CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Titash Biswas

Project Number

S1801

Project Title

Drowning the California Drought: A Novel Approach of Combining Biochar and Gypsum to Improve Crop Yield

Abstract

Objectives/Goals

California undergoes cycles of severe drought followed by El Niño for several years. The objective of this study was to determine which soil amendments, or combinations of biochar and gypsum, would improve the water retention capacity of average soil and efficiently combat the effects of droughts and excess water on Lycopersicon esculentum (tomato) and Allium cepa (onion).

Methods/Materials

Drought, normal, and El Niño conditions, defined as 10%, 50%, and 100% respectively, were quantified from the field capacity of average potting soil. The design of experiment utilized six soil compositions, average potting soil (control), 10% biochar, 30% biochar, 10% biochar and 5% gypsum, 30% biochar and 5% gypsum, and 5% gypsum, by weight, and three water levels for two replications of Lycopersicon esculentum and Allium cepa. Parameters such as plant height for Lycopersicon esculentum and root length and biomass for Allium cepa were measured over a three week period, after a seven day equilibrium period.

Results

Plant growth measurements of Lycopersicon esculentum showed that a soil composition of 10% biochar and 5% gypsum resulted in the highest growth rate during drought conditions. Lycopersicon esculentum#s growth was not significantly affected by 30% biochar. During drought conditions, Allium cepa#s growth rate increased with 30% biochar and 5% gypsum. Data displayed that the addition of 5% gypsum increased water retention and growth rates for both plants during El Niño conditions.

Conclusions/Discussion

This project's results suggest a combination of 10% biochar and 5% gypsum to be most beneficial for the growth rate of Lycopersicon esculentum and 30% biochar and 5% gypsum for Allium cepa. An integration of biochar and gypsum is the optimum solution to simultaneously combat the California drought and attempt to utilize excess water during El Niño years.

Summary Statement

I found a combination of biochar and gypsum with average soil to be the optimum soil amendment to increase soil's water retention and crop yield during drough conditions.

Help Received

Mr. Jonathan Ng assisted me with the statistical analysis of the data acquired from my project.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Milan S.S. Brennan

Project Number

S1802

Project Title

Using a Drone to Measure Cover Crops in Organic Strawberry Furrows

Abstract

Objectives/Goals

The objective of this study was to use aerial photography with a drone to measure cover crop canopy development to determine which planting arrangement (one versus three lines) closed canopy the quickest.

Methods/Materials

This experiment occurred at a USDA-ARS organic research field. On September 28, 2015, a cover crop mixture that by weight included 66% sudangrass and 34% mustard was planted in the furrow bottoms. Two planting arrangements (1 line versus 3 lines) were used to plant the cover crops. In the 3 line arrangement, the middle line was in the center of the furrow, and each of the outside lines was 51 mm away from the center line. This experiment had six replications. Each replication consisted of two furrows randomly assigned to either the 1 or 3 line planting arrangement. The furrow bottoms were drip irrigated as needed to germinate the cover crop. To prepare for winter rainfall, cover crop was planted approximately 1 month before transplanting the strawberries.

Cover crop canopy ground cover was recorded in photographs taken weekly by a drone for a month at approximately mid-day. A consistent height above the plot for each date and replication (ranged from 5-10 m) was maintained by using the altimeter feature of the App. The pilot stood at a fixed point on the north end of the plot, and the assistant stood in front of the furrow being photographed and photos were taken going from left to right.

The photos were cropped and a pixel quantifying program called easyleafarea was used to find the percent ground cover of the cover crops in the furrows. The data was then plotted in excel in a scatter plot.

Results

There was a faster rate of canopy development in the 3 line treatment when compared to 1 line, but overtime the 1 line treatment started catching up.

Conclusions/Discussion

The results agreed with the hypothesis that the 3 line arrangement would develop its canopy faster than the 1 line arrangement.

In conclusion this novel method of cover cropping in the furrows with 3 lines of mustard and sudangrass could make organic strawberry production more sustainable by increasing water infiltration and reducing runoff, soil erosion and nutrient loss during the winter.

Summary Statement

This project tested which arrangement (1 line or 3 lines) of a sudangrass and mustard mixture with the same amount of seed closed its canopy fastest in the furrows of an organic strawberry field in the month prior to strawberry transplantat

Help Received

Used drone at USDA-ARS under the supervision of Dr. Eric Brennan, conducted experiment at the USDA-ARS field at Spence Road under the supervision of Dr. Eric Brennan, Advisor was Dr. Eric Brennan at the USDA-ARS.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Anthony J. Castillo

Project Number

S1803

Project Title

Effects of Seed Priming on Germination and Seedling Vigor of Aged Yemeni Watermelon (Citrullus lanatus) Landrace Seeds

Abstract

Objectives/Goals

In Yemen, the production of native watermelon using landrace seeds has been disrupted due to civil war leaving farmers with aged seeds. Studies have shown that seed priming can improve germination of aged seeds. The objective of this experiment was to measure the effects of hydropriming, osmopriming, and hormonal priming solutions on the germination and seedling vigor of aged Yemeni watermelon (Citrullus lanatus) landrace seeds.

