CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Alexandra L. Arretche

Project Number
J1801

Project Title
The Effect of Aquaponics vs. Hydroponics on Plant Growth

Abstract

Objectives/Goals
The objective of this project is to determine the effects of hydroponic systems and aquaponic systems on plant growth.

Methods/Materials
Swiss chard seeds (30), green bean seeds (30), hydroponic system, aquaponic system, goldfish (8), 5 in 1 Test strips, ammonia test strips. Set up the two systems and planted sets of 10 plants in each. Measured growth, pH, ammonia, nitrate, and nitrite levels every two days for two weeks.

Results
After two weeks, increased growth was measured in both types of plants in the aquaponic system versus the hydroponic system. Ammonia levels decreased in the aquaponic system whereas there was little ammonia found in the hydroponic system. Nitrate and nitrate levels were higher in the aquaponic system and remained consistent throughout experiment.

Conclusions/Discussion
Based on the results, the increased plant growth from the aquaponic system is a result of the nitrogen products produced by the fish and circulated into the growth bed. Prior to adding the plants to the system, the ammonia level was higher but after a few days it decreased while at the same time the plants began increasing in height. This demonstrates the importance of nitrogen-based nutrients for plant growth. The experiment also demonstrates the effectiveness of aquaponic systems without the need for soils and added fertilizers. This experiment also demonstrated the overall conservation of water in growing plants in these systems.

Summary Statement
I demonstrated the effectiveness of a aquaponic system versus a hydroponic system on plant growth.

Help Received
My father helped me build the aquaponic and hydroponic systems.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Liann C. Bielicki

Project Number
J1802

Project Title
Sugar Levels in Drought Tolerant Biofuel Plants

Abstract

Objectives/Goals
The goal of my project was to determine if the sugar levels, and thus the biofuel viability, of a biomass plant called switchgrass would be affected by drought conditions. This determines its potential for growth and usage in drought-stricken areas like California and other places around the globe.

Methods/Materials
Five pots of switchgrass were grown under the recommended water conditions (0.25 cup of water) for a week. After they germinated, two of the pots were changed to drought conditions of 0.125 cups of water every other day and two pots to 0.125 cups daily. The plants were watered and measured thus for three weeks. Using the same amount of leaves by weight, a liquid sample was created from each pot and the dissolved sugar content was measured with a refractometer.

Results
For the control group switchgrass, I measured an average growth rate of 8.3mm per week. In the medium water group, there was a growth of 10.9mm per week. For the low water group, the growth was 5.7mm per week. This data was mirrored in the sugar levels; the control had a Brix measurement of 1.7, the medium water was at 1.8, and the low water was at 1.1. These data points show how water levels affect sugar in switchgrass.

Conclusions/Discussion
The data enabled me to determine the viability of switchgrass as a biofuel in drought conditions. The low water plants had the lowest average growth and sugar levels, while the medium water plants had the highest, illustrating the direct relationship between the water and sugar. This evidence suggests that medium water conditions had excellent growth for the amount of water given, so switchgrass would be a viable biofuel plant in places with restricted water. However, because the low water plants' sugar levels were so negatively affected, switchgrass would not be a candidate in areas of extreme drought for economical and environmental reasons.

Summary Statement
My experiment determined that heavy drought conditions, such as in California, negatively affected the sugar levels and biofuel viability in switchgrass plants.

Help Received
None. I completed all of my research and executed my experiment by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Aryaa Chanchani; Mira Ramachandran

Project Number

J1803

Project Title

Natural Green Revolution Part 2: Drought Resistance

Abstract

Objectives/Goals

Experiment to see the effects of Mycorrhizal fungus on the drought resistance of plants.

Methods/Materials

Our Procedure/Method:

1)The nasturtium plants were grown from seeds till they were all about the same height in regular soil without any added nutrients. 2)We filled regular soil into all 4 pots (the same amount). 3)We then divided the pots into groups, each with five nasturtium plants. 4)We put ½ teaspoon of fungus near the roots of the plants for only two of the pots, the other two had no fungus . 5)The 5 groups we as follows: Group 1: 250 ml water with fungus; Group 2: 250 ml water without fungus; Group 3: 500 ml water with fungus; Group 4: 500 mL without Fungus; Control group: 1000mL of water only . 7)We watered the plants the amount of water needed for each group every week for a period of eight weeks. 8)We measured the heights of the nasturtium plants using a ruler (in cm) every week before watering them and took the measurements of all five plants.

The Materials we used:

1)Several packets of nasturtium seeds. 2)Regular soil (no extra additives). 3)4 Oz, container of mycorrhizal fungus (in powdered form). 4)Water.

Results

The plants receiving 500mL of water with fungus grew 34% more compared to the group without fungus. The group that received 500mL of water with fungus was able to grow about the same amount as the group that received 1000mL (control group) of water and the root mass was denser and about 4x the amount of the plants without fungus.

Conclusions/Discussion

This fungus does help plants grow with less water and so it could be help farming in drought prone regions. California is undergoing through drought, and this fungus could help farmers grow crops with less water use.

Summary Statement

We proved that mychorrhizal fungus helps plants grow with less water and thus can help solve the problem of growing crops during periods of drought.

Help Received

We received help throughout our project from our science teacher and our parents.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Karly Condon; Isabella LeSage

Project Number

J1804

Project Title

Testing Aquaponics and Hydroponics to Find the Most Effective Watering Method to Address California's Drought

Abstract

Objectives/Goals

In this project we wanted to find out if there was a way to save more water when growing plants in California. We hypothesized that, "if alfalfa and radish sprouts are grown aquaponically, then it will result in a greater mass per liter of water for both crops than either hydroponics or the more common method of farming in soil."

Methods/Materials

Aquaponic Fish Tank, purchased at http://www.uncommongoods.com/product/water-garden, Betta Fish for aquaponic tank, alfalfa and radish sprouts, 3 mason jars, to experiment hydroponically; pots and soil, to experiment traditionally, and a triple pan balance to record mass. Grew sprouts using each method, measured mass and water usage of plants daily.

Results

The plants mass and water usage were measured daily to calculate the total mass per liter for each method. Although the plants grown aquaponically had a lesser mass per liter than the plants grown with distilled and tap water in a closed loop hydroponic system, they obtained a greater mass per liter than the plants grown in soil and in a non-closed loop hydroponic system.

Conclusions/Discussion

Plants grown aquaponically had a greater mass per liter than the plants grown in soil and in a non-closed loop hydroponic system, although they had a lesser mass per liter than the plants grown with distilled water and tap water in a closed loop hydroponic system. A difficulty that we encountered throughout our science fair project was that our fish tank water got really dirty from the radish and alfalfa seeds, and therefore we cleaned the tank to keep the fish safe. We theorize that perhaps the cleaning itself resulted in the closed loop hydroponic system caused larger mass than the aquaponic system. We performed this experiment to see if there was a way that we could help California in it's drought, and save water when growing plants.

Summary Statement

We grew plants using aquaponics, hydroponics, and soil to conclude that hydroponics is the most drought friendly method of farming.

Help Received

Ms. Tammy Levy, Elka Worner, and a phone call to Michael Hanemann (UC Berkeley)

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Samantha T. Crane

Project Number
J1805

Project Title
Efficacy of Human Excrement and Other Fertilizers in Dead Soil: Creating Lasting Food Sources for Deep Space Exploration

Abstract

Objectives/Goals
The purpose of this experiment is to determine the best fertilizers to use to create a sustainable food source for deep space exploration and colonization.

Methods/Materials
The Bush Blue Lake 274 string bean was the crop of choice. Gardening soil was used for plants in the control group. Washed plaster sand was used as dead soil. Fertilizers tested were store-bought fertilizer pellets, wood ash, and treated human excrements. They were tested in dead soil. Three grow bags were prepared for every fertilizer; each bag held three seeds. There were a total of nine plants for each fertilizer.

Results
At 17 days, the control group samples were just beginning to sprout. Plants grown in just dead soil were incredible pale, weak, and had started to rot. The store-bought fertilizer samples germinated, but had not sprouted. The wood ash samples sprouted and casing were splitting to reveal leaves. The excrement samples had an average stem height of 10 centimeters with two leaves each; these samples grew the healthiest and the fastest out of all the plants. At 40 days, all of the plants were growing. Plants in just dead soil died quickly after this reading. Excrement samples continued to grow faster and larger than the others. None of the plants samples survived or were observed long enough to produce bean pods.

Conclusions/Discussion
Excrement fertilized plants performed the best within the parameters of this experiment. