CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Amanda G. Arst

Project Number
S1901

Project Title
Phytoextraction of Zinc and Sodium from Contaminated Soil Using Hyperaccumulator Plants Corn, Broccoli and Kale (Year 2)

Abstract

Objectives/Goals
The objective of this experiment was to determine whether corn (Zea mays), kale (Brassica oleracea L.) and broccoli (Brassica oleracea var. italic) could be used as hyperaccumulator plants. If so, which plant will be the most effective in extracting elements from the soil?

Methods/Materials
Corn, kale, and broccoli plants were planted into containers (9 total). First group I did not add sodium selenite (SeNa2O3) or Zinc (Zn), the second group I added 50 Mg of Zn and the third group I added 50 Mg of SeNa2O3 - weight of sodium was 50mg- weight of selenite was 250mcg. These were observed and recorded for 60 days and were later analyzed. The soil content of nitrogen (N), phosphorous (P), potash (K), and pH balance levels were tested. I conducted a plant tissue analysis on the sap of the plant of the Zn plants. I conducted a Na sodium test analysis with the plants that had SeNa2O3 in it. I measured and observed the stems and leaves. I observed the roots of all plants.

Results
The Kale plant treated with Zn measured marginal accumulation, the corn plant with Zn measured low accumulation and the Broccoli with Zn measured high marginal accumulation. The control plant with no Zn had adequate zinc. The Sodium in the control plants was 0.7mg, 0.8mg and 0.9mg. The kale plant with SeNa2O3 accumulated 1.5mg of sodium, the broccoli plant accumulated 1.3mg of sodium and the corn plant accumulated 1.0mg of sodium. The soil with no plants was 6.0 acidic. The pH balance test of the control plants ranged from 6.5 (slight acidic) to 7.0 (neutral). The SeNa2O3 plants pH test ranged from 6.5 (slight acidic) to 7.0 (neutral) and the Zn 6.5 (slight acidic) to 7.0 (neutral). The N, P and K tests ranged from depleted to surplus.

Conclusions/Discussion
The results indicated that extraction of Zinc and Sodium from the soil using hyperaccumulator plants is possible. The broccoli plants were the most effective because it was healthier and they accumulated the most Zinc and Sodium solutions. Although the SeNa2O3 kale plant accumulated the most sodium it was not as healthy as the broccoli plant. The results supported my first hypothesis that these 3 plants could be used as hyperaccumulator plants. My second hypothesis that the corn plant will be the most effective has to be rejected since the corn plant died early and it accumulated the least amount of the zinc and sodium

Summary Statement
Whether corn (Zea mays), kale (Brassica oleracea L.) and broccoli (Brassica oleracea var. italic) could be used as hyperaccumulator plants if so, which plant will be the most effective in extracting elements from the soil.

Help Received
My mother took photos and checked over my work. My father guided me with safety requirements.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Edward Banuelos; Benjamin Wright

Project Number

S1902

Project Title

A Fishy Situation: A Study to Test the Efficiency of Aquaponics Farming Meathods

Abstract

Objectives/Goals

In a world where population sizes are increasing exponentially, and farmland is decreasing, there is a need for more efficient and space saving farming methods. If plants are fertilized using the dissolved nitrogenous waste from fish, then growth rate will increase and water consumption will decrease when compared to traditional farming methods.

Methods/Materials

2 fish tanks were fashioned out of 12 gallon tote boxes.Fish tanks were filled with water. Ten goldfish were then placed in each tank. The 5 gallon tote boxes were filled with a growing medium made of small clay beads. Vegetable seeds were planted in growing sponges to ensure that the seeds would not wash out when the grow beds are watered. Using PVC pipes, a siphon was constructed to give the aquaponics grow bed proper drain and fill times. It took 4 minutes for the grow bed to fill with water and 40 seconds to drain. A submersible pump was placed in the aquaponics tank and a hose was attached to bring fish waste to the grow bed. A fluorescent lamp was suspended 4 inches above the plants and turned on every day for 12 hours to provide a proper light cycle for the plants. Every day before the light was turned off, a picture was taken of each of the grow beds to accurately document growth. The fish in both tanks were fed 20-25 flakes of food twice per day. Plant height was measured in millimeters; plant volume and pigment were observed.

Results

A rating system was created based on plant height, plant volume and general pigmentation. These ratings were recorded on a weekly basis (+1 for positive change, 0 for no change and -1 for negative change). The cumulative scores established a rating of overall plant health with a maximum total of 56. By the end of two months, the aquaponics system had a cumulative weekly rating score of 42, whereas the control system had a cumulative score of 16. The control fish tank plus the water necessary to grow the plants used 152.53 L, whereas the aquaponics system used 79.50 L of water during the two month study period.

Conclusions/Discussion

The data shows that the aquaponics system produced a more healthy plant. All of the plants grew taller and had more volume in the aquaponics system compared to the control system. Along with overall plant health, during the study period, the aquaponics system used 73.03 L less water than the control system and filtered the water better based on visible water clarity.

Summary Statement

A study to test the efficiency of aquaponics farming methods

Help Received

Larry Wright, for aiding in the design of the project; Liz Wright, for helping with the board and notebook design; Kaitlin Wright for helping with graphs and analyzing data; Maria Caballero for acquiring materials and supplies; The AV Hydroponics Center for helpful advice

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Zachary Barram; Joyce Wilson

Project Number

S1903

Project Title

Germination Differences in Lettuce Seed Associated with Modifying Full Spectrum Light with Red, Green, and Blue Filters

Abstract

Objectives/Goals

To determine how green, blue, and red wavelengths of light would affect lettuce seed's percentage of germination and to observe the effects of different wavelengths of light on newly germinated seedlings as compared to the two white light controls.

Methods/Materials

Five isolated and insulated cardboard boxes were constructed with light fixtures suspended inside them. Blue, red, and green polycarbonate light filters were secured just beneath the light fixtures inside the boxes, a different colored filter was placed in each box. 20 lettuce seeds were planted in each of the five seedling trays equidistant from each other, and from the surface of the soil. One tray of seeds was placed beneath each of the filters in each of the five boxes. The trays were each watered every other day for ten days with 100 mL of water. This process was repeated, and data was gathered in four subsequent trials.

Results

It was found that the average germination percentages of the different wavelengths of light were: red: 65%, green: 62%, blue: 50%, the white light controls: 23%, and 2%. The average heights of the germinated seedlings were: red: 1.89 cm., green: 1.9 cm., blue: 1.3 cm., the white light controls: 0.12 cm., and 0.5 cm.

Conclusions/Discussion

It was determined that red light had the highest percentage of germination, green had the second highest percentage of germination, and blue had the the lowest percentage of germination among the colored filters. It was discovered that red light encourages stem growth, blue light encourages leaf growth, and green light is absorbed by seeds and the energy is then used in germination and growth for a short period of time, followed by the seedling withering. In conclusion, light wavelength does affect the germination process, height, and overall health of lettuce seedlings.

Summary Statement

To determine how red, green, and blue wavelengths of light affect the germination percentages of lettuce seeds, the average heights, and the effects on newly germinated lettuce seedlings.

Help Received

Both Mothers proofread the different components of the project, Father helped with the construction of the project setup, and Mother helped with recording data.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Sabrina Belen; Brandon Snyder

Project Number

S1904

Project Title

Volcanic Ash: The Beginning or the End? The Study of Volcanic Ash and Its Effects on Plant Germination

Abstract

Objectives/Goals

The purpose of this project was to determine what effects differing amounts of ash mixed with soil would have on the germination and growth or radishes, green beans, and pea seeds.

Methods/Materials

25 green bean, 25 radish, and 25 pea seeds were individually grown in 75 red solo cups with a drainage hole in each. They were grown in 100% soil 0% ash - 100% ash 0% soil. They were watered every other day and when done growing for a certain time period were measured on # of leaves, stem and root length, # of root branches,# of sprouting seedlings, color(radishes only), and root weight.

Results

The data supports the hypothesis. The growth of the seedlings was greatest in the 75%soil/25% ash and the 100%soil/0% ash.