Methods/Materials

Using Jiffy pellets as the growing medium, eight-year-old landrace seeds were subjected to five different seed treatments (5 seeds per treatment): (A) hydropriming-Scarification and water soak, (B) osmopriming-H(2)O(2) rinse followed by soak in oxygenated reverse-osmosis water with sucrose, (C) osmopriming-milk soak, (D) inorganic hormonal priming-Mad Farmer Nutrient Up-Take Solution with Silica sprayed on soil prior to planting (E) organic hormonal priming-HB-101 plant enhancer sprayed on soil prior to planting. Five untreated seeds were used as a control group. The pellets were placed on a tray indoors and observed for twenty-five days. Seeds were watered with 5 mL of reverse-osmosis water.

Results

Rates of Germination: Treatments A (hydropriming), B (osmopriming), D (inorganic hormonal priming), and Control 60% , Treatment C (osmopriming) 40%, E (organic hormonal priming) 20%. Qualitative analysis using the Seedling Vigor Classification Test showed that only 3 seedlings (one each from Treatments A, D, and E) were classified as strong with the potential of producing fruit if growing continued. Quantitative vigor was also used to analyze results. Treatment A had the highest measured and classified seedling vigor. Finally, growth rate was also measured in five day intervals, starting at Day 10. Treatment A (hydropriming) and D (inorganic hormonal priming) consistently had the highest growth rates. Treatment D had the highest with a growth rate of 1.9 cm/day from Day 10 to Day 15.

Conclusions/Discussion

The results of the experiment suggest that hydropriming with scarification is the most effective treatment to germinate viable Yemeni watermelon (Citrullus lanatus)landrace seedlings. Seeds treated with hydropriming and scarification consistently showed positive results in all measured categories: germination percentage, qualitative vigor, quantitative vigor, and growth rate.

Summary Statement

By testing seed priming techniques as a way to increase germination and seedling viability in aged Yemeni watermelon landrace seeds, I determined that hydropriming with scarification is the most effective treatment.

Help Received

Wesam Qaid, Executive Director at Small Micro Enterprise Promotion Service provided information on watermelon farming in Yemen. Staff of La Habra Hydroponics gave suggestions on hormonal plant treatments. The experiment was designed and conducted entirely by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Dina S. Dehaini

Project Number
S1804

Project Title
Plant Communication Experimentation

Abstract

Objectives/Goals
This project tested underground communication through endomycorrhizal networks against above ground communication through volatile organic compounds (VOC) on different plant types. It was hypothesized that underground communication would be more effective, as it allows plants to communicate directly, the bean plant would be the best above ground communicator, due to its broad leaves where more VOC can be released, and coriander would be the best underground communicator due to its deep reaching, fast developing tap root system.

Methods/Materials
Each plant type was planted in a control bin (separate cells and air tight bags on plants preventing fungal communication and chemical signaling), chemical signaling bin (separate cells and bag over whole bin), and underground communication bin (endomycorrhizae mixed into soil and airtight bags on plants). Plants were grown and measured for height and fresh weight. Two in each bin were stressed with glyphosate. Neighboring plants were allowed to #eavesdrop# and activate defense mechanisms. Salicylic acid (SA), produced by activation of defense mechanism, was extracted from leaf cuttings into a powder form. The ferric chloride test was used to test for presence of SA and reaction time was recorded (less time meaning more SA present meaning a better form of communication took place). A UV spectrophotometer measured absorbance of solutions and a calibration curve was used to find which plant produced a higher concentration of SA.

Results
Underground communication had produced an average of 16.15% more SA than underground communication and 41.95% more than above ground communication, making it the best form of communication. The bean plant had the greatest change in SA produced from the control to the above ground communication category, and the early sunglow corn had the greatest change in SA from the control to the underground communication category.

Conclusions/Discussion
Underground communication allowed plants to communicate directly and enhance their immune systems. The bean plant was the best above ground communicator because it can adapt easily to differing levels of sunlight which affects the amount of VOC it produces. The third hypothesis was proved to be incorrect as the corn was the best underground communicator rather than the coriander, due to the corn#s fibrous root system allowing for more bonds to form between the fungus and plant.

Summary Statement
This project found plant communication through mycorrhizal networks to be more effective than chemical signaling in most plants with early sunglow corn being the best underground communicator and the bean the best above ground communicator.

Help Received
Coach and professors gave advice on project. Student at the Jacobin's School of Engineering helped me gain access to a lab and equipment.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Alexander J. Ditto

Project Number

S1805

Project Title

Effects of Pisum sativum and Rhizobia Bacteria on the Ammonium Concentration in Martian Regolith Simulant

Abstract

Objectives/Goals

To determine if nitrogen fixation can occur in simulated Martian regolith and if so, to quantify the ammonium added to the soil through this process.

