidly increased initially, it inclined at a slower, steady rate, narrowly beating experimental group by .3. But the experimental group had a growth spurt from wk 0 to wk 1, then height leveled off and plants increased in leaf count. Result could stem from polyphosphate deficient soil; experimental group fed polyphosphate-rich mustard algae water, boosting height initially and then stimulating leaf growth.

Conclusions/Discussion
Results did not fully support hypothesis overall because experimental group average height was less than control group. Limiting factors involved experimentation for a 4-week period during frigid nite temperatures (inhibiting photosynthesis, equating to less energy for kale growth); lack of sunlight from move to new residence shrouded in shade; attack of caterpillars and slugs; and planter that may have restricted root growth. With further testing, this readily available mustard algae backyard swimming pool pest could become a viable organic fertilizer in lieu of synthetic fertilizers that can seep into groundwater, causing a host of health issues for future generations.

Summary Statement
I devised an experiment to test the efficacy of mustard algae (a prevalent swimming pool nuisance) as an organic fertilizer, used to bolster the overall growth of backyard vegetable garden plants, such as kale.

Help Received
Conducted experiment on my own. While I planned to work with a professional and have access to a research lab, I only received a response from one professor (out of ten) who politely declined.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Aadil M. Rehan

Project Number
S1913

Project Title
Avocado "Root Rot" Part Deux: A Multilateral Approach to Mitigating the Recurrence of Phytophthora cinnamomi

Abstract

Objectives/Goals
The water mold Phytophthora cinnamomi has been wreaking havoc on California avocado crops for decades. It infects the roots of avocado trees, resulting in an eventual death. 2 years ago, I developed a remedy that forced the pathogen into dormancy and thermally lysed the spores using a solarization bed. Although the problem seemed resolved, in December of 2016, some trees showed signs of recurrence of the pathogen. After having soil and plant tissue tested, it seemed that the spores had gone dormant inside the plant tissue of the roots themselves. I had to devise a new strategy to combat it. My current hypothesis is that it takes a multifaceted, systemic approach to drive off this pathogen entirely. This builds on the fact that my method of targeting only the roots proved to be unsuccessful in the long term.

Methods/Materials
I am using a four-part approach to tackle this problem. The first aspect is the use of root-on-root grafts with Phytophthora-resistant rootstock to existing root systems. This will ensure that new roots that grow will be resistant to P. cinnamomi. The second aspect involves the use of foliar spray supplements, which create a concentration gradient, allowing the nutrients to travel throughout the tree. They provide nutrition while the roots heal from their grafts.The third aspect of my solution is the introduction of mycorrhizae. They compete with P. cinnamomi for resources and boost immunity to infection. The fourth aspect involves the use of purslane along with other companion plants due to their abilities as pest repellents, pollinator attractants, and their ability to retain the water in the soil. After the root graft, the functionally defined soil amendment (with mycorrhizae) is spread about 4 to 6 inches deep. The foliar spray is applied to the underside of the leaves. These methods, when used in conjunction, should mitigate the infection.

Results
My experimental group consisted of 12 trees that were tested, and 12 untreated trees as my control. After 13 weeks of data collection, the results are promising. Both groups show new growth, but the test group shows considerably more, and the controls show root rot symptoms.

Conclusions/Discussion
While testing will continue until fruit growth, current soil and tissue tests yield negative results for the presence of Phytophthora cinnamomi. This indicates that my experiment was successful, and that the hypothesis was supported.

Summary Statement
Based off of past research, the goal of this project was to develop a sustainable and comprehensive method to combat the recurrence of Phytophthora cinnamomi infection that will remain effective in the long term.

Help Received
Based on the formulations that I provided, MBI Growcells created the functional soil amendment and foliar spray. I purchased some of my materials from various gardening stores, and my father supervised me for safety wherever necessary.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Yushan Su

Project Number

S1914

Project Title

Developing Rapid Technologies to Access Root Cell-Type Specific Gene Regulation in Rice (Oryza sativa L.)

