CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Grace Deng

Project Number
S1901

Project Title
The Characterization of Accelerated Growth of Helianthus annus L Due to Fertilization

Abstract

Objectives/Goals
We studied the growth and development of an ornamental sunflower, Helianthus annus L, in a statistically controlled experiment. The factor was the topical application of a liquid fertilizer at three levels. The goal was to produce high-quality statistical data that could be modeled mathematically and statistically over the plant's growth cycle to maturity. Of special interest was the acceleration of growth during the rapid growth phase. Also of interest were the comparative effects of the fertilizer in the two treatment groups relative to the control group.

Methods/Materials
A completely randomized experimental design consisting of a control group and two treatment groups each containing five plants was used. The plants were germinated in soil in a structured garden plot. When plants were seedlings of a height of 7 cm, they were randomly allocated to the groups. The fertilizer was applied weekly to leaves, stems, and the stem-soil interface. Daily observations were made of the plants growth and development, and weekly measurements of the plants height were taken in cm to the nearest 0.1 cm. Observations and measurements were recorded in the laboratory notebook and measurements were recorded on a master data sheet.

Results
The growth in the height of the plant over time forms a sigmoid curve. The data represent a latent time series, height vs. time index, with five plant heights at each index. The time series for each plant were averaged and analyzed as a univariate time series. The raw data and the univariate time series were analyzed using EDA procedures (summary statistics; boxplots; scatter diagrams; one-sigma confidence intervals). Four hypotheses were tested using CDA procedures (hypothesis tests). The scatter diagrams showed sigmoid curves in their proper relationship when shadow outliers were removed. The Richards empirical growth curve was successfully fitted to the scatter diagrams of the control group and the two treatment groups.

Conclusions/Discussion
The experimental design produced data enabling modeling of the accelerated growth of the plants. Treatment was effective against the control. Treatments had a higher rate of growth than control and higher overall growth. The Richards empirical growth curve adequately models the statistical data characterizing the plants sigmoid growth curve. The structured use of mathematics and statistics allows for deeper insight into plant science experiments.

Summary Statement
Statistical experimental designs can produce high-quality data enabling deeper insight into plant growth and development.

Help Received
Dr. John C. Howe was my mentor. Encouragement from my parents and paternal grandmother.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Rachel Dokko; Shreya Ramayya

Project Number

S1902

Project Title

Environmental and Commercial Benefits of Carbon Sequestration by Encelia californica and Salvia leucophylla

Abstract

Objectives/Goals

Global climate change is a widespread concern; therefore, studies that reduce the emissions of CO(2) and other greenhouse gases through plant carbon sequestration are of great interest. Plants are major reservoirs of atmospheric carbon, and CO(2) levels fluctuate with their photosynthetic patterns. Carbon sequestration refers to the storage of CO(2) into reservoirs and describes a method to delay global warming effects and slow the accumulation of greenhouse gases. Specifically, this study quantifies the biomass dry weight of two common drought-deciduous species, Salvia leucophylla and Encelia californica. These species are part of an ongoing coastal sage scrub CO(2) sequestration study also involving Eriogonum cinereum and Rhus integrifolia.

Methods/Materials

Two methods were used to collect S. leucophylla and E. californica samples. In Method 1, 12.5-50% of the sample was harvested and dried, and canopy measurements were recorded. Method 2 also required field measurements in addition to five branch samplings from each plant. This was the sub-sample later used to calculate the biomass. (Encelia californica was collected using only method 1.)

Results

Using regression analysis, the results showed that S. leucophylla displayed a strong correlation in its biomass and canopy dimension relationships. The correlation between the biomass and the surface area was y = 185.37x^1.4514 and the correlation between the biomass and volume was y = 117.92x^2 + 420.93x + 659.72. Encelia californica also displayed strong correlations. The correlation between biomass and surface area was y = 149.86e^1.5926x and the correlation between biomass and volume was y = 121e^0.4317x.

Conclusions/Discussion

The results highlight the significance of these plant species in maintaining our community#s environmental balance of carbon. These plants can be planted in other areas in order to achieve similar results and help maintain the natural balance of carbon between Earth and the atmosphere.