Methods/Materials

Planted Pisum sativum with Rhizobia bacteria in simulated Martian regolith. After plants had grown, soil was analyzed using High Performance Liquid Chromatography to detect and quantify ammonium in soil samples.

Results

Results from HPLC analysis showed a presence of ammonium in soil samples based on chromatograms from standard ammonium samples and soil samples. Physical evidence of nitrogen fixation was observed in the form of the formation of root nodules on the test plants.

Conclusions/Discussion

Nitrogen fixation using Pisum sativum and Rhizobia bacteria can occur in simulated Martian regolith. This process increased the ammonium concentration in the soil, making it more fertile for future generations of plants. Nitrogen fixation may provide a way to help fertilize soil on Mars and make it farmable for future settlements.

Summary Statement

I planted organisms cabable of nitrogen fixation in Martain regolith simulant in order to increase the ammonium concentration of the soil to show that farming on Mars may be possible in the near future.

Help Received

Dr. Greg Cauchon helped me learn the process and methods of High Performance Liquid Chromatography

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Danika R. Flemming

Project Number

S1806

Project Title

Investigating the Use of Agricultural Combustion Waste on Brassica Productivity

Abstract

Objectives/Goals

The goal of this investigation was to determine if agricultural combustion waste has any affect on the productivity of brassica plants.

Methods/Materials

Apple wood combustion waste, cherry wood combustion waste, plain soil, distilled water, radish seeds, plastic cups, and an electronic balance. Measure the biomass of brassica plants after two weeks of being grown with the addition of different types and amounts of agricultural combustion waste.

Results

According to the data, there is no statistically significant effect on the productivity of Brassica when agricultural combustion waste is added to the soil up to 30% ratio infiltration. The standard errors range between 0.001 and 0.002 and display complete overlap in all graphs which means the data that was significantly different occurred by random chance rather than an actual effect caused by the agricultural combustion waste.

Conclusions/Discussion

During my investigation, I found that the addition of agricultural combustion waste to Brassica plants will not to statistically significantly affect the productivity of the plant. These results are important because they display that these two types of wood ash in 10%, 20%, and 30% increments do not alter the growth of Brassica plants. In agricultural, instead of disregarding the combustion waste created, it can be infiltrated into the soil without negative effects. Also, no extra measures need to be taken to prevent the plants from interfering with the waste.

Summary Statement

I found that the addition of agricultural combustion waste has no statistically significant affect on Brassica productivity.

Help Received

I designed the project myself, but had help conducting it by my designated supervisor and my biology teacher.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Michael Garcia; Patrick Jackson

Project Number

S1807

Project Title

Transforming Plants

Abstract

Objectives/Goals

This investigation assess the effect of magnetic fields on a model organism: garden cress (lepidium sativum).

Methods/Materials

Eight samples of garden cress seeds were grown in hydrogel-filled test tubes. Test tubes were wrapped with copper enameled wire and attached to either an 8.5 W or 18 W power supply, or no power supply as a control group.

Results

The plants with no magnetic field grew the least, the plants with low radiation grew the 2nd least, and the plants with full radiation grew the most. The results also exhibited that plants placed under a stronger magnetic field had a warmer soil temperature.

Conclusions/Discussion

It was concluded from the results that the cause of the increased growth in plants placed under a stronger magnetic field could have been from either heat coming off the coil, or from a stronger magnetic field. If the latter is true, an effective way to increase specific types of plant's growth was brought about

Summary Statement

The project was to test the affect of magnetic fields on the growth of plants.

Help Received

Our biology teacher Mr. Krynen provided further explanation of plant growth. Our physics teacher Mr. Tom helped us to understand to properties of magnetic fields and its effect on plants.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Anita Garg

Project Number
S1808

Project Title
The Effect of Seeding Styles, Competition, and Slope Orientation on a Native Coastal Sage Scrub Community

Abstract

Objectives/Goals
Over the last four years, I have been conducting studies regarding the stomatal conductance and other measurements of coastal sage scrub species based on environmental factors such as seeding patterns, inter-species competition, and intra-species competition.
This year I decided to explore the apparent connection between the slope orientation of plots by analyzing the plants# specific leaf areas (SLAs).

Methods/Materials
I used a Decagon leaf porometer, 48 plants at the Loma Ridge Restoration site, 2 metric rulers, 28 plant pots, 21 native shrub plants, 21 native forb plants, 49 Brassica nigra plants, over 150 samples from the Stipa pulchra, the Artemisia californica, the Eriogonum fasciculatum, and the Sonchus oleraceus, an area meter, a scientific oven, and a scientific scale.
To test the effects of seeding styles, each of 48 Salvia apiana plants was measured with 3 stomatal conductance measurements. The height of the plants was also measured. To test the effects of competition, I tested four groups: Brassica nigra grown alone, Brassica nigra grown with native shrubs, Brassica nigra grown with native forbs, and Brassica nigra grown with its own species. To test the effects of slope orientation, I measured the SLA of four species, with a total of over 150 samples measured.

