CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Viviana Ayala

Project Number
S1901

Project Title
The Effect of Aspirin on Plants

Abstract

Objectives/Goals
This project was conducted in order to figure out what the effect of Aspirin on plants was. The objective was to find out whether or not Aspirin speeds up the growth of plants.

Methods/Materials
The materials used for this project were; 9 Round headed leek bulbs, 9 plant pots, Aspirin tablets, 7 cups, a ruler, dirt, water, and soil. A third of the plants were watered with plain water, another third was watered with ½ of an Aspirin tablet, and the last group of three were watered with a full Aspirin tablet.

Results
Both groups of plants watered with Aspirin water, resulted in growing faster (a week earlier) than the group of plants that were watered with plain water.

Conclusions/Discussion
The amount of Aspirin added to the water did not make a difference. The results of the project concluded that the effect of Aspirin on plants is; if you add Aspirin to the water used to water the plants then the plants will begin to grow faster than the plants watered with only plain water.

Summary Statement
The project was conducted in order to figure out whether or not Aspirin speeds up plant growth.

Help Received
Parents purchased the supplies, Uncle helped set up the project and boil water

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Kaylee Burdick; Caylie Denham

Project Number
S1902

Project Title
The Effects of Increasing CO(2) Levels on Plant Growth

Abstract

Objectives/Goals
To determine how various amounts of CO2 levels affect the rate of plant growth.

Methods/Materials
Materials: Wisconsin Fast Plants, distilled water, antacids, zip-lock Tupperware, large zip-lock bags, lights, ruler, scale, potting mix, dropper, Styrofoam boxes, wicks, markers and paper towels.

Method: To construct a stable environment to keep the plants in. Use styrofoam boxes to put plants in. Place 2 Wisconsin Fast Plant Seeds in each hole of the styrofoam box filled with potting mix. Then water the plants until soil is completely moist. Cut the tupperware top so it has a slit that a paper towel can fit through. In large zip-lock bag have the zip-lock tupperware filled with distilled water and have a paper towel submerged in the distilled water and draped over the lid of the tupperware. The plants in the styrofoam box will sit on the paper towel that will become completely wet from the distilled water. fill the bag with water at the bottom but not too much or the box will float. Have 4 different variables: Control (nothing added), 2 Antacids and 1 Antacid. Add the variable every 2 days and measure the plants length. Aside from measuring and re-administering the variables keep the bags closed and under the lamp.

Results
On average the plants that were given 2 antacids grew the least, 1 antacid grew the most, the control grew close to the amount that the 1 antacid did but slightly less.

Conclusions/Discussion
The results showed that too much CO2 sufficated the plants and stunted their growth. Too much of a good thing can sometimes be a bad thing. With the rising CO2 levels in the earths atmosphere, due to the use of fossil fuels, plants growth could be stunted. It is also possible that the lack of oxygen in the controlled environment prevented germination from occuring which could also hinder the plants growth. Overall too much CO2 throws off the equation of photosynthesis and stunts the plants growth.

Summary Statement
Testing how increasing CO2 levels impact the growth of plants.

Help Received
Used equipment and lab in Mr. Betzelberger's AP Biology class room.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Ray C. Huang

Project Number

S1903

Project Title

The Recipe for More Food: Increasing the Geographic Range of C3 Plants

Abstract

Objectives/Goals

The objective is to see if an increase of pH in the root environment of C(3) plants would induce stomatal opening.

Methods/Materials

With 14 C(3) plants in each group, (Tradescantia pallida) the EXPERIMENTAL and CONTROL were all placed under control lighting and temperature in an environmental chamber (2 60-watt light bulbs at 28 degrees Celsius/82.4 degrees Fahrenheit). The independent variable was the pH of each group, with CONTROL under a distilled pH 7 water solution, and EXPERIMENTAL under a distilled pH 10 water solution, all via root water exposure. 100 stoma were counted in each plant, and these counts were placed on a list based on how many open/closed stoma there were out of these 100 stoma.

Results

There was an average of 80 open stoma and 20 closed stoma in the EXPERIMENTAL and average of 30 open stoma and 70 closed stoma in the CONTROL. In order to reject the null hypothesis, an independent 2-tailed t-test was conducted. Calculation showed that t=7.1655. With a degree of freedom of 13, a t-distribution chart showed that (with a conventional confidence level of 5%) the critical t-value was 2.160. These statistics rejected the null hypothesis because t was greater than the critical t-value.