Summary Statement

This project focused on steps that can be taken locally to reduce environmental impact, such as working with native sage scrub.

Help Received

Work was done independently.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Jillian A. Drake

Project Number

S1903

Project Title

An Investigation of Chromosomally Integrated Bacteriophage in Candidatus liberibacter psyllaurous Bacteria and Its Effec

Abstract

Objectives/Goals

Greening (citrus), Psyllid Yellows (tomato) and Zebra Chip (potato) are diseases caused by Candidatus Lieberibacter bacteria. Symptoms include yellow leaves, poor growth and unusable crops. Vectored by psyllids and fastidious, there is no treatment for infected plants which must be destroyed. Infected plants have varying expression of symptoms, with some areas appearing healthy while others clearly infected. This projects objective is to ascertain bacteriophages effect on the expression of disease virulence.

Methods/Materials

The Ca. L. psyllaurous bacterial genome contains two P4 bacteriophage regions. 75 primers, in 7 experiments examined the entire genome determining the amount of initial DNA found in symptomatic and non-symptomatic infected plants. 672 samples, with controls were evaluated using primers in both phage and non-phage regions and SYBR green with a ABI 7000 QPCR. Additionally, PCR product for Ca. L. psyllaurous was refined, the results were confirmed by conventional PCR, cloned in TOPO TA vector and sequenced at UC Riverside. Plasmid serial dilutions were used to prepare a standard curve.

Results

Amplification plots, melt curves, Cycle Threshold C(t) were evaluated for each sample. Primers which gave erroneous results were excluded. Sample c(t) value data was tabulated 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, more DNA was found in the symptomatic samples in phage region primers than non-symptomatic ones. Additionally, samples from winter seasons yielded overall less DNA than those taken in summer, both for phage and non-phage primer regions.

Conclusions/Discussion

As the non-symptomatic plants had more bacterial DNA than symptomatic ones, clearly 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 the phage#s transition from a lysogenic state. Samples taken from both summer and winter, yielded a greater amount of DNA in both phage and non-phage regions, indicating that the bacteria is more active when warmer. The presence of phage was demonstrated to clearly have an effect upon disease virulence, with evidence of a phages lytic state leading to more pronounced symptoms.

Summary Statement

The role of bacteriophage in disease expression for plants infected with #Candidatus Liberibacter psyllaurous# was validated, 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. Chandrika Ramadugu.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Emily Guerard; Ricky Sottile

Project Number
S1904

Project Title
Seedling Responses to Starter Fertilizers

Abstract

Objectives/Goals
The objective of this experiment is to determine if the complete starter fertilizer grows the best rye grass seedlings compared to the incomplete starter fertilizers or without any fertilizer at all.

Methods/Materials
In the first phase of the experiment the rye grass seedlings were planted and fertilized with 5 different treatments with 6 replications of each treatment. Each fertilizer was expected to effect the growth of the rye grass seedlings differently. Treatment 1: 4-0-0. Treatment 2: 4-5-0. Treatment 3: 4-0-3. Treatment 4: 4-5-3. Treatment 5: Untreated control (water only). These numbers represent the % by weight of nitrogen, phosphorus, and potassium in that order. The growth of the plants was recorded daily and then watered every 3 or 4 days.

Results
After recording all of the final averages of the five treatments, the third treatment with only Nitrogen and Potassium turned out to grow the highest plants with a 6.43 cm average height. The fourth treatment that included a fertilizer with Nitrogen, Potassium, and phosphorus had the second highest averages with a 5.63 cm average. The next highest was the fifth treatment that did not include any fertilizer (just water). That treatment had a 5.37 cm average height. The second and first treatments had the two lowest growth averages. Treatment two, which had Nitrogen and phosphorus only, had a 5 cm average growth rate and the first treatment, which had only Nitrogen, had a 4.66 cm average height.

Conclusions/Discussion
Based on the results that were received from the experiment, it was obvious that the treatments without potassium did not grow as well as the plants that had potassium included in their fertilizer and they also did not grow as high as the plants treated with only water. However, the third treatments, which included only nitrogen and potassium without phosphorous, grew higher than the fourth treatment (treated with nitrogen, phosphorous, and potassium), which was a little unexpected.

Summary Statement
Starter fertilizers were used on seedlings to determine which fertilizer components stimulated the most growth of the seelings.

Help Received
Mr. Guerard helped us with the fertilizers and planting.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Kaitlyn A. Jennings

Project Number
S1905

Project Title
A Comparative Analysis of Various Types of Manure on Plant Growth

Abstract

Objectives/Goals
My objective was to find what manure would produce the largest,fullest plants, for one's garden.

Methods/Materials
I tested five commonly used manures for plant growth: dairy cow manure, horse manure, goat manure, chicken manure, and rabbit manure. All manures were obtained locally, they were not store bought. I then tested each type of manure on three different types of flowers: primroses, pansies, and Iceland poppies. I tested these flowers spacificly because they are commonly used and also, they are very hardy plants. Every 2-4 days I would give each pot ¼ of a cup of water, depending on how hot it was. All the flowers received the same amount of sunlight. I measured the width, height, the number of leaves, wilted leaves, flowers, wilted flowers, and buds. I also took pictures of the flowers weekly. These tests lasted one month.

Results
By the end of one month, I discovered that rabbit manure was the best overall fertilizer for pansies, primroses, and Iceland poppies. These flowers excelled in width, height, fullness of flowers, leaves and were one of the fastest to bloom. In addition, rabbit manure was beneficial because it allowed the flowers to withstand the heat as well as the cold. During the four weeks all the flowers experienced frequent changes in the weather, however flowers with rabbit manure were the only ones that were not negatively affected by the weather. In fact some of the flowers even grew more during this time.

Conclusions/Discussion
This type of experiment occurred to me because I have rabbits, and I have always used their manure to fertilize my plants. When I would use the manure I would always see really good results. So I tested my theory, and I believe this project could help my community greatly. I live in a agricultural community, and I think it is important for farmers and plant growers to know which fertilizer is the most powerful. In addition, California is one of the most agricultural states in the nation. California feeds more than 50% of the nation and as much as 12% of the world. California plant growers need the best fertilizer for their plants. I believe that my project could have a impact on my state.

Summary Statement
My research project tested five manure-based fertilizers, obtained locally in Chico, to determine what would produce the largest, fullest growth on three popular flowering plants.

Help Received
Mother supervised the experament. Also, heped with calculating the measurements for the plants; My Chemistry teacher helped me come up with the idea; My English teacher helped me with my Abstract; Home Depot donated all the flowers; Friends and the Chico State Agricultural Department provided

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Vidur Kailash

Project Number
S1906

Project Title
Efficiency in Irrigation Systems

Abstract

Objectives/Goals
The objective is to determine whether Matthiola plants grow taller when being watered by a sprinkler system or a drip system. Also another objective was to see which system conserves more water and still gets the job done.

Methods/Materials
Bought 12 Matthiola plants and split them into 2 groups of six, one for the drip system and the other group for the sprinkler system. Then split the drip system group in to 2 groups of 3 and planted all the groups away from each other in soil with no fertilizer. Finally, I waited and recorded the height of each plant on a daily basis for 5 weeks.

Results
Through this experiment I have found out that the drip system is a better method than the sprinkler because it makes the plant grow equally tall and in certain cases taller than the sprinkler system, even though it is using less water. Because the drip is using less water to accomplish the same goal as the sprinkler system, it is a more efficient way of watering plants.

Conclusions/Discussion
Since the drip system conserved more water ans still made the plants grow the same height and taller, the drip system is one the that is more environmentally friendly. One annoyance that I had was that between weeks sometimes some of the plants# stem or flowers vanished which ended up as an outlier in the data charts. Also, my guess that so many stems and flowers went missing was because of the wind, or animals eating them.

Summary Statement
Determined whether plants grew taller when being watered by a sprinkler system or a drip system.

Help Received
Mother helped plant the plants.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Cali C. Magdaleno

Project Number
S1907

Project Title
How Does Soil pH Affect Plant Growth?

Abstract

Objectives/Goals
This science fair project is to test the effects of a soil#s pH on the growth of grass. For my project, I adjusted the soil#s pH, varying from 5.0-9.0, making it acidic, neutral, or alkaline. Usually a neutral pH is best for all plant growth, but I wanted to test a variety of pH's to clarify which aids growth the most. I checked the grass each week for three weeks, looking to see how many, if any, grass seeds had sprouted, the color of the grass, and the lengths of the smallest and largest blades(in cm).

Methods/Materials
-Materials: 12 Pots, soil, dirt, grass seed, lime, aluminum sulfate, pH measuring device, water, and ruler
-Procedure:
1. Measure a cup of soil for each of the ten pots(A cup of dirt for the remaining two pots.)
2. Add lime or aluminum sulfate to the soil(depending on the specific pH wanted)
3. Measure the pH in each pot to make sure each is correct.
4. Add 20 grass seeds to each pot.
5. Water daily.
6. For the next three weeks, observe the growth patterns, once a week, and check the color, number of sprouts, and length.

Results
The results to the experiment were not all similar. The pots with the pH of 5.0 had no growth whatsoever. The pots with the pH of 6.0 had little growth, each with only 4 blades of grass. The pots with a pH of 7.0 grew well, one pot with more blades of grass than the other, an average of 11 blades of grass. The pots with a soil pH of 8.0 did as well as the 7.0 with an average of 11 blades of grass, also. The pots with a soil pH of 9.0 and the pots with just dirt had the best growth, with 17-20 blades of grass grown in each. These results showed that a slightly alkaline pH of about 8.0-9.0 is best for the growth of grass.

Conclusions/Discussion
The question for this project is #How Does the Soil pH affect Plant Growth?# My hypothesis was the more neutral the pH, the better the grass will grow. Based on my results, my hypothesis was incorrect. In most gardening opinions, a neutral pH is the best environment for plant growth, but in doing my experiments, the pots that showed the most growth were the ones that were slightly alkaline. The pots with the best growth overall were the pots with a pH of 8.0 and 9.0. I#ve learned that not all plants have to have a neutral pH to grow properly; sometimes alkaline or even acidic can work better for growth. Overall, I would say this experiment was a true success.

Summary Statement
This science fair project is to test the effects of soil pH on the growth of grass.

Help Received
No help with the entire project

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Adriana Navarrete; Maria Santana; Oscar Sebastian

Project Number

S1908

Project Title

The Correlation of the Surface Area or Specific Gravity of an Acorn's Predicted Viability

Abstract

Objectives/Goals

The objective of this study was to determine whether the attributes of an acorn dictates its propensity for viability.

Methods/Materials

Twenty-five trials were conducted using 2,007 blue oak acorns. Each acorn was measured by mass, volume (specific gravity), length, diameter (surface area), color, insect damage, and visible radicals. Acorns were planted and recorded as being viable once the radical and stem emergence appeared.

Results

The data of the entire population(2007 acorns) was analzyed by first conducting random selection of each harvest date (25 trials). Averages were taken of each trial and standard deviation was then calculated to determine if there was a significant difference between the specific gravity or the surface area to the viability of acorns. There was no significant difference, but there was a numerical difference in the germination rate when comparing the rate to the surface area of the acorns.

Conclusions/Discussion

In conclusion the data supported the hypothesis that there is no direct correlation between germination rates and the specific gravity and surface area of individual acorns. There was a numerical difference between the surface area and the viabilty of an acorn.Suggested studies to continue experimentation concerning the regeneration of blue oaks in the Southern Sierra Nevada foothills are as follows. The second year of this experiment will be to take 50% of the germinated acorns (saplings) and allow them to grow without competition from grasses. The other half of the population will be transplanted to bags that have evidence of annual broadleaf weeds and narrow-leaf grasses (Hall, 1990).

Summary Statement

Our project is about the re-generation of blue oaks.

Help Received

Teacher directed and advised; Professors emailed suggestions; Private company donated poster printing and board.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Rebecca M. Sine

Project Number
S1909

Project Title
"Zapped" Veggies: The Effects of Battery Electricity on Plants

Abstract

Objectives/Goals
What technique can agricultural farmers use that is mildly safe and doesn't involve harmful chemicals and pesticides, to enhance their crops? This project demonstrates the effects of a crop-enhancing method called electro-culture, which is the application of electricity via connection from an outlet, DC battery, magnetic field, etc. to seeds, plants, or soil. This technique is not widely-known, but it has been proven to be able to accelerate growth rates, increase yields, improve crop quality, protect plants from diseases, insects, and frost, and reduce the requirements for fertilizer or pesticides, simply by the induction of electrical ions in a plant's cells, in addition to mandatory sunlight, water, and air. In this project, electromagnetic electricity from the positive and negative terminals of 9-volt DC batteries was inserted into the soil of pots containing Raphanus sativus seeds (champion radishes), a very productive farming crop. Based on my research, I predicted that the radish seeds with electromagnetic energy applied to its soil will germinate faster and grow taller than the radish seeds without any electric source.

Methods/Materials
For my procedure, I had a total of 32 individual radish plants (4 seeds for each of 8 pots). Of the eight pots, four of them were tested with the electromagnet, and the other four were controls. The electromagnets were made with DV9-volt batteries and insulated-copper wire wound around zinc nails. The battery energy completely depleted after five hours, and then were removed. Half of the total plant specimens were allowed to grow for five days, and the other half for ten days.

Results
According to my experiment, the radish plants that were not given any battery electricity grew only slightly taller than the radish plants that were given electricity, on average. Yet, the plants with electricity did germinate earlier than the ones without.

Conclusions/Discussion
My experiment contradicts my hypothesis, because overall, the electrically induced radishes grew out to be slightly shorter than the radish specimens without any electromagnetic stimulation, which is the opposite of what I predicted the outcome would be.

Summary Statement
This project demonstrates the effects of electro-culture by inserting electricity in the soil of radish seeds.

Help Received
My biology teacher (Mrs. Ramirez-DelaCruz) helped me through the scientific method. My parents helped me purchase materials for the procedure.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Aradhana Sinha

Project Number
S1910

Project Title
Triforine Sensitivity in Lettuce: Year Two

Abstract

Objectives/Goals
The objective of this experiment is to more precisely define the location of the gene for triforine sensitivity (Tr) based on the segregation of alleles in the F4 filial of a cross between PI491224 and Iceberg. In addition I tested whether Tr is in the same or similar location in different accessions, and whether marker BAIS can be used to predict responses to triforine in different lettuces.

Methods/Materials
In the first phase, I developed a primer pair that amplifies an InDel on marker BAIS. PCR amplification and analysis of the BAIS marker segregation was used to find the location of Tr more precisely in the PI 491224 x Iceberg mapping population. Next, I grew different accessions of lettuce and determined whether they were sensitive to triforine by spraying them with a diluted triforine solution. Finally, I tested the primers developed in Phase 1 on these accessions to determine whether Tr is linked to BAIS in these cultivars, and if the BAIS marker can be used to predict reactions to triforine.

Results
Phase A: Primers were successfully designed with products around 1000bp.
Phase B: The experimental recombination rate between the gene for triforine sensitivity (Tr) and BAIS was 2 in 41 plants.
Phase C: There were sensitive and insensitive cultivars, all controlled by the same single dominant/recessive gene. The mutation is monophyletic for Lattuca sativa
Phase D: Tr and BAIS were linked in non-romaine cultivars

Conclusions/Discussion
I found the location of the gene responsible for triforine sensitivity and developed a method to predict triforine sensitivity without killing plants; I also found that triforine can be used to distinguish self-crossed plants from hybrids.

Summary Statement
I found the location of the gene responsible for triforine sensitivity and developed a method to predict triforine sensitivity without killing plants; I also found that triforine can be used to distinguish self-crossed plants from hybrids.

Help Received
My mom drove me to and from the USDA. Dr. Ivan Simko, and Ms. Amy Atallah at the USDA guided me through my project.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Alisa Smith; Ian Sophie

Project Number

S1911

Project Title

How Does Water Salinity Affect the Plant Armeria maritima californica?

Abstract

Objectives/Goals

The purpose of our project was to see how different levels of water salinity affect the plant Armeria maritima californica over the course of two months.

Methods/Materials

We bought 12 Armeria maritima californica plants and planted them in four separate planter boxes# three plants per box, with each box representing a separate trial. The first box, planter box A, received pure distilled water. Planter box B received water with 3.5 ppt salinity, planter box C was watered with 8 ppt salt water, and planter box D was watered with 31.5 ppt salt water.

Every three days we measured and recorded the growth of the plants in both the area and heights. We did so by finding the three tallest leaves of each plant and measuring the height, in centimeters, that each leaf stuck up above the top of the planter box.

Area was measured by taking pictures of each plant from above at a consistent height and lighting. These pictures were then uploaded onto the computer and put into Photoshop where we measured area by a color selection method that selected the green pixels of the plant. We compared the pixels of each plant by a 10 cm by 10 cm white square that we calculated the pixels of previously.

Results

Group D, the test group receiving the highest concentration of salt water that was almost that of the ocean off our local coast, had the lowest average growth of area. On average, it lost 3 mm in height. Control group A, the group receiving pure water, had the highest average overall growth in area at 57.7%. Group B, the group that received the lowest concentration of salt water, showed the most growth in height with an overall growth of 9 mm.

Conclusions/Discussion

Our results show that a plant receiving high amounts of salt water is not healthy for a plant, supporting our hypothesis. However, the test groups receiving lower amounts of salt water didn't differ too much from each other. In the future, we might try testing a greater variety of salt water concentrations in order to observe the tipping point at which a plant can thrive with salt water and when salt water proves detrimental.

Summary Statement

Our project is about how a native coastal plant to Northern California is affected when exposed to water of increasing salinty levels.

Help Received

Grandpa helped in desiging the experiment, Mother and Father helped assemble board

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Garrett K. Soiland

Project Number
S1912

Project Title
Effects of Dilution on Carnivorous Pitcher Plant Digestive Enzyme Concentration

Abstract

Objectives/Goals
Objective was to determine whether pitcher plants (specifically Nepenthes Ventricosa,) a type of carnivorous plant, are capable of reacting to changes in their trap environment and taking compensatory action to maintain a particular set of conditions in their pitchers.

Methods/Materials
23 pitchers of the carnivorous plant Nepenthes ventricosa were covered with plastic bags before opening. One group of pitchers had been covered in October and their digestive fluid was diluted in December; these were the "old" pitchers. The other group of pitchers was covered in December and diluted after opening; these were the "new" pitchers. Controls measured normal enzyme levels. In non-control pitchers, digestive fluid was diluted with distilled water. Samples were taken immediately before and after dilution, and also at several day intervals after dilution for several weeks to track the rate at which plants secreted more digestive enzymes.

Results
Data varied greatly but in general indicated that older pitchers did not react to dilution, but younger pitchers did secrete more enzymes after dilution. This also occurred in the young controls, which indicates that the younger pitchers were not reacting to the dilution of their digestive fluid, but instead were still in the process of secreting the enzymes they were to use throughout their lifetimes when dilution was carried out.

Summary Statement
Carnivorous pitcher plant digestive fluid was diluted and the concentration of digestive enzymes was tracked for weeks afterward to determine if the plants secreted extra digestive enzymes to compensate for the dilution.

Help Received
Prof. Nick Anast supervised lab work, gave input on how to collect samples and scope of project. Prof. Patricia Ellison donated some lab supplies. Prof. Kenji Takahashi and many, many others gave advice on how to test for nepenthesin enzyme. California Carnivores allowed greenhouse access.

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Hannah B. Spinner

Project Number
S1913

Project Title
The Effects of Mycorrhizal Inoculation Compared to Pesticide Use on Milkweed Plants

Abstract

Objectives/Goals
Mycorrhizae is a natural fungus that increases the surface area of the roots. This makes hard-to-capture nutrients available to plants, allowing them to be bigger, and healthier. It is also known to speed up the pest-defense mechanisms in plants. The goal of this experiment was to see if the mycorrhizae could be used as effectively as commercial pesticides.

Methods/Materials
A total of 270 milkweed seeds were planted into 50 mL cups of sterilized soil. Five seeds were placed into each cup. The soil was sterilized in an oven so that none of the dirt had preexisting organisms. First the seeds were sprouted in petri dishes and once sprouted, transferred into the dirt and planted into 9 rows, each row having a different level of mycorrhizae in each plant cup (4g, 3g, 2g, 1g, 0g). There was a second row planted without mycorrhizae to spray with pesticide, seeing how effective it was with this plant and pest coupling. They were allowed to grow for 3 weeks. When the bugs were released, mesh screen was put around the plants on a wooden frame, so that the bugs could not escape. On the top of this screen, there were 5 holes cut (one at each corner and one in the center) to drop the milkweed bugs through. Upon releasing the bugs, the holes were taped up and the bugs were free to eat. The plants were observed at three different times to see where the bugs preferred to eat.

Results
When growing, it was found that the 3g row had the highest average growth (more than 1cm taller than the rest); followed by 4g; 0g; 1g; and lastly, 2g. A majority (77%) of the bugs were on the control and pesticide-sprayed rows. Observations were taken on bug arrangement at three different times. On average (rounded to the nearest whole number), there was 1 bug out of the 40 on the row with plants given 4g of mycorrhizae; 2/40 bugs on the 3g row; 1/40 bug on the 2g row; 2/40 bugs on the 1g row; 7/40 bugs on the control row; and 7/40 bugs on the pesticide row.

Conclusions/Discussion
With these results, it is clear to see that mycorrhizae have a positive impact on the plants# resistance to pests. Mycohhizae can limit the use of pesticides. For future studies, it would be beneficial to do this experiment on a larger scale, with more trials, and find the specific level at which the mycorrhizae is most affective.

Summary Statement
The effects of a natural pesticide, mycorrhizae, were compared with a chemical-based pesticide; it was found that the mycorrhizae is a better pesticide than chemicals.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
Hannah T.M. Contreras

Project Number
S1997

Project Title
The Effects of Pesticides on Plant DNA (Deoxyribonucleic Acid)

Abstract

Objectives/Goals
The objective of this experiment is to measure the amount of DNA extracted from organic and nonorganic carrots (Daucus carota), raspberries (Rubus ideaeis), and spinach (Spinacia oleracea)and determine whether or not pesticides has an effect on the amount of DNA extracted.

Methods/Materials
Using the method of cell lyses, purification, and precipitation I was able to successfully measure the amount of DNA extracted. DNA was extracted from carrots (Daucus carota), raspberries (Rubus ideaeis), and spinach (Spinacia oleracea) and measured by the amount extracted.

Results
I came to the conclusion that although nonorganic produce is available at local markets, that does not mean that the produce is safe to eat. The DNA extraction experiment showed that pesticides have a negative impact on the quality of various fruits and vegetables such as carrot (Daucus carota), raspberry (Rubus ideaeis), and spinach (Spinacia oleracea). I found that the nonorganic produce held the least amount of DNA while the organic produce had the most amount of DNA.

Conclusions/Discussion
After finding that all three non-organic subjects held less DNA extraction, it was conclusive that the application of pesticides had a negative effect on the produce.Studies have shown that pesticides have been found inside produce and animals and we as humans are susceptible to consuming small intervals of pesticides that will consequently build up over time and cause various health issues. As a result of the various disease-causing factors, I suspect that the reason for the lesser amount of DNA in non-organic produce is due to the pesticides# DNA damaging factors. Furthermore, the only way to protect the body from the adverse effects of pesticides is to either raise home-grown plants or buy organic from select markets and grocery stores. In terms of the DNA, the organic produce held the most DNA.

Summary Statement
The Effects of Pesticides on Plant DNA.

Help Received
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CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Keegan V. Mendonca

Project Number

S1998

Project Title

The Effects of IAA and IBA on Laccaria bicolor

Abstract

Objectives/Goals

The objective is to determine the effects of IAA and IBA, two plant hormones, on growth in Laccaria bicolor, a fungus that is involved in mycorrhizal relationships with plants.

Methods/Materials

Laccaria bicolor spores were grown in 9 petri dishes each of 1 microgram IAA, 2 micrograms IAA, 1 microgram IBA, 2 micrograms IBA and a control. The diameters of the mycelia were measured after 10 days, and the growth in different groups was compared.

Results

There was a statistically significant difference in the measured diameters of the mycelia diameters in 1 microgram IAA ($p=0.016$), 2 micrograms IAA ($p=0.0041$), and 2 micrograms IBA ($p=0.0016$) against those of the control. There was no significant difference between the measured diameters in 1 microgram IBA against those of the control ($p=0.47$).

Conclusions/Discussion

Plant hormones do have a statistically significant effect on the growth of fungi. This relationship has important effects for agriculture, because knowing this relationship could enable us to grow crops in places where we currently cannot, simply by adding these auxins to the soil in very low concentrations.

Summary Statement

This project aims to test the effectiveness of plant hormones on mycorrhizal fungal growth.

Help Received

Mr. Matt Trappe provided spores; Mr. Francis Martin provided culture and information on the fungus; Ms. Amanda Alonzo and Ms. Kathleen Loia helped me with lab equipment

CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)

Moniyka Sachar

Project Number

S1999

Project Title

DNA-Binding Protein in Xcv Bacteria Alters Plant bHLH Gene to Promote Pathogen Growth during Infection: A Genetic Study

Abstract

Objectives/Goals

Xanthomonas, the causal agent of Bacterial Spot Disease in plants, releases 30 effector proteins, including XopD, into the plant host cell during infection. This research is aimed at elucidating the genetic role of pathogen-released DNA-Binding protein XopD in promoting bacteria growth during tomato plant pathogenesis.

Methods/Materials

Initially, a DNA microarray assaying over 22,800 tomato plant genes was conducted to identify gene levels most affected by XopD. bHLH gene levels were unusually high, indicating that this gene may be critical in promoting the growth of Xanthomonas bacteria. Then, Arabidopsis model plants were engineered with the inserted bHLH gene using Agrobacterium-mediated transformation and the floral dipping method. Both engineered and wildtype plants were inoculated with Xanthomonas and bacterial growth was recorded to determine the function of bHLH in bacteria-plant pathogenesis.

Results

I observed that 70% more bacterial colonies grew in engineered plants than in wildtype plants. A 2-sample statistical T-test reported a p-value of 0.022, indicating that 97.8% of the time, the higher bacteria colony counts in plants with bHLH compared to plants without bHLH was due to the effect of the gene alone.

Conclusions/Discussion

The results conclude that XopD protein promotes pathogen growth by stimulating the overexpression of a critical bHLH gene in tomato plants. In the future, scientists can engineer plants without the bHLH gene to develop resistant crop varieties. There are currently no effective bactericides or agricultural practices to control Bacterial Spot Disease, a disease which costs the United States 480 million dollars per year - a number that can easily decrease if such transgenic resistant crop varieties are successful.

Summary Statement

Using a DNA Microarray, Agrobacterium-Plant Transformation, and Bacterial Assays, I discovered the specific genetic role of pathogen-released protein XopD to propose a novel way of controlling the epidemic Bacterial Spot Disease in plants.

Help Received

Dr. Jung-Gun Kim, research associate, taught me critical lab techniques and procedures. I used equipment in the Department of Biology, Stanford University, under the supervision of Dr. Marybeth Mudgett, primary investigator. My science teacher, Mr. Chan, supported me and fed my curiosity.