Results
The average height for the shrubs only plot was higher than that of the mixed plot. The average stomatal conductance for the Salvia apiana in the mixed plot was higher than that of the plants in the shrubs-only plot. For the competition measurements, the average number of leaves was highest when Brassica nigra was grown with shrubs. For the slope orientation measurements, the Sonchus oleraceus had the highest specific leaf area, then the Artemisia californica, then the Eriogonum fasciculatum, and lastly the Stipa pulchra.

Conclusions/Discussion
The seeding style of a plant community affected the height and stomatal conductance of its plants. The invasive species Brassica nigra grows the least when it is grown with its own species, and grows well with native shrubs. My hypothesis regarding which species would have the highest to the lowest SLAs was supported by data. I also found a unique link between the slope orientation of a plot and the average SLAs of the coastal sage scrub plants.

Summary Statement
I found that native plants grow best with a mixed seeding style, that competitive native forb plants are best at combating invasive mustard plants, and that more drought-resistant plants should be planted on south-facing slopes.

Help Received
I would like to thank Dr. Sarah Kimball of the UCI Center for Environmental Biology for providing guidance throughout my project. I would also like to thank my mother for driving me to and from the Loma Ridge Restoration Site.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Sandhya Kalavacherla

Project Number

S1809

Project Title

Mutants of Leucine Rich Receptor-like Kinase Proteins Show Increased Biomass: A Proteomic Study

Abstract

Objectives/Goals

The objective was to manipulate plant biomass through determining membrane protein interactions with cellulose synthase interactive protein and characterizing the mutants of the interactions.

Methods/Materials

created a 1,536 membrane protein library in yeast, transformed CSI1 (protein of interest) into yeast, conducted a mating based split ubiquitin assay with 1,536 membrane proteins in Arabidopsis Thaliana, screened for strong protein interactions, ordered mutants of these CSI1 protein interactors and planted against wild type to observe difference in phenotype

Results

I found that CSI1 has 54 strong protein interactions with the 1,536 membrane protein library. Four receptor like kinase proteins (RLK) were found to interact strongly with CSI1, two of which--RLK proteins AT1G34110 (182) and AT1G16670 (217)-- showed significant increase in biomass compared to wild type (24.68% increase in leaf area, 31.60% increase in stem length, 93.13% increase in rosette area compared to wild type for the 182 mutant). A two sample statistical t test shows that 99+% of the time, the increase biomass in the two mutants is due to the mutation in the RLK proteins.

Conclusions/Discussion

The increase in biomass due to the mutations in the two RLK proteins is directly applicable to the bioethanol industry, which harvests plant biomass to create biofuels. The increased biomass minimizes the amount of land necessary to sustain biofuel feedstocks, as countries are increasingly struggling to allocate land to grow biofuel feedstocks. In addition, these LRR-RLK proteins are present in important food crops, such as sugar cane, and in leafy vegetable food crops, such as kale and spinach. Mutating the AT1G34110 (182) and AT1G16670 (217) LRR-RLK proteins in these plants has strong potential to increase stem length and leaf area, and thus increase food production.

Summary Statement

Mutants of 2 receptor-like kinase proteins show increased biomass,i.e. greater stem length, leaf area, and rosette area--a result that'll improve biofuel production and possibly crop yield as these RLKs are present in important food crops.

Help Received

Dr. Renate Weizbauer and Dr. David W. Ehrhardt of the Carnegie Institution of Science at Stanford University provided mentorship and lab access.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Nicolas Laqua; Annam Tran

Project Number

S1810

Project Title

Novel Transfection of Macroalgal Azolla and Lemna Mediated by Agrobacterium to Elevate Neutral Lipid Biofuel Production

Abstract

Objectives/Goals

This affiliated research delves into genetic modification of the aquatic duckweeds Azolla caroliniana and Lemna minor in order to elevate triacylglycerol, diacylglycerol, wax ester, and other long chain lipid production for the purpose of biofuel production. These macroalgal duckweeds Azolla and Lemma were selected for a magnitude of reasons, including reduced difficulty of reliable harvest and rapid growth employed by both Azolla and duckweed. In order to catalyze potential biofuels, we transferred our gene of interest, bifunctional wax ester synthase/acyl-CoA diacylglycerol acyltransferase or atfA1, the key to biosynthesis of storage lipids in Acinetobacter sp. strain ADP1 located within the enzyme WS/DGAT, into A. tumefaciens strain pET21a-IfeR to allow catalyzation formation of triglycerides and WE from DAGs and fatty alcohols: Our research isolated and transformed A. baylyi ADP1's WS/DGAT into modified Agrobacterium tumefaciens pET21a-IfeR, acting as a vector for our goi, and isolated from Acinetobacter baylyi ADP1 via gel purification after electrophoresis and restriction digest. A. tumefaciens then transfected WS/DGAT into Azolla via novel spore propagation, and duckweed via calli induction. Upon utilizing Agrobacterium tumefaciens novelly for modification of Azolla, and performing modification of Lemna via calli induction andexposure to A. tumefaciens, both species# fatty acid production was statistically elevated. The product of processed duckweeds was utilized after solvent-lipid fsaa extraction; we converted our extracted lipid into functional biodiesel by transesterification. TAG production elevated an average 10% in the transfected L. Minor samples; 7% in treated Azolla samples. Functional biodiesel production was obtained from the rapidly growing azolla and duckweed in the form of neutral lipids at a rate deemed "percent efficiency" or production efficiency: Dry weight percentage of long chain neutral lipids usable in biodiesel. The term "percent efficiency" (pe) models the elevation of fatty acids, increasing from 10.1 to 18.7 and 14.2 to 16.8, (Lemma /Azolla respectively). Based upon our experiment, A. caroliniana, and to a greater extent L. minor, are vectors for elevated fatty acid production, serving as a backbone for continued research into renewable, reliable, carbon negative biodiesel production from fast growing macroalgal sources.

Summary Statement

Through novel processes we transfected two species of macroalgal duckweed, Azolla caroliniana and Lemna minor, in order to elevate long chain lipid production for the purpose of biodiesel production.

Help Received

All research was done in the Canyon Crest Academy QUEST Laboratory with contributions from Thermo-Fisher Scientific, United States Biological Life Sciences, The Addgene Repository, and CCA Foundation. Funding and donations for Gel electrophoresis supplies, restriction enzymes, live cultures,

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Dina Mirbabaei

Project Number
S1811

Project Title
The Effect of the Number of Stomata on the Transpiration Rate of Plants

Abstract

Objectives/Goals
The purpose of this project was to discover whether the transpiration rate of a plant is affected by the number of stomates contained on the leaves. In my experiment, I collected 200 leaves from two species of citrus plants. Citrus limon and Citrus sinensis. According to my research, orange trees have higher transpiration rate than lemon trees. Transpiration is the evaporation of water through the stomates so my hypothesis states that the higher the rate of transpiration, the more stomata is found on the leaves of a plant.For further proof, I estimated the stomatal density from various orange and lemon trees.

Methods/Materials
I collected 100 leaves from the plant C. limon (Lemon), and 100 leaves from C. sinensis (Orange). Next, I used nail polish and clear tape to take the stomata off the surface of the leaf. Following, I taped the specimen on a slide and Viewed it under high power of magnification. I took pictures of the image under the microscope and used them to count the stomates of the leaves. Then, collected 90 more leaves from various trees and counted the number of stomata. Knowing the diameter of high power field of view, I Calculated the area of the field of view under high power using the formula for area of a circle and divided the number of stomata in each leaf by the area of the field of view under high power.

Results
The results of the data tables and graphs show that orange leaves have greater number of stomata and larger stomatal density than lemon leaves. As a result, because orange leaves have more stomata; therefore, they will have a greater transpiration rate than lemon leaves. Consequently, more water evaporates from the surface of orange leaves which makes Lemon trees more drought tolerant compared to orange trees in dry areas such as Southern California.

Conclusions/Discussion
Based on my data and graphs, I approve my hypothesis which states that the greater is the number of stomata on the leaves of a plant, the higher is its# transpiration rate. This is because my results show that orange leaves have greater number of stomata and stomatal density than lemon leaves. Additionally, according to the research from the International Journal of Applied Science and Technology, Orange tree has higher transpiration rate than lemon tree. In conclusion, this proves that number of stomata affects the transpiration rate of plants.

Summary Statement
I showed that the transpiration rate of a plant is affected by the number of stomata the leaves contain which consequently proved that lemon trees are more drought tolerant than orange trees.

Help Received
My biology Teacher Introduced me to the idea of taking the stomata off the surface of the leaves using clear nail polish and tape. Then, I conducted and performed my own experiment related to counting the number of stomata and measuring the stomatal density of lemon and orange leaves.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Sofia Perez; Janet Reyes-Zamora

Project Number

S1812

Project Title

The Effects of Increased Air Pressure on Seed Germination

Abstract

Objectives/Goals

This experiment was conducted to compare the effects of atmospheric pressure and increased air pressure on germinating seeds.

Methods/Materials

In this experiment, seeds from four varieties of pea plants were grown using two procedures: Test Tube and Soda Bottle methods. Fizz keepers were used to pump air into test tubes and 12 ounce soda bottles for increased pressure. Soda bottle caps were used to cover test tubes and soda bottles for atmospheric pressure. Seeds were grown using both methods and placed under experimental conditions for one week. The increased air pressure from the fizz keepers was estimated by measuring the amount of air that was pumped into the bottles and test tubes and the amount of air in the test tubes and soda bottles that were covered with soda caps. The pressures for both atmospheric and increased air pressure were calculated by using the amount of measured air from the bottles and test tubes and Beer's Law.

Results

The average sprout length results for Sugar Snap peas were: 6.78 cm for seeds that germinated under sea level pressure and 1.48 cm for seeds that germinated under increased air pressure for the Test Tube method. The Soda Bottle method had similar but less significant results. The average sprout lengths for Sugar Snap and garden peas were 2.65cm for seeds that germinated under sea level pressure and 1.65cm for seeds that germinated under increased pressure.

Conclusions/Discussion

Our hypothesis was that an increase in air pressure during germination would help increase sprout length. This was incorrect. An increase in air pressure during the first week of germination caused shorter sprout lengths for pea plants. A possible reason was that a week was too long. In future research, the experimental germination period will be shortened and plants with different seed types will be investigated

Summary Statement

The difference between atmospheric sea level pressure and increased air pressure was compared for optimal germination conditions for four varieties of pea plants.

Help Received

My science teacher helped us design the project and we conducted the experiment and collected data by ourselves.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Andee L. Poole

Project Number
S1813

Project Title
Effect of Bovine Manure Age on Food Crop Productivity

Abstract

Objectives/Goals
The purpose of my science fair experiment is to investigate if aged bovine manure loses its nutrients and effectiveness as a plant fertilizer as it decomposes, or ages. The objective is to determine at what age, or level of decomposition, bovine manure should be used as a plant fertilizer based on its effectiveness as a fertilizer on radish plants, fescue grass, and alfalfa grass, three important, food producing crops grown in the Central Valley. Learning at what age the manure fertilizes plants best will allow farmers to use the most productive agricultural techniques to grow crops at the highest productivity rate possible.

Methods/Materials
Used bovine manure at three different levels of decomposition (180 days, 90 days, and 7 days) to hydroponically grow radish plants, fescue grass, and alfalfa grass over a fourteen day period. Compare the shoot biomasses (in grams) of the individual plants grown by the different manures to determine if bovine manure age affects food crop productivity based off of a statistical analyzation.

Results
The biomasses of different plants grown by bovine manure at varying levels of decomposition were compared. The results regarding the effects of bovine manure age on food crop productivity indicate that age did have an effect on the shoot biomass (in grams) on the three food crops. The manure aged 7 days was not as productive as the manure aged 90 days and 180 days. Although the manure aged 90 days and 180 days did have some significant comparable values, it was proven that the age of bovine manure does effect food crop productivity; thus the null hypothesis was rejected.

Conclusions/Discussion
The 7 day old manure was the least effective plant fertilizer, proven by the average shoot biomasses and the t-test that was calculated. The manure had a probability of less than 5%, so the results indicated a significant difference between the 7 day old manure and the older manures. The 90 day old manure was the best plant fertilizer. However, when the manures effectiveness on the fescue grass was compared with a t-test, there was no significant difference between the 90 day old and 180 day old manures. P = 99.34%, so random chance was not responsible for the results of the fescue grass# growth. In sum, bovine manure age did affect food crop productivity.

Summary Statement
I proved that bovine manure age does affect food crop productivity on the shoot biomass (in grams) of radish plants, fescue grass, and alfalfa grass.

Help Received
Mr. Aalto explained the statistical analyzation to apply to the project.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Sherry Y. Xu

Project Number
S1814

Project Title
The Effect of Drought on California Native Plant Diversity

Abstract

Objectives/Goals
Determine how California native plant diversity is affected by varying drought conditions ("Low" water level, "Mid" water level, and "High" water level) over a 3.5 week testing period.

Methods/Materials
The experiment took place in an environmental chamber, which allowed me to keep temperature and light constant. I set up 18 germination trays, 6 of which were given "Low" water treatment, 6 were given "Mid" water treatment, and 6 were given "High" water treatment. Each tray contained 600 seeds: 100 seeds of each of the 6 California native species I chose for this experiment. I counted the number of germinants per each species in all 18 trays every 3 days throughout the course of 3.5 weeks. I used monocultures to help me identify the species of each germinant. I then used germinant count to determine diversity using metrics such as species richness and Shannon diversity.

Results
All calculations of diversity metrics revealed most diversity in "High" water treatments, and least diversity in "Low" water treatments. All one-way ANOVA tests for germination, species richness, Shannon diversity, and Simpson's Index yielded p-values of less than 0.01, showing significant differences between all 3 water treatment groups.

Conclusions/Discussion
The experiment found that germination and diversity are positively correlated with increased water treatment. The results support my hypothesis and indicate that increased drought conditions threaten native California plant diversity in terms of germination, species richness, Shannon diversity, and Simpson's Index. Additionally, by creating a linear mixed model with time, water, and the interaction between time and water, I observed a correlation between time, water, and diversity. Over time, species richness in "Mid" water level trays started to follow the trends of species richness in "Low" water level trays. I also observed that in the "Mid" and "Low" germination trays over time, there were some decreases in species richness, which suggest plant mortality, another possible drastic effect of drought on California ecosystems. Lastly, a comparison of Shannon Diversity and Simpson's Index results indicated that choice of metric plays a large role in determining diversity.

Summary Statement
I found a positive correlation between California native plant diversity and increased water treatment, and also that over time, even "mid" water treatment has similar negative effects on plant diversity as a "low" water treatment.

Help Received
My mentor Dr. Barbara Fernandez-Going (D'Antonio Lab, UCSB) helped me with finding materials and taught me how to use PivotTable and JMP. This was an independent project; I designed/performed the experiment & analyzed data myself. The environmental chamber was at UCSB.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Isabelle H.S. Yardumian

Project Number

S1815

Project Title

The Effect of Tilting Phaseolus vulgaris Plants at a Forty Five Degree Angle on Biomass and Overall Growth

Abstract

Objectives/Goals

The purpose of this experiment was to test the effect of tilting Phaseolus vulgaris plants at forty five degree angles on their biomass production and overall growth.

Methods/Materials

Phaseolus vulgaris plants were all planted in cups in soil of the same brand and were watered with fifty milliliters of water every Tuesday and Thursday. Once the plants had germinated and began to grow, they were staked, four of them staked at forty five degree angles, and four of them staked and grew vertically at ninety degree angles. After the plants had grown for four weeks, the plants were measured for height, leaf count, leaf length, and were placed in an oven to dehydrate before massed using a Quadra-beam balance.

Results

The results of this experiment supported the hypothesis that tilting these plants would increase the biomass produced and aid in their overall growth. The control group plants grew to an average of about 39.030 centimeters, while the experimental group plants grew to an average of 60.960 centimeters. It was also observed that the control group produced on average about 1.86 grams of biomass, while the experimental group produced on average 4.57 grams of biomass. However, the control group had percent deviations of 35.032% and 48.3%, which is significantly larger than that of any of the trials for the experimental group.

Conclusions/Discussion

The plants in the experimental group showed a greater overall biomass as well as more successful overall growth. It can be concluded that the tilting of these plants at forty five degree angles is the cause for this, however, a way to ensure that conclusion would be to test this experiment on a wider variety of plant species in order to be confident in that conclusion. A way to expand on this experiment would be to not only try a wide variety of plants in this experiment, but to also grow these plants to full term as well as try other stresses and observe these effects on the plant growth and overall biomass.

Summary Statement

My project showed that tilting Phaseolus vulgaris plants at forty five degree angles increases their biomass production and overall growth.

Help Received

My chemistry teacher, Mike Antrim from Woodbridge High School, aided me in finding a category that interested me and was possible to design experiments for.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Elina B. Yon

Project Number
S1816

Project Title
The Effects of Silicate Applications on Drought Tolerance and Growth of Lolium perenne and Lactuca sativa var Longifolia

Abstract

Objectives/Goals
Determination of silicate's effects on drought tolerance and growth of Lactuca sativa var Longifolia and Lolium perenne.

Methods/Materials
Lactuca sativa var longifolia and lolium perenne seeds, pots, soil, plant growing racks, milligram balance, oven, autoclave, spectrophotometer, sodium metasilicate. Recorded final height, biomass, and dry weight of around 50 replicates for both plant species.Estimated silicon uptake of Lolium perenne following the Autoclave Induced Digestion method by Elliot and Snyder.

Results
In the Lactuca sativa var Longifolia study, plants treated with silicates in sufficient amounts displayed significant increases in biomass. Plants treated with silicates in drought simulated conditions generally displayed increased biomass when compared to the control. In the perennial ryegrass study, all groups treated with sufficient and drought levels of sodium metasilicate showed increases in biomass, dry weight, and height of perennial ryegrass, as well as an uptake of silicon into their plant tissues as compared to the controls.

Conclusions/Discussion
The silicate concentration that promoted optimal growth varied by plant type and watering condition. Most increases in measurements of biomass, dry weight, height, and estimated silicon uptake were statistically significant. Adding silicates to agricultural fields is possibly a cost-effective way to improve biomass yields of produce with the same amount of water used. Silicates could also be beneficial in reducing water used for landscape irrigation, even at small concentrations while increasing cost-effectiveness.

Summary Statement
By analyzing biomass, dry weight, height, and silicon uptake, I found that silicates prove to be beneficial in enhancing the growth and drought tolerance of Lactuca sativa var Longifolia and Lolium perenne.

Help Received
Got help on experiment design, data collection methods, and statistical analysis from my teacher Mrs. Messenger.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Teevyah Yuva Raju

Project Number

S1817

Project Title

Drought Impact on Soilborne Fungal Pathogen of Tomato

Abstract

Objectives/Goals

The Goal of my research is to study each factor that may contribute to Fusarium Oxysporum Lycopersici Race 3 growth/decline and learn whether my hypothesis is true or false.

Hypothesis: Under a drought condition, soilborne pathogen will increase because of changes in the soil such as its water retention capacity, affecting the pathogen population to harm the plant.

Methods/Materials

First, I tested 6 Main Soils used in farming throughout California by using an autoclave to find the dry/wet weight of the soils, as this gave me a good estimate of how much water the soils can retain. Thereafter, other labs were completed using a Hemocytometer, Scanning Tunneling Microscope, and Laboratory Counter; to cultivate, inoculate, and test the pathogen in the soil. Later, after I finished conducting the root dip, and raising the tomato plants. I counted the Fusarium count in the soil and plated the samples, where I was able to find the results on how much harm the pathogens had on the plant.

Results

My Experiments found that Soil #3 (Euic Soil) did the best in terms of Water Retention, Soil Separation, and Pathogen Severity.However, in the Amount of Pathogen Test it had the highest pathogenic cell count of Fusarium.

Soil #4 (Potting Soil) did the worst in all of the experiments except for the Amount of Pathogen Test. It had the least amount of pathogen, but the most harm. It was noted that both of these soils were completely different, and in the conclusion I analyze these results and show why this occurred.

Conclusions/Discussion

I learned that my hypothesis is false. In fact the pathogen level went down in all of my samples. For example, in Potting Soil it had the lowest amount of pathogenic cells, but it had the worst effect on the Tomato Plants. Analyzing the soils I conclude that: Pathogens thrive in a soil that contains good properties for plants and they don#t harm the plant because the plant is tougher due to these factors.However, if the soil is unable to retain water, and is dry; the Colony Formation Unit will be smaller, but they will impact the plant rapidly. My project alerts not only farmers, but the general population about the diseases that is affecting their food and how the drought is harming agriculture in the status quo.

Summary Statement

This project looks at the Fusarium growth/decline in Early Pak Race 7 tomato plants, under 6 main different soils while simulating a drought condition.

Help Received

Dean of Agriculture at UC Davis: Helene Dillard. She helped me understand the necessities of how a lab would be carried out, and connected me with Mrs. Pia van Benthem. Mrs. Pia introduced me to a PHd student, Hung Doan; who gave me guidance on materials and basic procedures.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Esther E. Koh

Project Number

S1899

Project Title

Sucrose Efflux Mediated by SWEET Proteins as a Crucial Aid for Whitefly Feeding

Abstract

Objectives/Goals

Bemisia tabaci is responsible for transmitting plant viruses causing the ongoing and devastating 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 of East and Central Africa, which has in turn increased the spread of CMD and CBSD. However, areas of the world that cannot afford insecticides are subject to the devastating effects of B. tabaci feeding.

1. By investigating whether Bemisia tabaci reaches the phloem through the help of the sugar gradient secreted by SWEET sucrose transporter proteins, I hoped to gain some understanding of the feeding strategies of whiteflies.
2. I needed to determine which SWEET mutant, if any, had the least successful whitefly feeding.
3. If the whiteflies on a particular SWEET mutant showed increased difficulty in reaching the phloem, I needed to analyze the probing time of whiteflies (directly corresponding to less time feeding) and directionality of their stylets while probing.

Methods/Materials

Prior to infestation, I had 10 seeds per line for Col-0, the single mutants atsweet11 and atsweet12, along with the double mutant atsweet11, atsweet12. Each leaf was infested with either 1, 2, or 3 adults because the number of sheaths that was laid down is not definite. After feeding for 24 hours, the whiteflies were counted and removed, and whole leaves were stained with McBride's stain to track the stylet sheaths. I documented the number of stylets, bifurcations, and locations of said branches in the leaves, and compared the results from the mutants to Col-0.

Results

After analyzing the stylet destination, directionality, and the individual successes of whitefly feeding in the mutants and Col-0 using linear regression and chi-square goodness of fit tests, I determined that whiteflies on atsweet12 had the most difficulty and the least success in reaching the phloem for feeding.

Conclusions/Discussion

By inducing the gene expression of SWEET12 proteins, whiteflies had an extremely difficult time locating the phloem for feeding. This new knowledge of the feeding mechanisms of whiteflies is crucial to improving plant defenses against whiteflies. With this data, we can bioengineer plants through the manipulation of SWEET proteins to have natural defenses against these pathogens.

Summary Statement

I have determined that by directly inducing SWEET gene expression (particularly SWEET12) and therefore the sucrose gradient present in leaves, whiteflies 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.