Conclusions/Discussion

With an ever-increasing human population, there must be enough food to feed it. The most widespread food consumed globally is rice, which provides more than one fifth of calories consumed by humans. One important factor that is affecting the amount of rice produced is the geographic range of this crop. Rice is a C(3) plant that must close its stoma in a high temperature environment to conserve water. This stomatal closure initiates photorespiration which lowers glucose production and kills the plant. The data suggested in this experiment showed that an artificial high pH stimulus could override the water-conserving stomatal closure of C(3) plants, and thus prevent photorespiration. These results could be the basis for the expanded growth of food C(3) plants such as rice.

Summary Statement

Increasing the geographic range of C3 food plants by inducing stomatal opening to prevent photorespiration.

Help Received

Parents helped make board; Teacher provided lab equipment at Clovis West High School

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Anika Jain; Anuva Mittal

Project Number
S1904

Project Title
The Effects of Thyroxine and Insulin on the Growth of Brassica rapa

Abstract

Objectives/Goals
Inability to grow plants efficiently is a common inhibitor of the food and medicine consumerism market. Finding a viable solution to this problem would be net beneficial, so we tested the effects of animal insulin and thyroxine on Wisconsin Fast Plants (Brassica rapa).

Methods/Materials
We created eight groups of plants with varied concentrations of the hormones: 5 and 50 mcg/mL of just insulin, 5 and 50 mcg/mL of just thyroxine, 5 mcg/mL insulin and 5 mcg/mL thyroxine mixed, 50 mcg/mL insulin and 50 mcg/mL thyroxine mixed, 5 mcg/mL insulin and 50 mcg/mL thyroxine mixed, and 50 mcg/mL insulin and 5 mcg/mL thyroxine mixed. Using a micropipette to measure out the exact amounts of hormone, we created solutions dissolved in water, and we watered the plants with the solution three times a week.

Results
The plants treated with solely insulin at a low concentration grew more than those with a higher one, but they all unexpectedly died after approximately 20 days. The plants with thyroxin barely grew. With the mixed hormones, the plants with 5 mcg/mL of both thyroxin and insulin grew the most compared to the control.

Conclusions/Discussion
In the human body, secreted from the pancreas, insulin absorbs excess sugars from the bloodstream, keeping the level of sugar balanced in the body. If there is too much or too little insulin in the body, it will not allow the brain to function properly. Based on these facts, the plants reacted the same as the human body to the insulin. On the other hand, in the human body, thyroxine is a metabolic hormone. Again, there needs to be an exact balanced amount in the human body for it to properly function. The plants reacted in this same way in response to the thyroxine. In the future, we can experiment with different plants or hormones, such as glucagon, which has a role opposite that of insulin.

Summary Statement
Our central goal was to determine the effect of animal hormones, specifically thyroxine and insulin, on plants.

Help Received
Mentor helped us create the solution that the thyroxine was dissolved in, as it was a toxic acid

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Maya Jayanth; Resya Sastry

Project Number

S1905

Project Title

Let's Save Water: Maximizing Crop Yield with 50% Less Water through Precision Irrigation Monitoring

Abstract

Objectives/Goals

One of the opportunities to save water is in Agriculture irrigation, which consumes almost 61% of total water consumption and there is wastage of > 50% due to runoff. This project focuses on testing the impact of precision irrigation, by testing the impact of the amount of water on plant yield. This experiment monitored the growth of Pisum Sativum (pea) plants from seeds to full growth and compare the produce yield for 5 treatments (50, 100, 200, 300 & 400 ml/day). The Pisum Sativum was used by Gregor Mendel the #father of modern genetics# and serves as the ideal winter plant for research. There are four replications with a total of 20 plants and a random block design was used to complete the analysis

Methods/Materials

Data was used to compare yield and impact of independent variable (water) on dependent variables plant height, number of leaves, stem thickness and number of flowers/pods. The constant factors included Soil pH, amount of light and very minimal impact due to wind. The experiment will demonstrate that up to 50% (60,000 million gallons per day) of water can be saved by comprehending key factors influencing crop yield that would help innovate the next generation automated precision irrigation system.

Results

The data collected, resulted in the notice of different aspects affected by the water.

Conclusions/Discussion

In conclusion, the experiment demonstrated that > 50% water conservation could be achieved through precision irrigation. Statistical analysis demonstrated that yield from 50 ml was the same as yield from 300 ml. The variance due to each treatment for plant height, number of leaves, number of flowers/peas was not significantly different As part of the future direction, we are able to successful demonstrate that we could build a low cost monitoring solution using an Intel Galileo board to collect moisture data and provide real time data in the cloud. Developed a functioning motorized robot with a switch that stops at each plant, it is integrated with a solenoid valve to deliver specified amount of water for specific duration of time and at the lowest flow rate for each plant. It could be automated to deliver water based on weather conditions and moisture level.

Summary Statement

This project is about conserving water in agriculture, with precision irrigation and monitoring, by studying the impact of water on plant yield.

Help Received

Dr. Aradhya helped experimental setup; Mr. Keshavmurthy helped with connecting to the cloud with the Intel galileo board.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Rachit Kataria

Project Number
S1906

Project Title
A Novel Approach to the Maximization of CO(2) Intake through I-3-AA, Kinetin Chemical Enhancement, and Mycorrhizal Fungi

Abstract

Objectives/Goals
The objective is to maximize the amount of Carbon dioxide taken in during photosynthesis by Red Mangrove plants, which act as natural carbon sinks, in order to alleviate the detrimental effects of Global Warming.

Methods/Materials
I implemented a cytokinin called Kinetin, a plant hormone in the class of Auxins known as Indole-3-Acetic Acid, and a fungi known as Endomycorrhizae. These factors were applied singularly and in pairs to root tips and leaves of 15 plants per combination or single factor. The intake was recorded using several Vernier Labquest Carbon dioxide gas sensors within closed environments replicating tropical atmospheric conditions, with each group of plants regulated in temperature and light. The results were then statistically analyzed using Student's t - interval and compared to the intake of the control group of Mangroves.

Results
The combination of Mycorrhizae, Kinetin, and Indole-3-Acetic acid yielded an final Carbon dioxide atmospheric level of 28 ppm, or parts per million, as opposed to the 542 ppm remaining from the control's intake after the recording period of 10 hours. This is an inherent 19-fold increase in intake of Carbon dioxide and has multiple potential implications for the future of our prevention of Global Warming.

Conclusions/Discussion
With the prevalent detrimental impacts of excessive Carbon dioxide damaging the Earth's biosphere today, my project shows the ability to neutralize this excessive amount of gas by maximizing Carbon dioxide intake rather than adopting the mindset of wasting biomass and planting more plants. I estimate that by implementing this procedure on 20,000 Mangroves per each of the world's coastal countries, we can save 600,000,000 tonnes (1,000 kg per tonne) of Carbon dioxide annually.

Summary Statement
My project is a novel approach to maximizing the intake of Carbon dioxide in plants acting as carbon sinks in order to effectively combat global warming, with a potential intake of 600,000,000 tonnes of Carbon dioxide annually.

Help Received
Consulted with Mangrove Action Project; Mother helped make board

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Madison P. Meredith

Project Number

S1907

Project Title

The Effect of Microorganism Additives on Nitrogen Efficiency Related to Plant Growth

Abstract

Objectives/Goals

Conventional fertilizers may cause issues from low nitrogen uptake from plants. The increase of available, yet unused, nitrogen in the soil may also cause adverse effects to the nitrogen process, impeding the soil system. This study was performed to determine if growth rates and amount of nitrogen in soil and water, similar to what can be found using today's practices, can be effected by the addition of microorganisms found in worm feces.

Methods/Materials

A hundred and thirty-five plastic, 30.48 centimeter (cm) pots were separated into three equal groups, Treatment 1 (T1), grower standard soil/UN-32, Treatment 2 (T2), grower standard soil/microbial mix/UN-32, and Treatment 3 (T3), untreated grower standard soil/control group. The three treatments were put into a randomized block design in a greenhouse, and tested for 6 weeks. All three treatments received one Swiss chard transplant, same height, mass, and age. Water samples were taken after week 3 and 6, soil, root and green biomass samples were taken after week 6.

Results

Root and green biomass data proved that Treatment 1, grower standard soil/normal nitrogen, had almost equal performance with Treatment 2, soil/irrigation microbial mix. Water analysis proved treatment 1 to have the most amount of Total Kjeldahl Nitrogen/Nitrogen. When comparing the soil and water data for Treatment 1; approximately 60% of the nitrogen applied entered the plant or stayed in the soil. Treatment 2 released approximately 13% of the nitrogen applied, receiving or capturing around 87%. The addition of the microorganism additives supported a 27% decrease in the amount of nitrogen lost from the system.

Conclusions/Discussion

The addition of microorganism additives did have an effect on the growth of the plant, while improving the uptake of the plant. Treatment 2 received 27% more of the nitrogen applied than Treatment 1. With the leftover nitrogen in the soil, it could be projected that in a normal 6 week growth season, the nitrogen would then be available to replace the need for 10 applications. Economically, with the use of the microorganism additive, the price per 10 acres for irrigation and fertilizer is $12.50 more than without the mix. In turn, the revenue received from crop will increase, due to it being larger and healthier. The farmer will also save money from the lesser need for artificial nitrogen.

Summary Statement

The addition of a liquid microorganism additive during irrigation increased nitrogen efficiency in agricultural crops by 27% percent and increased growth rates; while also providing a long term, inexpensive solution to soil infertility.

Help Received

Used lab equipment at Research For Hire under the supervision of John Corkins; Compared project with student and professor at California Polytehnical State University.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Chau Nguyen

Project Number
S1908

Project Title
Do Non-Green Plants Still Contain Chlorophyll?

Abstract

Objectives/Goals
The objective of the project is to use chromatography to measure whether non-green plants still have chlorophyll.

Methods/Materials
I will be measuring or testing my hypothesis using chromatography, which is the separation of a mixture by passing it in solution through a medium. Chromatography involves acetone, which is an organic solvent that can split the aqueous impurities from the pigment in leaves. I will need filter paper, a jar, a coin, acetone, and the leaves. First, I will cut a piece of filter paper about 1 cm wide and a bit longer than my jar#s height. I will then place my first leaf over the top of the strip, roll the coin across the strip, and add some acetone to the bottom of the jar. Then, I will suspend the paper in the jar so that the bottom end is sticking a few millimeters into the acetone, which will separate out the colors of the leaf. If there is any green color, then that would be the chlorophyll.

Results
The green leaves quickly and clearly showed the presence of chlorophyll. The purple cabbage leaf showed green colors after a five consecutive trials in the acetone. The process took longer than it did for the green leaves because of the purple cabbage#s anthocyanins, which mask the green pigmentation very well. Most of the autumn leaves contained hardly any chlorophyll. It was pretty difficult to get the color onto the filter paper also because the leaves were pretty dry. The red leaf simply showed up a bright, fire red. The orange leaf showed up its own color. The yellow leaves were light yellow, and the brown leaf did not come out on the filter paper at all because it was much too dry and dead.

Conclusions/Discussion
I accept my hypothesis because my experimentations gave me evidence that non-green plants still do contain chlorophyll. These non-green plants# green pigmentations are just masked by the other pigments.

If I were to do my project differently, I would definitely add some plants that have blue leaves, like the Colorado blue spruce, or plants that have natural red leaves, such as the Japanese red maple. I would just like to have more leaves to work with. Also, research says that autumn leaves do still contain chlorophyll, but after time, the chlorophyll leaves fade. I must have waited too long to do the trials for the autumn leaves, so another thing that I would do differently next time is test the autumn leaves earlier in the fall season.

Summary Statement
The process of chromatography may be used to measure chlorophyll levels in green plants as well as non-green plants.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Danielle S. Ortiz

Project Number
S1909

Project Title
Aquaponics

Abstract

Objectives/Goals
The objective of this project is to investigate whether or not an aquaponics system can grow taller crops than those growing in fertilized soil. Aquaponics is a method for growing plants and aquatic life in a nearly self-sustainable environment where the crops absorb the excess nutrients in a fish tank and use it as fertilizer. The fish benefit from this system by living in an environment that is constantly being purified by plants. This method of farming is more environmentally conscious and arguably more efficient than traditional farming methods.

Methods/Materials
-Aquaponics system
-5 8" goldfish
-pea seeds
-spinach seeds
-20 small pots
-dirt (control)
-fertilized soil
There are three mediums being tested: the aquaponics system, fertilized soil, and dirt that has not been enhanced in any way (control).

Results
After growing spinach and peas in the aquaponics system, fertilized soil, and dirt (control), the data and observations of both types of plants showed that the aquaponics system generated the tallest plants.

Conclusions/Discussion
The results of the experiment supported the hypothesis that aquaponics should generate taller plants in comparison to fertilized soil. This is impressive since, in spite of the fish tank being understocked for the ensured safety of the goldfish, the aquaponics plants still grew taller. The research conducted for this project strongly suggested that aquaponics is a better method for growing both plants and fish. To know for certain whether or not this is true, this experiment has to be run again, this time investigating the growth of fish. Overall, this experiment has answered some questions as to the efficiency of aquaponics, but it has also raised numerous questions that will be answered by further experimentation.

Summary Statement
In this project, a more efficient method of growing crops is sought in order to one day supply less privileged areas of the globe with much needed nourishment.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Dale J. Risk, III

Project Number
S1910

Project Title
Water Sources and the Growth of Lolium multiflorum (Annual Ryegrass) Year 3

Abstract

Objectives/Goals
In the Coachella Valley, the golf industry consumes an enormous amount of water; they frequently use aquifer water to achieve this. However, this resource is limited. The other two water sources are Colorado River water which is fed through a canal system and Reclaimed water which is treated waste water. My goal was to mix different percentages of Reclaimed, Aquifer, and Colorado River water to find a solution that will help the golf courses: maintain lakes with a low amount of algae; save aquifer water and using more reclaimed water; and help golf courses use less fertilizer.

Methods/Materials
I used Aquifer, Reclaimed, and Colorado River water, hereafter referred to as (A)quifer, (C)olorado, and (R)eclaimed; I prepared mixtures with varying concentrations of these water sources. I placed water absorbent beads in 200 ml glass vials to hydrate the 10 Ryegrass seeds. I observed the germination and measured the subsequent growth of the samples.

Results
At Day 4, I observed:

# of Seeds Germinated in mixture:			Sample with maximum length of growth:		
Mixture Composition	S1	S2	Mixture Composition	S1	S2
33% (A)/33% (C)/33% (R)	4	4	33% (A)/33% (C)/33% (R)	4	3
50% (A)/30% (C)/20% (R)	5	4	50% (A)/30% (C)/20% (R)	4	3
30% (A)/20% (C)/50% (R)	3	3	30% (A)/20% (C)/50% (R)	2	2
20% (A)/50% (C)/30% (R)	8	7	20% (A)/50% (C)/30% (R)	5	4
60% (A)/20% (C)/20% (R)	5	5	60% (A)/20% (C)/20% (R)	3	4
20% (A)/60% (C)/20% (R)	9	9	20% (A)/60% (C)/20% (R)	6	5

As I repeated these tests, my results were materially the same.

Conclusions/Discussion
The mixtures containing Colorado River water, demonstrated the most amount of growth in the seeds. Over the space of 4 days, the 50% Colorado, 30% Reclaimed, and 20% Aquifer demonstrated the best qualities for interested Golf Courses. It uses more abundant resources, such as Colorado and Reclaimed water, and less of our vital drinking water.

Summary Statement
My goal is to find a mixture of aquifer, reclaimed, and/or Colorado River water that reduces dependence on aquifer water while increasing reclaimed or Colorado River water usage by golf courses in their maintenance of their landscape.

Help Received
Coachella Valley Water District provided water samples and technical guidance and my mother prepared my data charts.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Kapil Sinha

Project Number
S1911

Project Title
Molecular Characterization of Wild Beet in the Imperial Valley's Commercial Sugar Beet Fields

Abstract

Objectives/Goals
Wild beet poses a major risk to the 1.2 billion dollar sugar beet industry in the US, since hybridization will allow the glyphosphate resistance gene to transfer to the wild beet. This would render RoundUp, currently the most effective herbicide for wild beet, ineffective.
1. I needed to determine if hybridization has occurred between the wild beet and sugar beet and understand the likelihood of future crossing.
2. I identified geographic areas where wild beet are more likely to obtain resistance.
3. I characterized the wild beet to identify it.
4. I developed a quick and inexpensive test for glyphosphate resistance.

Methods/Materials
I had three phases in my project. In the first phase, I did fragment analysis of 32 SSR markers on the plants and analyzed it to yield its population structure. I verified these results by doing Sanger sequencing the ITS sequences and creating a phylogenetic tree. Next, I mapped the geographic location information of the wild beet with their corresponding population structure to find any correlation between them. Finally, I tested several concentrations of RoundUp to determine if a lower concentration can show whether a plant has glyphosphate resistance.

Results
Phase 1: Hybridization has likely already occurred between the wild beet and sugar beet and can occur again in the future, according to both the population structure and phylogeny.
Phase 2: All of the hybridized wild beet plants are only in the southern part of the Imperial Valley.
Phase 3: The lower concentration of RoundUp was able to kill or show damage on all the plants that do not have glyphosphate resistance and can inexpensively and quickly be used to test for it.

Conclusions/Discussion
Both the phylogenetic tree and population structure suggest that hybridization has most likely occurred, so gene flow between wild beet and sugar beet is a real threat. Both of them also identify the wild beet as being Beta macrocarpa. By comparing geographic location with population structure, I found that special attention must be placed in the southern part of the Imperial Valley to avoid future hybridization. Finally, the chemical assay that I developed can be used to inexpensively and quickly test for glyphosphate resistance.

Summary Statement
I have determined that hybridization between wild beet and commercial beet is a real threat and the area where this threat is the greatest is in the southern part of the Imperial Valley.

Help Received
I thank Dr. Richardson, Ms. Maria Meza, and Ms. Linda Pakish for being my mentors for this project. They permitted me to use USDA equipment, and taught me basic laboratory procedures. The experiment was designed and conducted entirely by myself.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Christy E. Warden

Project Number
S1912

Project Title
Fishing for Efficiency: A Study of Symbiotic Relationships

Abstract

Objectives/Goals
My objective was to study the efficiency and commercial potential of growing plants in a system that mimicked symbiosis between plants and fish. I wanted to grow plants in a hydroponic system, but didn't want to use chemicals associated with this. I built a system that utilized fish waste as a fertilizer for plants and compared their growth to traditionally grown plants.

Methods/Materials
2 five gallon buckets, A goldfish, Four California Bell Pepper plants, Water, Dirt and pot, A fountain pump, A ball siphon, Clear tubing, Lava rocks, Fish food, Ply wood, A ruler, Lab Book
I built a system that pumped water from a fish tank containing one fish into a plant tray where plants absorbed the nutrients from the water. The water then flowed back down to the fish through a ball siphon. I planted two plants in this system and two plants in normal soil. I compared the growth of plants in each system and fed the fish/noted its behavior each day. I recorded this information in my lab book.

Results
The plants grew for a total of 47 days. The experimental plants averaged a growth of 1/47 centimeters per day and the traditional plants averaged 7/94 centimeters per day. The traditional plants grew faster while the experimental plants deteriorated in health.

Conclusions/Discussion
The results of my experiment with the pepper plants is that the symbiotic relationship is not viable for the growth of these plants however I do not think that this experiment warrants a rejection of my hypothesis. I think that the nature of the pepper plant that I used prevented it from being successful in an aquaponic system at all, because these plants do not typically live in moist climates and did not take well to their roots constantly being submerged in water. The growth of the algae in the system may have also been detrimental to the plants. In another sense, the growth of the algae proves that my hypothesis still could stand because the algae thrived in the system and clearly took in nutrients from the water. Plant life can be sustained in the system, just not pepper plants. I am now experimenting with apple mint plants that typically grow in moist climates. Thus far, the growth of these plants is equal to the growth of the traditional plants. All in all, this experiment has opened doors for further research into the viability of aquaponic systems.

Summary Statement
My project tests the efficiency and potential of mimicking symbiosis between plants and fish.

Help Received
My father helped me use a saw to cut the bucket and drill a hole in it.

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)
Saumya R. Keremane

Project Number
S1998

Project Title
An Eco-friendly RNA Interference-based Insect Control for Management of Citrus Greening Disease Using a Model System

Abstract

Objectives/Goals
The goal of the project was to develop an RNA interference (RNAi)-based highly specific, bio-pesticide for the control of the psyllid vector of citrus greening disease. Citrus greening disease has killed over 50% of the trees in Florida, and is a threat to the 2-billion dollar California citrus industry. Because of quarantine regulations and ease of experimentation, a tomato model system was used. The objective was to demonstrate the efficiency of RNAi in effective control of the target psyllid and to develop a field delivery system using a viral vector.