Abstract

Objectives/Goals

The prevalence of environmental stress factors, such as flooding and drought, have resulted in significant loss of yield for rice farmers.This study serves to create tools to understand the specific gene regulation mechanisms that govern rice's response to environmental stress and apply this understanding to the creation of stress tolerant varieties.

Methods/Materials

Two technologies were addressed and improved upon in this study.

The INTACT technology serves to isolate nuclei from specific cell types of a tissue. Two tissue samples were tested- a wildtype sample, and a sample tagged with the 35S:NTF transgene that biotinylates the nuclear envelope of cells. The tissue was exposed to magnetic beads coated with streptavidin, which binds to the biotin of the nuclear envelope. Nuclei were quantified using a hemocytometer to determine efficiency of capture.

Two methods of transformation were tested to determine their respective efficiencies. The traditional method involves the induction of calli from rice seedlings by infection with Agrobacterium tumefaciens. Plants were transformed via this method with GUS reporter constructs, with GUS enzymatic assays used to analyze the activity of promoters in tissues of transgenic lines. The new method uses A. tumefaciens inoculation of 3-7 day-old seedlings. Plants were transformed via this method with the 35S:NTF construct. Analysis of transformation success was via fluorescence microscopy for presence of GFP on the nuclear envelope.

Results

Isolation of nuclei via INTACT was successful, with a total nuclear yield of 25,000 nuclei at a 24.39% efficiency rate. GUS assays showed significant staining in the root tip, leaf, and shoot meristemic region of plants transformed by the traditional method. Results from the new method were observed within three weeks.

Conclusions/Discussion

The INTACT technology allowed for successful isolation of the nuclei, allowing us to gain access to the epigenome and transcriptome for analysis of the cell-type specific gene regulation mechanisms in rice. A new transformation method allowed for the application of these genes and their regulation mechanisms to the creation of stress-tolerant varieties.

Summary Statement

This project develops two technologies to understand how plants respond to stress at the genetic and molecular level and apply this understanding to creating stress-tolerant crop varieties.

Help Received

I would like to thank Dr. Julia Bailey-Serres for allowing me to partake in this research project at her lab at UCR, and Dr. Germain Pauluzzi for his continued guidance and mentorship throughout the research process.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Alana R. Tessman

Project Number

S1915

Project Title

Testing Seed Viability after Imbibition of Produced Water Treated with Enzyme Additive to Bioremediate Residual Toxins

Abstract

Objectives/Goals

To test a possible solution through bioremediation to the uptake of chemicals during seed imbibition of produced water intended for agriculture.

Methods/Materials

Sorted/weighed 400 Phaseolus lunatus (Lima Bean) and 200 Lactuca sativa (Lettuce) Soaked 50 seeds each (Lima) in 4/ 400ml glass beaker solutions of: Produced Water (PW), Enzyme Add.(EA), (PW+EA), H(2)O (Distilled) w/pH 4-8 (Control), in triplicate, repeat w/ 100 seeds (Lettuce) at 25ºC, covered, zero light, 24 hrs. Reweighed imbibed seeds. Preformed TZ (Triphenyl Tetrazolium Chloride) test on samples of 10 seeds each from 24 solutions. Extracted seeds, removed testa, opened seeds, evaluated viability. Deep red coloring identifies areas of respiration- 3 tired Classification: High Viable / Low Viable / Non-viable . Conducted (EC) Electrical Conductivity test on Leak Water using a CAS TI-nSpire cx w/Vernier Conductivity Prob. Prepared 4 solutions in triplicate for each seed type totaling 24 test solutions/ 200 Lima- 400 Lettuce. Conductivity readings taken pre and post imbibition after 24hr. Fluorescence Testing of Leak Water and Seed Imbibed with the 4 solutions, kiln dried/1400ºF, powderized and measured for residue oil on Hitachi Spectrophotometer & Fluorescence Photometer using surfactant heated to Cloud Point 30ºC.

Results

TZ Imbibition tests showed Produced Water (PW) seeds rendered the most non-viable while both Enzyme Additive (EA) tests rendered the most viable. (Control) produced all viable seeds -1. Electrical Conductivity (EC) test results of Leak water showed decreased conductivity in all but Control w/(PW) showing the greatest loss of EC. Weight Measurement tests showed (PW) had lowest seed weights post-imbibition. Fluorescence testing indicated (PW) imbibition contained trace elements of oil while (PW)+(EA) indicated oil free results.

Conclusions/Discussion

Results of all four tests showed unique and possible supporting experimental responses to two of the standard vitality tests for seeds. Conclusive findings of both toxic chemical uptake during imbibition and remediation of these toxins when treated with an Enzyme Additive Bioremediation agent present possible answers/solutions to questions surrounding the use of produced water within the oil/ag commercial industries.

Summary Statement

I positively identified uptake of chemicals from produced water during seed imbibition and the extraction of these chemicals through bioremediation.

Help Received

I researched and designed the fluorescence experiment on seed imbibition but carried it out with the help of the lab technician at Turner Labs in Fresno. I also visited the Ransom Seed Lab in Carpentaria to learn how to effectively preform the TZ test. My science teacher helped me acquire the chemicals for the TZ

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Emily M. Yu

Project Number
S1916

Project Title
The Effect of the pH of Water on the Height of Raphanus sativus Plants

Abstract

Objectives/Goals
The objective was to determine which pH of water will cause the plants to grow the tallest.

Methods/Materials
To conduct the experiment, the pH of water was changed to 3, 5, 7, 9, or 11 using pH up (potassium hydroxide and potassium carbonate) or pH down (phosphoric acid). The seeds were planted then watered each their pH specific water everyday for 20 days. The height of the plants were recorded each day.

Results
On the last day of observations, averages from all the trials showed that plants given water with a pH of 7 grew the tallest.

Conclusions/Discussion
The pH of 7 was the best pH of water to help plants grow the tallest. However the results were not strong enough to conclude that the pH of the water was the sole reason for the differences in height.

Summary Statement
I found that water with a pH of 7 yielded the tallest growing radish plants.

Help Received
I performed the entirety of the project by myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Teevyah Yuva Raju

Project Number
S1917

Project Title
The Reversal of Harms Done by the Drought: How Carbon and Nitrogen Levels Affect F.O.L. in Soils to Impact Plant Growth

Abstract

Objectives/Goals
Food scarcity has become a prevalent problem facing our world today, in fact, the UN Food and Agricultural Organization finds that 795 million people are suffering from hunger which is further exacerbated by drought conditions. Farmers have less water to provide to their crops, making them more prone to the ascomycete fungal pathogen Fusarium oxysporum f. sp. lycopersici race 3.Thus, the Encyclopedia of Food Microbiology writes that one of the major causes of food shortage is the Fusarium Oxysporum increase in countries. So, my objective was to determine whether or not an increase in Carbon and Nitrogen amounts in the soil influenced the Fusarium.

Methods/Materials
I conducted 5 Main Methods/Procedures and 5 Main Experiments which included the use of an autoclave, elemental analyzer, growth chambers, Solanum Lycopersicum (tomato) seeds, compound microscope, the 6 Main Soil Types farmers use, and Fusarium oxysporum f. sp. Lycopersici race 3.

Results
My hypothesis was correct. After an analysis of the different tests conducted throughout my experimentation, it is concluded that Carbon and Nitrogen do have a positive effect on the tomato plants. In regards to which soil performed the best, the Euic Soil produced the toughest plants with the least amount of disease severity because its soil properties were closest to the 25% ratio, described in the Soil Separation test; affirming my prior year's research.

Conclusions/Discussion
My project encourages the discussion on agricultural reform through soil studies and the understanding of the benefits of organic molecular formulas to improve crop yield. Fusarium has been a prevalent disease in the agricultural community for nearly a century now, but its ability to evolve has made it harder for farmers and scientists alike to eliminate it using synthetic solutions. However, my research is important because it demonstrates that my organic solution is able to suppress the harms of Fusarium while allowing farmers to save water by using the correct ratio of soil properties in any climate.

Summary Statement
With different soil properties, in different conditions, do Carbon and Nitrogen influence Fusarium?

Help Received
Laboratory Facilities