Conclusions/Discussion

This project concludes that not only is it possible to grow plants with ash, but that volcanic ash can actually enhance a plants' growing environment.

Summary Statement

The study of volcanic ash and its effects on plant germination

Help Received

Mr. Grubb analyzed the ash and Albertsons provided a weight scale.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Alyssa Buter; Karina Dauven

Project Number

S1905

Project Title

Plant Protein: Blue Light vs. Sunlight

Abstract

Objectives/Goals

We observde the effects of different color lighting, specifically blue light, on the protein levels in vegetables. After extracting proteins from the dried, ground leaf samples, I purified the proteins using a column chromatography technique. To determine the concentrations of proteins in each of the fractions, I used a spectrophotometer to measure the optical absorbance at 280nm. The tomato plant exposed to blue light contained more protein in it than the tomato plant exposed to sunlight.

Methods/Materials

I purchased tomato plants and separated them into two different containers. Both groups received equal amounts of water. I left each of these groups in their appropriate light source for about 30 days because I assumed it was enough time for the plants to fully absorb their lightsâ## energy and give accurate results.After 30 days, I picked the leaves from both tomato plant groups. We dryed the leaves so that I could grind them down to powder. Then I took out two mortars and pestles to turn the leaves into powder. Then I put the individual samples into their own microcentrifuge tube. The next step was to add extraction buffer. Then I prepared my vertical gel. With the remaining samples from the tubes I used to collect from the columns, I used the spectrometer to note the absorbance levels of the proteins. I measured the absorbance for all 24 tubes and recorded the results and created a graph.

Results

My results show that the plants exposed to blue light did in fact produce higher levels of protein. I made a vertical gel but there was a significant error. Fortunately the spectrometer was able to verify that there were proteins in those tubes. The first thing I noticed was the color difference; the leaves under blue light had a darker green pigment that the leaves under sunlight. The leaves exposed to blue light had a darker pigment than the leaves that were in sunlight.

Conclusions/Discussion

Overall, this experiment was successful and gave me the results I was looking for. Now that I have learned color alters the natural state of plants, I have become more curious as to what effect blue light will have on red roses for example. I learned that the color of light increases pigment production and that it can help plants to produces higher levels of protein. I conclude that if one wants more protein in their vegetables, they should grow them under blue light.

Summary Statement

The effects of blue light and natural sunlight on plants to see which develops more proteins,

Help Received

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Kevin Y. Chen; Amit Patel; Anfal Siddiqui

Project Number

S1906

Project Title

Contribution of Core Type III Xop Effector Proteins in Bacterial Spot Disease

Abstract

Objectives/Goals

Bacterial spot disease is caused by four Xanthomonas species and results in, annually, up to 50% loss of marketable tomatoes. Genomic studies revealed that the four species share 11 core effector proteins injected into plant hosts by the bacterial type III secretion (T3S) system. This study explored whether three of the highly conserved T3S effectors, XopN, XopD, and XopX, play critical roles in pathogenesis and host-range determination in both species X. euvesicatoria (Xcv) and X. perforans (Xp). We hypothesized that core proteins XopN and XopD share important immune suppressor roles in both Xcv and Xp, while XopX plays a pivotal role in blocking XopA detection during effector-triggered immunity (ETI) in Xcv. In addition, we tested the hypothesis that XopN interacts with different isoforms of tomato 14-3-3 proteins (TFTs) to inhibit PAMP-triggered immunity (PTI) during Xcv and Xp infection.

Methods/Materials

We created effector mutants in Xp and Xcv by engineering gene deletions using homologous recombination. We inoculated resistant and susceptible tomato plants with wild type and mutant Xp strains to test the contribution of the effector genes to pathogen virulence. Over 11 days, we quantitatively measured bacterial growth and compared phenotypes of Xp mutants with those of Xcv mutants. To examine XopN-TFT physical interactions, we performed a directed yeast two-hybrid assay using XopN proteins from Xcv and Xp and 11 tomato TFT isoforms (results reported at fair).

Results

Deletion of XopN from Xp reduced Xp growth 10-fold while deletion of XopD only reduced Xp growth 3-fold, suggesting that XopN is more important than XopD in immune suppression during Xp infection in tomato. In the double mutant, Xcv ΔxopXΔxopA, we observed an additive mutant effect resulting in slower, steady pathogen growth. This suggests that in addition to interfering with ETI, XopX also suppresses PTI. Two-sample statistical T-tests also reported that at least 95% of the time, results were attributed to the gene deletions.

Conclusions/Discussion

We conclude that XopN and XopD play central roles in both Xcv and Xp pathogenesis; however, XopD is less important in Xp. In Xcv, XopX is required for the suppression of PTI and ETI. Based on this work, the identification of tomato resistance to XopN, XopD, and XopX may be a crucial step towards developing effective genetic resistance in the field against bacterial spot disease.

Summary Statement

We discovered that not all conserved core type III Xop effector proteins were important to pathogenesis among all species of Xanthomonas and that in Xcv, XopX and XopA do not interact exclusively.

Help Received

Dr. Mudgett and Dr. Kim for teaching us critical lab techniques and editing our report; Mr. Chan for helping us start the project and giving us advice throughout the project; Our parents for supporting the project and driving us back and forth from the laboratory

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Kevin Chiv; Andre Poon

Project Number

S1907

Project Title

Antimicrobial Chemicals in Plant: Identifying the Chemicals that Contribute to Oxalis Pes-caprae's Resistance to E. coli

Abstract

Objectives/Goals

This is a two year research project that is focused on the antibacterial properties in plants.This time, we are trying to identify the specific compound Oxalis pes-caprae produces in response to E. coli infections. We predict that pathogenesis related proteins (PR proteins) are largely responsible for the antibacterial properties of the weed. Previous studies indicate that PR proteins, in particular, share homologous relations with antimicrobial mechanisms. It is then logical to hypothesize that the specific compound we are looking for is a PR protein.

Methods/Materials

By using a spectrophotometer and a color sensitive JAVA program, our group was able to test if there were increases in protein concentrations in the plant extracts. The plant extracts were exposed to Biuret solution, which is an indicator from proteins. By creating 2% concentrations of the control group (not infected) and the infected oxalis plants, we made the solution's hues as similar to each other as possible to eliminate color difference prior to the experiment. The JAVA program gave us a RGB color concentration reading, and the spectrophotometer would give us an accurate reading of the actual color change.

Results

My hypothesis was generally being supported. Although the null hypothesis was being rejected, the alternative hypothesis was still being supported, since there was a clear increase in color concentration. An average of 7.78% color change between infected and the control group was observed from the JAVA program measurements, and a 634% difference in absorbance and -32.4% difference in transmittance was observed from the results from the spectrophotometer.

Conclusions/Discussion

Errors in this experiment include a false plant concentration, external factors that may have affected the oxalis population prior to the experiment, and the lack of trials. These errors could be avoided in the future by obtaining more materials for more trials, and by keeping track of what procedures were being completed. For our next procedure, SDS-page and Western-bloting would be implied to identify the protein size and concentration, which would allow us to narrow down the types of pathogenesis related proteins down, and would show what PR proteins are produced by the plant in response to the infection.

Summary Statement

Identifying the antimicrobial chemical that is produced by Oxalis pes-caprae in response to bacterial infections.

Help Received

equipment aid from Gabrielino High School; Prof Mok's advice and assistance on the project, especially on particular steps; $2500 USD sponsorship from family to purchase material and equipment; supervision under Mr. Velekei at school laboratory, and Prof. Mok on procedures and experiment quality.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Jillian A. Drake

Project Number

S1908

Project Title

Chromosomally Integrated Bacteriophage in Candidatus liberibacter Bacteria & Its Effect on Plant Disease Expression Yr2

Abstract

Objectives/Goals

Citrus Greening citrus, Tomato Psyllid Yellows and Potato Zebra Chip are all severe diseases caused by Candidatus Lieberibacter bacteria. Vectored by psyllids and nonculturable, there is no treatment for infected plants which must be destroyed, resulting in significant crop loss worldwide. Infected plants show varying expression of symptoms, with some areas appearing healthy with others infected. This project#s objective is to determine the effect of chromosomally integrated bacteriophage in Ca. Liberibacter and its effect on the expression of disease virulence.

Methods/Materials

DNA was extracted (Qigene) from over 20 healthy, infected but completely non-symptomatic, infected symptomatic and infected but with non-symptomatic shoots on symptomatic plants. Using qPCR (ABI 7500), the extracted DNA was evaluated with 70 primers in both phage and nonphage regions of this genome determining the quantity of DNA found in 3,500 samples during 37 experiments. C(t) values were evaluated in both phage regions, non-phage regions with each plant sample type. Each primer was evaluated individually over the all the same plant samples, and results were indexed against the 16s rRNA primer for comparison.

Results

Amplification plots, melt curves, Cycle Threshold C(t) were evaluated for each of the 3,500 samples. Primers which gave erroneous results were excluded. Sample c(t) value data was analyzed and graphed for analysis.Infected non-symptomatic plants yielded more initial bacterial DNA than symptomatic samples when considering primers over the entire genome and in non-phage regions. However, significantly more DNA was found within symptomatic samples using phage region primers than in the non-phage region primers.

Conclusions/Discussion

With this bacterium and the psyllid vector now endemic to the United States and most other world regions, studying the mechanism of disease virulence within this pathogen is extremely important. As the non-symptomatic plants had more bacterial DNA than symptomatic ones, results indicate the bacteriophage became lytic , destroying the bacterial cells in the symptomatic samples. In phage primer regions, more bacterial DNA was found in symptomatic plants, giving further evidence to phage transition from a lysogenic to lytic state, demonstrating that the presence of bacteriophage does increase disease virulence.

Summary Statement

The role of bacteriophage in disease expression was validated for plants infected with Candidatus Liberibacter, which causes severe diseases in citrus and solanaceous crops, indicating that lytic phage causes increased disease virulence.

Help Received

Experiments were conducted at the United States Department of Agriculture, Agriculture Research Service (USDA-ARS), National Clonal Germplasm Repository for Citrus and Dates in Riverside, under the supervision of Dr. Manjunath Keremane and Dr. Richard Lee. My parents provided transportation.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Brian S. Elder

Project Number

S1909

Project Title

The Effects of Hypergravity on the Germination and Development of Brassica rapa

Abstract

Objectives/Goals

The purpose of this experiment was to observe the effects hypergravity has on the germination, growth, and development of Brassica rapa. My hypothesis was that hypergravity has an adverse effect on plant development, and will slow the development of Brassica rapa.

Methods/Materials

In order to simulate a hypergravity environment, a centrifuge was built out of various materials, and the plants were attached to several locations on the centrifuge wheel. Plant group A was placed at a 10 inch radius, in three locations, simulating a hypergravity environment equal to 400% of Earth#s gravity. Plant group B was placed at a 5 inch radius, in three locations, simulating a hypergravity environment equal to 200% of Earth#s gravity. The hypergravity in each location was achieved by spinning the centrifuge at a rate of 180 RPM. Plant group C was designated the control group, and experienced normal conditions. Soil was kept damp and the lights were kept on.

Results

After 10 days, plants were taken out of the centrifuge, and measurements were taken. The plants in the hypergravity environments, groups A and B, experienced adverse effects from the hypergravity environment. Compared to the control, Group A had 68% germinated seeds, 21% height, 53% length, and 50% of the developed leaves. Compared to the control, Group B had 100% germinated seeds, 75% height, 84% length, and 50% of the developed leaves. Compared to Group B, Group A had 68% germinated seeds, 28% height, 63% length, and 100% of the developed leaves.

Conclusions/Discussion

All plants must overcome the effects of terrestrial gravity when they grow. NASA has experimented with growing plants in microgravity and hypergravity conditions. The findings from such experiments could lead to some important information on how plant species would react to being grown in an environment with a different gravity than Earth#s. In conclusion, hypergravity stunts the growth and development of Brassica rapa, and presumably, other plant species as well. The seed germination, height and length of stems and leaf development were all effected by hypergravity, but some more than others. The variable least affected was seed germination, and the variable most affected was the height of the stems. Overall growth wasn#t as affected by hypergravity than vertical growth. Trends in the data further indicate that there is a correlation between hypergravity and slowed plant development.

Summary Statement

The central focus was to measure the effect hypergravity has on the germination, stem growth, and leaf development of Brassica rapa.

Help Received

Mr. Snow suggested that I use Brassica rapa; My father supervised construction of the centrifuge; Dr. Smith helped me brainstorm a solution to a problem with the belt.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ai Enkoji

Project Number
S1910

Project Title
Mold As a Potential Biological Control for Wisteria

Abstract

Objectives/Goals
Mold found on the scarlet wisteria (Sesbania Punicea) at Scout Island was seen to be weakening and killing off the wisteria without any visible effect to any adjacent or surrounding plants.
The objective of this experiment was to determine whether that mold alone has the potential to be a biological control for scarlet wisteria and to identify what the mold is doing to the wisteria to cause it to weaken and die.

Methods/Materials
15 scarlet wisteria plants were grown from the collected seed pods (sterilized via bleach). The wisteria were separated into 3 groups of 5. Group 1 was the control group, Group 2 was the variable group, and Group 3 was a reserve group for use by the reisolated mold from Group 2 (Koch's postulates). The mold was topically applied to the leaves of the variable group with sterile swabs. Two of the variable group plants are placed next to four different plants other than wisteria as well as one of the control wisteria to determine if the mold can spread to adjacent plants. Plants were observed every day for changes.

Results
All wisteria in the variable group showed signs of weakening and yellowing or falling of the leaves, but the control group remained healthy. All adjacent plants to the variable group showed no signs that the mold had spread to them.

Conclusions/Discussion
The mold was deduced to be capnodium which is spread by plant-sucking insects that leave honeydew on leaves. This experiment made sure no other factors such as plant sucking insects could be involved. This may explain why the mold could not grow as widely or spread to other plants. Regardless, I was able to find substantial evidence that the mold can potentially be a biological control for scarlet wisteria.

Summary Statement
A mold found to be killing scarlet wisteria at Scout Island was applied topically to new wisteria plants to determine if it alone could potentially be a biological control for scarlet wisteria.

Help Received
Scout Island naturalist Conrad Bitters allowed access to the scarlet wisteria plants and mold and provided background on the scarlet wisteria. Mrs. Rebecca Avants (biology teacher) provided lab equipment, supplies, and facilities as well as advice on handling the mold and growing the wisteria plants.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Brandon Fong; Austin Raymundo

Project Number

S1911

Project Title

Which Plant, Organic or Genetically Modified, Is the Most Economical for California Farmers?

Abstract

Objectives/Goals

The objective is to determine whether Organic Green Beans or Genetically Modified Green Beans are the most economical for California Farmers

Methods/Materials

100 Blue Lake Bush Green Bean seeds were planted into 5 different sections in groups of 20. 1 section was organic whereas the other four were different variations of Genetically Modified Green Beans. The green beans were watered 1 tablespoon of water daily on the first month and 2 tablespoons of water daily the second month on. The height, quality and quantity of the green beans were noted on a semi-weekly basis. Within 70 days, the crop yield (amount of green beans)data was collected. The best green bean in terms of economics was determined by crop yield, quality, and quantity.

Results

It was found that about GMO Plants grew faster by about 91.3% taller and 90% more in quantity compared to the organic plants. Genetically Modified Green Bean plants produced about 25% more crop per plant and 89% more crop per variation of green bean than the organic plants. However Organic Green beans produced higher quality produce and plants than GMOs. All of all Organic plants lacked any visible mutations. However, on average 30% of all GMOs had visible leaf mutations. Therefore, it can be concluded that GMOs are not 20% more cost effective in terms of the consumer, but rather they are 90% more economical.

Conclusions/Discussion

It was found that Genetically Modified plants are simply more economical for California Farmers because they produce a much higher crop yield, more plants are grown, and common plant diseases rarely affect these plants. California Farmers look to make the greatest amount of net income and therefor, need to maximize the amount of crops per square acre and GMOs meet this objective. However, if the consumer is looking in terms of quality and health, Organic plants provide a higher quality crop, free of pesticides and genes that could potentially create a protein or enzyme that may unintentionally spark an allergic reaction.

Summary Statement

This project is aimed to find which green bean, organic or genetically modified, is the most economical for Californnia Farmers.

Help Received

Mr. Geoffrey Barraclough, a Statistics Teacher, helped with the statistical analysis

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Anthony Glum; Rene Gonzalez; Daniel Ortiz

Project Number

S1912

Project Title

The Effects of Eucalyptus globulus Trees on Native Plants

Abstract

Objectives/Goals

Eucalyptus trees are controversial because they are non-native large trees that reproduce well in the central coast. Eucalyptus trees are native to Australia but were widely planted in California. We observed that oak habitat appeared to have higher diversity than Eucalyptus habitat. We wanted to test whether Eucalyptus trees had a negative effect on native plants and what the mechanism might be.

Methods/Materials

We transplanted a native species, Stachys bullata, into both habitats and measured survival. We conducted a greenhouse experiment to test differences in soil quality between soil collected from underneath both Eucalyptus and oak trees. We also tested seed germination in water strained from leaf litter from both habitats to test for toxic water soluble compounds. We used several different materials consisting of a wide variety from quadrats and Transect tape to different native plants such as Stachys bullata.

Results

We found that on average the number of species in the two habitats weren#t different (~1.25 species/quadrat), but the overall diversity was much greater in the oak habitat (9 species verses 21 species, respectively). However, there was no difference in Stachys survival between habitats. Greenhouse plants grew the same in Eucalyptus and oak soil until 3 months later when all plants in Eucalyptus soil died. There was also no difference in seed germination in water leached from Eucalyptus and oak leaf litter. While we found a difference in diversity between the habitats, we cannot attribute this difference to soil differences or water soluble compounds

Conclusions/Discussion

Overall, we found that Eucalyptus habitats do not have an immediate negative effect on native plants. Future work should address the effects of light, temperature, and the thick duff layer observed under Eucalyptus trees.

Summary Statement

The allelopathic effects of Eucalyptus trees on native plants.

Help Received

Members of SCWIBBLES program helped us out on the field

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Shivani Gupta

Project Number
S1913

Project Title
It's Getting Toxic Here!

Abstract

Objectives/Goals
The purpose was to determine the allelopathic effect of juglone on the growth of vegetable plants. Allelopathy is the beneficial or harmful effect of one plant on another plant through release of chemicals. In this experiment, juglone is used as the chemical, found in different parts of the California Black Walnut tree. It has been suggested in scientific literature that plants having shallow root systems are more tolerant of juglone than deep-rooted species. Thus, the Solanaceae family of plants would be adversely affected by this allelochemical. Corn and bean plants are both shallow-rooted crops. Further, bean plants are known to improve soil fertility. Thus, the hypothesis was that tomato plants would be most affected, and bean plants would be least affected by juglone.

Methods/Materials
5 seeds of each plant, tomato, bean, and corn, were placed in 9 Petri dishes. Juglone solution was prepared by grinding walnut tree leaves with distilled water. Seeds of each plant were treated with three different concentrations of juglone solution: 0% as the control, 10% and 50%. After initial treatment, seeds were watered every day over a period of 7 days. Seed germination and plant height were recorded on a daily basis for each seed. 2 repeat trials were conducted for each plant.

Results
Data for this experiment was analyzed by taking the averages from each experiment for each plant in terms of seed germination and plant height. The results showed that tomato plants were most adversely affected, showing reduction in seed germination and plant height with increasing juglone concentration. Bean plants treated with 10% juglone showed results very similar to the control. Corn plants with 10% and 50% concentrations of juglone showed decrease in plant growth but to a less severe extent.

Conclusions/Discussion
The hypothesis was correct. Since juglone was taken in by the tomatoes, they were unable to retrieve sufficient nutrients. On the other hand, the bean plants have shallow-rooted systems, allowing them to effectively obtain nutrition. We can use the allelopathic property of juglone to suppress weeds. Many of the weed population come from the Solanaceae plant family, like the nightshade species. Juglone can replace synthetic herbicides and prevent soil pollution. Allelopathic crops can be used as smother crops, crops specifically cultivated for weed suppression, or in companion cropping.

Summary Statement
This project determines the allelopathic effects of juglone on the seed germination and height of vegetable plants.

Help Received
My father helped me with ordering the plant leaves and making the graphs for the experiment.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Garron W. Ireton

Project Number
S1914

Project Title
Can Mesquite Compete? A Study Regarding the Potential of Mesquite Beans as California's Newest Biofuel Stock

Abstract

Objectives/Goals

Hypothesis: Mesquite (Prosopis glandulsa) pods are more efficient bio-fuel stock than corn (Zea maize). When processed similarly mesquite will:
1) Produce more sugar dissolved in solution as measured by specific gravity (SG) than corn
2) When fermented, yeast will consume mesquite's greater amount of sugar to produce more ethanol (bio-fuel).
Formal Hypothesis (applicable to parts 1 and 2 above):
Null Hypothesis (Ho): $\mu m <= \mu c$ (where μ is the sample mean of mesquite/corn)
Alternate Hypothesis (H1): $\mu m > \mu c$

Methods/Materials

Methods and Materials: Ten fermentation trials were performed; 5 each with dry corn and dry mesquite bio-fuel stock. Equal volumes of dry milled corn and dry milled mesquite were combined with equal volumes of distilled water, boiled and treated with alpha and gluco-amylases. The purpose of these two enzymes, the first a heat resistant type and the second a non-heat resistant type, was to convert starch to sugar. The mixture was strained and the hulls were rinsed with equal volumes of distilled water to wash any remaining sugars into the catch basin. Each solution's specific gravity (SG) was measured once the solution cooled to approximately 35 oC (95 oF). The solutions were poured into the fermenters with one packet of brewer's yeast. After 96 hours the fermentation was complete. Each solution's SG was again measured. Ethanol content, based on the difference between the starting to the ending SG, was computed.

Results

Hypothesis 1: The sample mean for corn was 39.9 and for mesquite it was 40.4 thousandths of a unit of SG. The alternate hypothesis was accepted with a confidence level of 93%. In other words, mesquite produced more sugar in solution than corn with a 93% confidence level. See the Statistics portion of the presentation board for details.
Hypothesis 2: The sample mean for corn was 78.5 ml and for mesquite it was 79.5 ml of ethanol produced. The alternate hypothesis was accepted with a confidence level of 94%. In other words, mesquite produced more ethanol than corn with a 94% confidence level.

Conclusions/Discussion

Mesquite produced more sugar and ethanol than corn. Mesquite needs less fertilizer and water and is therefore a more efficient bio-fuel stock.

Summary Statement

Investigation of the superiority of mesquite beans to corn as a biofuel stock

Help Received

Mother purchased needed materials. Father taught statistics, helped with questions regarding mathmatical analysis and chart development

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Weston Isheim; Jackson McClain; Zachary Vavra

Project Number

S1915

Project Title

The Paradoxical Parasite

Abstract

Objectives/Goals

In our project we researched, tested and identified the anomaly that we discovered on a sequoia semperviren. This anomaly was a branch of the tree that was still growing in spite of the fact that it lacked the green pigment that is usually in pineneedles. After weeks and weeks of research including but not limited to both group and individual internet research; textbook researching; inquiring the Extension Plant Pathologist Director at the Texas Plant Disease Diagnostic Laboratory, Kevin L. Ong, PhD via email and many more methods, we were able to conclusively prove what it isn#t. Proving what it is however was not as easy as we initially thought.

Methods/Materials

One of our intermediary hypotheses was that the anomaly contained chloroplasts that were void of the natural green pigment. To test this we ran an AP Biology Lab called The Floating Leaf Disk Assay Lab. This proved that the pine needles did not undergo photosynthesis and therefore we could infer that they were, in fact, lacking chloroplasts.

Results

This proved that the pine needles did not undergo photosynthesis and therefore we could infer that they were, in fact, lacking chloroplasts. During this lab however we found that there was one pine needle that was half filled with chloroplasts and half void. It looks like there was a line drawn down the middle seperating the normal side from the anamolous. This caused us to continue researching in a new direction.

Conclusions/Discussion

While conducting our project we put serious thought and effort into several possibilities of what the anomaly could be. Originally we thought it was a genetic mutation, or disease, but eventually we concluded that this branch is a previously undiscovered manifestation of a transposable element infecting a meristem tissue, which then caused the loss of chloroplast. This anomaly has only been documented in corn thus far but hopefully our possible additions to the scientific community will further the knowledge of the plant sciences and open the doors of investigative inquiry for us and others.

Summary Statement

Studying and identifying an anamoly in local sequoia semperviren.

Help Received

Used Lab Equipment from Western Sierra Collegiate Academy

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Brianna L. Magallanes

Project Number

S1916

Project Title

Glowing Green: The Effects of Acidification on Egeria densa's Chlorophyll B Levels

Abstract

Objectives/Goals

The purpose of the experiment was to determine whether the acidity level in water would greatly affect the chlorophyll b levels in Egeria Densa.

Methods/Materials

Three plastic containers were cleaned. 3.8 grams of Elodea Densa was added into each container. Each container was filled with 1500 ml of water. The ph. level 5 container was given 20 drops of 0.1%Hydrogen-Chloride. The ph. level 3.5 container was given 50 drops of 0.1% Hydrogen-Chloride. Both of the containers were placed outside and their ph. levels were measured using ph. tape. The plants were observed and after no visible disturbance, 1 g of the control plant was taken and paper toweled dried. The sample was cut into little and small pieces and then added into the mortar. Using a pestle, the leaves were crushed into small pieces and the liquid coloring from the leaves was released. 3 ml of acetone was added into the mortar and more crushing was done. The liquid was added into the micro centrifuge tube with a small sampling of the leaves. The exact same process is done for the ph. level 5 and 3.5 samples. The micro centrifuge tubes were placed in the centrifuge until all leaf samplings were collected at the bottom. The micro centrifuge tubes were placed in a rack and set to rest. Three microscope slides were obtained and cleaned. 250 ml of ethanol was added into the Silica gel and it was mixed until all substance at the bottom was gone. The slides were quickly dipped into the silica gel and then left hanging above, allowing all of the excess liquid to drop. This was done to all three slides and once they were dried, the slides were placed on a clean paper towel. Using a pipette, 6 ml of 95% ethanol was added into three 250 ml beakers. One side of the dipped slides was cleaned using acetone. The micropipette tip was dipped inside the micro centrifuge tube filled with the ph. level 7 liquid sample. Gently, the tip was tapped on the side of the dipped slide. The tip was tapped in the same place 20 times. The slide was then placed into the 250 ml beaker filled with ethanol with the green spot closest to the bottom. The same was done for the ph. level 3.5 and 5.

Conclusions/Discussion

Since the plants were able to survive, chlorophyll b must not be as important role as previously believed. The plants must have a factor contributing to its survival. If the unknown variable can be added to other plants, then survival strength will rise.

Summary Statement

The project will determine whether the chlorophyll b levels in egeria densa will be effected by the acidity of water.

Help Received

Mentor helped edit report

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Anna Maxwell; Adela Weigel

Project Number
S1917

Project Title
Sudden Oak Death: The Spread and Its Correlation to Abiotic Factors

Abstract

Objectives/Goals
Many Oak trees in Santa Cruz Country are infected by Phytophthora ramorum, a type of Stramenopile that is similar to a fungus. Our objective is to determine if any abiotic factors we test, including relative air humidity, illumination, air temperature, soil temperature, and soil moisture, affect the spread and amplitude of the pathogen#s progression.

Methods/Materials
Our procedures include recording infected trees at both of our two sites, and confirming our diagnosis with ImmunoStrips. We are also collecting air temperature, soil temperature, soil moisture, relative humidity, and light exposure with a Vernier LabQuest along a transect at each site.

Results
Looking at our data from September 2012 through February 2013, the abiotic factors and the rate of SOD show no significant correlation. The readings for the abiotic factors illumination, soil temperature, and air temperature are erratic and do not follow with the increase in Sudden Oak Death. The abiotic factors soil moisture and humidity increase due to the occurrence of higher moisture levels during the winter.

Conclusions/Discussion
Through the process of measuring abiotic factors from contrasting climate sites, and by recording the percent of oaks infected over time, our data consistently shows that there is no correlation between abiotic factors and the spread of sudden oak death, disproving our hypothesis. Although soil moisture correlated with the spread of SOD on our Fall Creek site, soil moisture does not correlate with SOD on our Quail Hollow site, leading us to conclude that soil moisture is not a significant factor.

Summary Statement
We are recording the spread of Sudden Oak Death at two sites in San Lorenzo Valley, and are looking for a correlation between the spread of sudden oak death and the abiotic factors at our sites.

Help Received
Jane Orbuch, science teacher, provided us with equipment; Michael Loik helped us plan the start of our project.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Joseph A. Nora

Project Number

S1918

Project Title

Effects of ABA on the Inhibition of IAA in Thigmotropic Reactions and Resistance toward Weather on Pisum sativum

Abstract

Objectives/Goals

The objective of this project is to test the effect of ABA (Abscisic acid) on the inhibition of IAA(Indole-3-Acetic-Acid)in thigmotropic reactions alongside ABA's ability to increase a plant's resistance by retaining water. My hypothesis is plants with higher concentrations of ABA will have lower thigmotropic
activity but higher resistance toward weather.

Methods/Materials

In this project varying amounts of an aqueous solution of ABA was applied to plants. The thigmotropic activity of plants will be measured by the curvature of the most dominant stem. Curvature is measured with an equation "da / dl = k" da represents change in stem angle, dl represents change in stem length and k represents curvature. Because it is measured in the change of an upright stem at 90 degrees at the average length of stems on the plant was used as a reference point. Plants were set near a mechanical stimulus so that they may react toward it for thigmotropic reaction.

Results

My hypothesis was partially correct, plants with a higher amount of ABA had lower thigmotropic activity however had less resistance toward opportunistic fungus. Because ABA increases the amount of water and surface area the opportunistic fungus were able to take advantage of the increased moisture and growing space.

Conclusions/Discussion

Because ABA increases resistance toward weather by helping retain water the increased surface area and water allowed opportunistic fungus to invade the plant. ABA is also naturally used in plants in times of harsher weather like winter the concentration of ABA was much higher than it would normally be in another season. By applying ABA the natural balance between IAA and ABA was disturbed causing in a failure to continue the plant's normal functions.

Summary Statement

Effects of ABA on the inhibition of IAA in thigmotropic reactions

Help Received

Used gram scale at UCI's toxicology department

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Roshini N. Ravi

Project Number
S1920

Project Title
The Effects of Recycled Water on the Native Plant Species: Festuca arundinacea and Lolium perenne

Abstract

Objectives/Goals
As the demand on a limited water supply increases, the use of recycled water in gardening has become popular as it is both an environmental and economic option. Nevertheless, the effects of this liquid on plants is practically unknown. In order to verify that recycled-water can be used as a substitute for fresh-water, at least in gardening, the following experiment was performed.

Methods/Materials
Materials include:
1. Two Jiffy Seed Starter Greenhouses (72-plant)
2. Recycled Water
3. Tap Water
4. Seed Co. Bonsai 2000 Tall Fescue Lawn Seed
5. Pennington Perennial Ryegrass Grass Seed
6. Hyporex Extended Feed All Purpose 16-16-16 Lawn Starter
7. Miracle Gro Perlite
8. Sakrete All-Purpose Sand

Two native plant species: Festuca Arundinacea and Lolium Perenne, were treated with either recycled water or normal tap water. Two Jiffy Seed Starter Greenhouses with 72 compartments each, was used. Each compartment in the Greenhouse was filled with an equal part mixture of sand and pearlite. Lolium Perenne was grown in 72 compartments and Festuca Arundinacea was grown in the remaining 72 compartments. Of these 72 compartments, 36 were treated with recycled water and the other 36 with tap water. A starter fertilizer and approximately 40 seeds of grass were added to each compartment. The height of the plants was recorded every week for 6 weeks.

Results
After a 6-week study, the data shows that regardless of the water treatment, both types of grass grew equally well. Although the height of the grass differed by an insignificant amount, the eventual growth and development of the grass was similar if not exactly the same.

Conclusions/Discussion
The conservation of the earth's limited supplies is essential and each tiny step we take can be instrumental. If just a few of us can incorporate recycled water into our gardens and backyards, the amount of fresh-water saved is phenomenal. The application of this project's results can be valuable and can also enhance the lives of our future generations.

Summary Statement
To discover the potential effects of recycled water on two grass species:Festuca Arundinacea and Lolium Perenne

Help Received
Ms. Julie A. Finzel, as the advisor, answered several of my questions throughout the course of the project. Mr. Zachary Meyer provided the recycled water and my parents supervised the experiment that took place in my home.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Manisha K. Sajnani

Project Number
S1921

Project Title
The Mysterious Benefits of Rice Solutions

Abstract

Objectives/Goals
Determine the effect of rice solutions on a seed#s germination phase.

Methods/Materials
-Weight out 5.0 grams of rice grains and blend. -Place powdered rice in a plastic cup. -Place 2 mL of distilled water into each test tube. -Weight out 0.5 grams of rice-powder and place in test tube. -Centrifuge for five minutes. -Place one wisconsin seed in each well. -Use dropper to extract the supernatant layer from each of the rice solutions. -Place two drops of the rice-extractions into each well. -Next, obtain one drop of the solid rice from the solution that was centrifuged and place one drop into each of the 20 wells. -Using the dropper, place three drops of distilled water into each of the ten wells (control). -Cover each well plate with clear plastic wrap.

Materials: 100% Whole Grain Rice, Sweet Rice, Basmati Rice, Golden Parboiled Rice, 2 mL Pipette, 50 mL Beaker, Blender, Weighing Scale, 8 Test Tubes, Centrifuge, 100 Wisconsin Seeds, Distilled Water 50 mL, 4x5 Plastic Well Plate (5).

Results
Sweet rice slows down the germination process drastically as 50% of the seeds tested under a sweet rice solution, did not germinate. 30% of wisconsin seeds germinated with golden parboiled rice solutions did not germinate, resulting in being the second best solution. Whole grain rice solution came in third and Basmati rice was least effective. For my control group, 40% germinated up to the E stage. Compared to the rice solutions, the amount of germination the wisconsin seeds went under controlled conditions, the percentages were a lot higher, showing that rice solutions slowed down the wisconsin seeds germination.

Conclusions/Discussion
Potential errors could have occurred when placing one drop of rice into each well; a potential difference in concentration. The results could be due to the composition of the rice. White rice has undergone milling, however, it does not contain much of its germ layer which holds the basic nutrients, while brown rice does. Basmati rice showed the least amount of decrease in the germination phase which could be due to a lack of fiber or nutrients.

Summary Statement
I conducted this experiment to determine the effect rice solutions had on seed germination and use these results to determine whether or not similar solutions can provide similar results on cancer cells.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Ivonnie A. Shih

Project Number
S1922

Project Title
The Effects of Ethephon, Its Decomposition Products, pH, and Calcium on Berry Cracking in Flame Seedless Grapes

Abstract

Objectives/Goals
The purpose of this study was to investigate the effects of the plant growth regulator ethephon, its decomposition products, and pH in increasing cracking in flame seedless grape berries. In addition, this project investigated the effectiveness of calcium in reducing cracking.

Methods/Materials
To induce cracking, grape berries were completely immersed in solution, with 30-55 berries in each treatment. At 1, 2, 4, 7, 20, and 47 hours, berries were inspected for macroscopic cracks; cracked berries were recorded and then discarded. To test the effect of pH, solution pH was increased by adding PBS buffer or sodium hydroxide (NaOH). The effect of ethylene (a decomposition product) was tested by exposing berries to air or 100ppm ethylene gas. After 48 hours, all remaining uncracked berries were soaked in water and inspected at the set time intervals.
Berry cracking was compared in terms of mean cracking time.

Results
Neither ethephon's decomposition products (chloride, phosphate, and ethylene) nor its buffered analogs (phosphorous acid and ethylphosphonic acid) significantly increased berry cracking. Acidic solutions, including ethephon, promoted cracking. Calcium was effective in reducing ethephon-induced cracking only when in the same solution as ethephon, and increasing the pH of ethephon solution suppressed cracking even more than adding calcium did.

Conclusions/Discussion
The low pH of ethephon, rather than the chemical itself, appears to be one of the main reasons for increased cracking in grapes. Adding calcium and increasing the pH of ethephon solution are both potential practical solutions to reduce cracking. Cracking is a costly problem that reduces fruit quality and storage life; this study will help identify a practical solution to cracking in grapes and other fruits, benefiting industry and consumers.

Summary Statement
This project investigated the effect of ethephon and pH in promoting grape berry cracking and the effectiveness of calcium in suppressing cracking.

Help Received
Mentored by Yan Zhuang; Used the Matthews Laboratory at UC Davis; Advised by Dr. Ken Shackel of UC Davis

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Hannah B. Spinner

Project Number

S1923

Project Title

Do Plants Talk? The Effects of Mycorrhizal Networks on Defense Signaling in Corn

Abstract

Objectives/Goals

The purpose of this research was to determine if Zea mays, corn, inoculated with mycorrhizal fungi would be able to communicate with their neighbors and warn them about pest attacks.

Methods/Materials

Forty corn seeds were planted into two plastic bins (each bin had 20 seeds), which were filled with one cubic foot of sterilized soil. In one bin, 62.5 grams of mycorrhizal fungi was added to the soil; and the other acted as the control and did not contain mycorrhizal fungi. After the plants grew for six weeks, 7 plants were pulled from each population so that all remaining plants could have as much room to grow as possible. The corn grew for two more weeks and then two plants in each population were infected with a xylanase elicitor (enzyme that triggers the plants# defense mechanisms). Then they were taken to the plant pathology USDA lab in Florida and defense mechanisms were tested with a gas chromatography mass spectrometer. They were analyzed and grouped based upon how close they were to the plants infected with elicitor.

Results

The plants with mycorrhiza in their roots had the largest amount of MBOA, a product of plant defense chemicals. The mean value of MBOA in all plants grown with mycorrhiza was 3,259,673.25. The control plants had much less MBOA, more than 2 million less, with a mean value of 1,132,703.66.

Conclusions/Discussion

The hypothesis of plant communication through mycorrhizal networks was supported because all mycorrhiza plants, not just the two that were infected, thought that they were under attack. The control plants did not release as many defense chemicals, showing that they did not communicate with each other. This clearly illuminates that Zea mays are able to communicate through mycorrhizal networks and warn their neighbors about pest attacks. Future research will be pursued, including an investigation of the possible pesticide uses of this fungus.

Summary Statement

This research is about the defense chemicals in corn being activated and transmitted through fungal networks; even plants that are not attacked can be alerted of a pest attack.

Help Received

Used lab equipment at USDA Plant Pathology lab in Florida

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Emma M. Sydir

Project Number
S1924

Project Title
The Effect of Light Exposure on Circumnutation Size

Abstract

Objectives/Goals
Plants are all around us and are essential to our survival, providing us with oxygen, food, medicine, and so much more. Despite years of research, there is still so much that we do not understand about plants. Neither the purpose nor mechanism of circumnutation, the helical movement of plants which is mostly unrelated to stimuli, is fully understood by botanists. Greater understanding of circumnutation could provide a window into plant evolution and provide insight into the ways that plants will be affected by changing environmental conditions. Thus, I decided to study circumnutation. Specifically, I tested the effect of different amounts of light and shade on the circumnutation radii, hypothesizing that the more time a plant was shaded, the smaller its circumnutation radii would be.

Methods/Materials
I planted three groups of morning glories of which I shaded one group for three hours, one group for six hours, and one group not at all. I then set wireless security cameras to take pictures of the plants as they circumnutated. Using Adobe Photoshop Elements 10, I traced the movement of the plants and calculated the length of the radii of the circumnutations. I then compared the sizes of the circumnutations between the groups.

Results
The circumnutation size of the plants that were not shaded was about three times larger than the circumnutation size of the plants that were shaded. The plants that were shaded for three hours showed circumnutations that were about 15% greater in size than the circumnutations of the plants that were shaded for six hours.

Conclusions/Discussion
The results support my hypothesis that circumnutation size will decrease the more a plant is shaded. This indicates that circumnuation could potentially be related to vining plants' search for a support to grow on.

Summary Statement
This project explores the effect of varying light exposure on the circumnuation size of morning glories.

Help Received
Dad helped mount cameras

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Jonathan E. Tynan

Project Number
S1925

Project Title
Fibonacci Numbers and the Golden Ratio in Plants

Abstract

Objectives/Goals
Many scientists believe that certain plants have a Fibonacci number of spirals in a golden ratio phyllotaxis (the arrangement of leaves on a stem) because the limit of two consecutive Fibonacci numbers approaches the golden ratio. For me that conclusion did not have enough support, so I investigated why plants with a golden ratio rotation between each new leaf/cell exhibit a Fibonacci number of leaves/spirals.

Methods/Materials
Examined and recorded data from plants at the San Francisco Botanical Garden to get a tangible understanding. Used a protractor to measure divergence angles between leaves and counted the number of leaves/spirals around their phyllotaxies. Calculated the first 50 ratios between consecutive Fibonacci numbers. Drew the phyllotaxies from the ratios in the previous step with a protractor.

Results
The limit of two consecutive Fibonacci numbers approaches the golden ratio. The drawings of the phyllotaxies showed that the denominator of the ratios was also the number of spirals.

Conclusions/Discussion
The rotation of each successive cell in a plant's phyllotaxis is determined by a ratio. The ratio's denominator is the number of spirals around the phyllotaxis because that is the maximum number of possible rotations between each cell/leaf without overlap ("Denominator Rule"). Since the ratio of two consecutive Fibonacci numbers approaches the golden ratio, a golden ratio phyllotaxis follows the "Denominator Rule" of the ratio between two consecutive Fibonacci numbers; therefore, a golden ratio phyllotaxis has a Fibonacci number of spirals. A golden ratio phyllotaxis may also have engineering applications. Since the cells in golden ratio spirals are compacted very tightly, engineers may treat molecules the same way, producing stronger materials.

Summary Statement
I investigated why plants with a golden ratio phyllotaxis exhibit a Fibonacci number of leaves/spirals.

Help Received
Mother helped glue the board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Lisa A. Yanuaria

Project Number
S1926

Project Title
Vitamins as Antioxidants

Abstract

Objectives/Goals
The goal of this experiment is to determine which vitamin (A, C, or E) has the strongest antioxidant activity.

Methods/Materials
Solutions of each vitamin (A, C, E) were mixed with 1.5% hydrogen peroxide solution in a 5:1 ratio and applied to 20 radish seeds in a total of 14 trials (a total of 840 radish seeds). A negative control using 20 radish seeds grown in 3% hydrogen peroxide and a positive control containing 20 seeds grown in distilled water were used.

Results
The results indicated that vitamin A as retinyl palmitate had the strongest antioxidant activity.

Conclusions/Discussion
My hypothesis that vitamin A as ascorbic acid would be the strongest antioxidant was not supported by my results.

Summary Statement
My project is about which vitamin (A, C, or E) is the strongest antioxidant.

Help Received
Mrs. Ramirez-De La Cruz helped design the controls. Bryan Ruiz, Mr. Morgan, and Dr. Renders helped determine the products of the chemical equations involved.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Brittany R. Salyers

Project Number
S1995

Project Title
The Effect of Flavonoids on the Growth and Inhibition of the Tobacco Mosaic Virus

Abstract

Objectives/Goals
To test which flavonoid is most effective at inhibiting the Tobacco Mosaic Virus: Quercetin, Fisetin, or Rutin.

Methods/Materials
Materials: #Nicotiana Glutinosa tobacco plants, #p100 micropipette, #p20 micropipette, #pipette tips, #Celite, #tobacco mosaic virus, #gloves, #Quercetin, #Rutin, #Fisetin, #hand lens, #beakers.
Procedure: 1.Labeled plants that were to be control, TMV then flavonoid, flavonoid then TMV, flavonoid used, etc. using a black Sharpie to mark pot. 2.Used a black sharpie to premark each replicate (or half leaf) that was to be inoculated.
For control plants: 1.Inverted vial (containing virus) and flicked at least three times to displace Celite/Virus evenly. 2.Measured 25uL TMV using p100 micropipette. 3.Dispensed the 25uL of virus onto designated half leaf and used one gloved finger to apply virus. (Applied by rubbing gloved finger 8 times in a forward and back motion, using enough pressure to wound (and not destroy) the epithelial cells of the tobacco plant. 4.Repeated this process per replicate (or half leaf) for all designated plants.
For TMV then Flavonoid plants: 1.Repeated above procedure to inoculate plants with virus, being careful to apply the same amount of pressure as previously done. 2.Changed gloves (to prevent contamination of virus to flavonoid). 3.Measured 25 uL of designated flavonoid and applied using various concentrations:
Flavonoid: Amount of Flavonoid:
Rutin 100 ppb dilution*, 500 ppb dilution, 1000 ppb dilution
Fisetin 100 ppb dilution, 500 ppb dilution, 1000 ppb dilution
Quercetin 100 ppb dilution, 500 ppb dilution, 1000 ppb dilution
4.Dispensed flavonoid onto designated half leaf and used gloved finger to gently apply virus (repeating same technique as was used for virus application).

Results
Average inhibition in Rutin- treated plants: 74.71% inhibition.
Average inhibition in Fisetin- treated plants: 72.44% inhibition.
Average inhibition in Quercetin- treated plants: 68.41% inhibition.

Conclusions/Discussion
Rutin was the most effective inhibitor of the Tobacco Mosaic Virus, at approximately 74.71% inhibition. The 100 ppb solution was the most effective at inhibition, and that there is no correlation between the order of inoculation and inhibition. Possible sources of error: cold weather, lack of humidity, or an error

Summary Statement
I tested which flavonoid inhibited the TMV most efficiently: Rutin, Fisetin, or Quercetin.

Help Received
Mother gave time/gas, Dr.Mathews gave plants and TMV, Dr.Cauchon gave advice, and Dr.Tannaci gave flavonoids.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
Guadalupe Melgarejo

Project Number
S1996

Project Title
Eucalyptol: A Plant's Worst Nightmare?

Abstract

Objectives/Goals
Eucalyptol is allopathic, meaning it eliminates and kills bacteria. Therefore, I hypothesized that if eucalyptol is allopathic, then its inhibition in an area of germinating seeds will result in lower germination rates and impede the sprouting of seeds with lower resistances. The response of the plants to the eucalyptol is highly significant to determine what types of ecosystems will be affected the most affected as a result of the foreign growth of eucalyptus trees, determine how to balance invaded ecosystems, save native species living in the area, and create a natural pesticide.

Methods/Materials
I first tested one native California plant, the California poppy and a vegetable plant, the radish. I planted them in 12 different containers and separated them into three groups for both plants. To the experimental groups I added one third of a cup of fresh and crushed eucalyptus leaves and added soil, and for the control groups I only added soil. Each day, I watered them half of a cup of water and placed them in sunlight equally. After noticing a great change between the two groups, I tested 4 more native plants: bent grass, small fescue, red fescue, and dwarf barley. I also tested 4 more vegetable seeds, broccoli, fescue, alfalfa, and wheat. I used a high, medium, and no concentration. I used the filtered liquid as my medium concentration, and the unfiltered liquid as my high concentration. I planted and watered them 25 milliliters with their particular liquid for 18 days and recorded the heights.

Results
From the many tests, I saw a significant difference between the experimental and control groups. However, the native plants showed more vulnerability to the eucalyptol than the vegetable plants and overall failed to grow in the concentrations. Only one native, the red fescue, grew in the medium concentration, while all of the vegetable seeds successfully grew in the medium concentration, but only the wheat grew a few millimeters in the high concentration.

Conclusions/Discussion
The great effect of the eucalyptol on the native species of plants show that eucalyptol greatly affects ecosystems with native species. The inhibition of eucalyptus trees will result in the elimination of native plants and animals and will welcome foreign species creating an imbalance in the ecosystem. Also, the presence of eucalyptus trees and will result in the nightmares or farmers by resulting in undeveloped crops.

Summary Statement
The strong oil of eucalyptol is tested on native and crop seeds to determine what ecosystems will be affected most affected to save native animal and plant species, and help farmers prevent crop shortages.

Help Received
The company S&S Seeds donated four native seeds and natural resource specialist, Ms. Vartanian suggested what seeds I should test.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Aradhana Sinha; Kapil Sinha

Project Number

S1997

Project Title

Evaluating Peronospora Presence in Salinas Valley & Analyzing DNA Similarity in Downy Mildew Pathogens Affecting Spinach

Abstract

Objectives/Goals

Downy mildew is one of the most destructive plant pathogens across the globe, and the major production constraint on the $200,000,000 spinach industry in California, the majority of which is grown in the Salinas Valley. Fungicides are costly and time-consuming. They may also stain spinach leaves (copper residue) making even healthy plants unmarketable. Yet they are effective only when immediately applied. Though all downy mildew look exactly the same, only one species Peronospora effusa can infect spinach.
1. There is a need to be able to quickly accurately distinguish an unknown downy mildew to screen seeds and plants alike, and determine whether fungicides are necessary.
2. Understand how isolates Peronospora farinosa f.sp.betae and Peronospora farinosa f sp.cicla (found in Salinas Valley) are related to the rest of the Peronospora genus.
3. Assess whether Peronospora is a threat in the Salinas Valley. Analyze how it spreads, and propose solutions.

Methods/Materials

We screened crops and commercial seed for Peronospora using industry approved methods. We used E.Coli to clone the internal transcribed spacer (ITS) region, purified the DNA and sent it for Sanger sequencing to find genetic variations in Peronospora. Next, we created a phylogenetic tree to better understand how the species are related.

Results

Peronospora filaments were repeatedly found on commercial seed and on crops in the valley.
Genetic variations were found between the isolates we sequenced and Peronospora effusa.
Peronospora farinosa f. sp. betae and f. sp. cicla have the exact same ITS sequence. Interestingly they are more closely related to the P. effusa than they to other P. farinosa that attack the Chenopodiaceae family of plants.

Conclusions/Discussion

Genetic differences make it possible to identify unknown isolates and determine whether to use fungicides.
Peronospora is systematically evading seed screening procedures, because spinach screening techniques involve culturing seed debris on agar from 20C-25C.
Peronospora is an obligate parasite and cannot survive on agar. It prefers cool temperatures and degrades at these high temperatures. Seed debris should be cultured at about 13°C on spinach leaves, not agar.

Summary Statement

We discovered downy mildew is infecting SalinasValley spinach and spreading by contaminated seed;we developed a way to identify the lethal pathogen, and proposed more effective seed screening methods to prevent further spread of Peronospora

Help Received

We thank Ms. Amy Anchieta and Dr. Steve Klosterman for being our mentors for this project--they permitted us to use USDA equipment, and taught us basic laboratory procedures. The experiment was designed and conducted entirely by ourselves.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Shivali Gowda; Preeanka Mazumder

Project Number

S1998

Project Title

Difficulties of Farming in Alkaline Soils: Absorption of Iron in Spinach Grown in the Presence of Marble

Abstract

Objectives/Goals

The experiment was conducted to determine the difference in the iron intake of spinach in the presence of marble (alkaline soil) versus regular soil. If the marble increases alkalinity in soil and causes the precipitation of iron, then there will be an indirect relationship between the amount of marble in the soil and the amount of iron absorbed by the spinach plants.

Methods/Materials

There were ten experiment groups. Each had ten cups. For groups 1-5, only iron was added to the soil in increments of 0.5 grams starting from 0 going to 2. In groups 6-10, 20 grams of calcium carbonate was added to each group, and again the iron was added in the same increments. Two months later, before extracting the iron from the plants,standards were created. The purpose of these standards was to compare the iron absorptions of the spinach samples to the linear graph of the standards to find the concentration of iron in the spinach samples.To extract the iron, each of the ten samples was massed and burned to create ash. Then this ash and 10 ml of HCL were put in a beaker on a magnetic stirrer for ten minutes to break open the cell walls and extract the iron. This was repeated with each of the ten samples. Then the excess ash was filtered out and 5 ml of potassium thiocyanate was added to each sample to show the color of the iron so the spectrophotometer could accurately read the absorption. With this absorption, the concentration was found and mathematical analysis was performed to find the mg of iron in the spinach plant.

Results

The cups that contained 20 grams of $CaCO_3$ absorbed less than the cups that did not contain $CaCO_3$ 3 out of 5 of the times. There was also a general trend of as the amount of iron in the soil went up, so did the amount of iron absorbed into the spinach plant.

Conclusions/Discussion

The results had a tendency to prove the hypothesis. If there was a larger sample size, this trend would be more obvious. Alkaline soils cannot produce plants with a high concentration of iron because the iron is precipitated in the soil as iron hydroxide.The marble decreased the absorption of iron in the soil due to the fact that it causes precipitation of iron, making it difficult for the iron to be absorbed into the plant.

Summary Statement

This project analyzed the impact of calcium carbonate on the ability of spinach to absorb iron from soil.

Help Received

Mrs. Hampton (teacher) helped provide lab equipment; Father helped put together board.

CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Sabrina L. Houston

Project Number

S1999

Project Title

Solving Salt Stress: Chemical Genomics with an Agricultural Implication

Abstract

Objectives/Goals

Purpose was to find chemicals from the PMRA/PMRP libraries that would cause resistance in the Arabidopsis thaliana seedlings in a salt stressed media. The PMRA 1 library would be the most affective in causing resistance; the PMRA 2 library would be the most affective in causing sensitivity.

Methods/Materials

A 200mM NaCl media was created, pipetted 199mL of the salt media into a 96 well plate then added 1mL of the chemical from the PMRA/PMRP libraries, a four day old Arabidopsis thaliana seedling was placed, with the cotyledon facing up, into the gel media.

Results

Five trials were found to extremely resistant to the salt stress. Only one trial from the PMRA 1 library was found to be other under the 10th percentile of the mean color values of green and above the 90th percentile of the area of the cotyledon. This trial was the B7 trial with an area of the cotyledon being 0.008cm3 and the mean green value being one of the lowest collect, 81.229nm. The PMRA 2 library was able to produce two trials that appeared to have resistive qualities; the G5 trial resulted in an area of cotyledon of 89cm3 as well as a green mean color value of 113.404nm. The second trial was the H2 chemical well that contained a 92cm3 cotyledon area and an 113.804nm green mean color value. The PMRP 3 library was able to produce also two different chemical well trials that are resistant. The F5 trial had a 127cm3 area of cotyledon as well as a 103.74nm green color mean value, and the A3 trial had a 157cm3 area and a 103.968nm color value. In chemical structure, the structure of the chemicals in the PMRA 1 B7 trial and PMRA 2 G5 trial are incredibly similar suggesting that the structure and elements associated have an effect on the trans-Golgi network.

Conclusions/Discussion

The experiment could be expanded on by testing the chemicals found to be resistant on tomato seeds to see if all the different plant seeds react. The agricultural industry is a $43.5 billion dollar industry. California, has access to an immense amount of salt water. It is possible to find a chemical that will allow agrarians to use salt water for farming rather than strictly fresh water.

Summary Statement

To uncover a cure for salt stress on land plants by using the PMRP/PMRP libraries

Help Received

Nolan Ung allowed me to use his resources as well as the resources at UCR to conduct my project