Methods/Materials
Abnormal wing disc (awd) gene from tomato psyllid was partially sequenced. Using an awd clone, transcripts were synthesized in both directions using T7 RNA polymerase. Nymphs were treated with dsRNA and allowed to mature on tomato plants. Mortality and wing phenotypes were recorded, and awd gene expression levels were studied using real time PCR. The awd gene was cloned into a tobacco mosaic viral vector separately, in forward and reverse orientations, and viral transcripts were used to infect tomato seedlings. Nymphs were reared on these plants, mortality and wing phenotypes were recorded.

Results
A fragment of the awd gene from tomato psyllids was PCR amplified, cloned and sequenced. The treatment of psyllid nymphs with awd dsRNA preparations caused very high levels of mortality, as well as abnormal wing phenotypes in many surviving adults. Gene expression levels of awd, analyzed in 72 individuals, showed a much lower level of expression in dsRNA treated psyllids. Full length transcripts generated from an engineered viral vector (using a tobacco mosaic viral vector) with awd in forward and reverse orientations were used to infect tomato plants, and the effect on nymphal mortality and adult phenotypes are being analyzed.

Conclusions/Discussion
In absence of any other control strategies, the management of citrus greening disease is mostly dependent on the use of extensive insecticidal sprays. As many as 26 sprays/year have been reported from Brazil which may be harmful to beneficial insects as well as to human health and the environment. Using a tomato model system, a simple molecular method of gene silencing was shown to be an effective bio-pesticide targeted to the psyllid. No harmful effects are expected on other insects (eg. Honeybees) and humans. An effective way of field application is demonstrated with the use of a viral vector.

Summary Statement
An environmentally friendly and targeted bio-pesticide technology was developed using a tomato model system which can be applied to protect California#s citrus industry from an insect (Asian citrus psyllid) that transmits the deadly citrus

Help Received
I would like to thank Richard Lee (for mentoring and providing lab facilities), Greg Kund (for plants and insects), James Ng (for providing viral vector), and Tien Wu and Subhas Hajeri (for technical advice on RNAi).

CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

Virginia F. Hsiao

Project Number

S1999

Project Title

WiFi? Evaluating the Effects of Human Radiofrequency Waves on Raphanus sativus Seeds

Abstract

Objectives/Goals

As the use of technology increases in modern society, an increased exposure to human radiofrequency (RF) waves emanated by these devices results. Even with research, scientists remain uncertain of the effects. The goal of this project is to evaluate the effects of relatively high human RF waves (2.4 Ghz and 5.8 Ghz) on Raphanus sativus seed germination, quantified through changes in growth, biochemical production, and other signs indicative of potential radiation damage.

Methods/Materials

Thirty similarly sized Raphanus sativus seeds were acquired and separated into three groups (control, 2.4 Ghz, and 5.8 Ghz). 2.4 Gigahertz and 5.8 Gigahertz directional wireless antennas were directed at respective seed samples. Root growth and shoot growth were recorded daily. At the conclusion of the project, three samples from each group were selected for chlorophyll quantification and submerged in 5 mL of ethanol. Eight hours later, samples were analyzed in the spectrophotometer at the lambdamax of 430 nm and 662 nm.

Results

T-tests indicated that the root growth of both the 2.4 GHz and the 5.8 GHz were not statistically significant in comparison to the control. Conversely, T-tests found the comparisons of the shoot growth between the control and 5.8 GHz ($P = 0.00004$) as well as the control and 2.4 GHz ($P=0.0002$) to be statistically significant. Following spectrophotometer analysis, it was determined that the control had the most chlorophyll present, as the average absorbance unit doubled that of the 5.8 GHz sample.

Conclusions/Discussion

This study suggests that there is an effect of human RF radiation on the germination of Raphanus sativus radish seeds. As T-tests indicated the statistical insignificance of the root growth, such growth can be dismissed as similar structural growth. However, the disparity in chlorophyll production indicated that while systemic growth remained similar, biochemical production differed. As the production of chlorophyll decreased as the radiation exposure increased, there is an association between the radiation of radio waves and changes on the biochemical level. Thus, human RF waves, over time, do affect Raphanus sativus plants, leading to drastic differences in biochemical that could potentially lead to the demise of the plant.

Summary Statement

My experiment seeks to elucidate uncertainties regarding the effects of RF radiation on developing cells and found that while systemic growth of affected samples remained similar, biochemical changes characterized RF exposure.

Help Received

Teacher Ms. Katherine Ward, for supporting experimental work and providing lab space; Aragon Video Production Club for lending directional wifi antennas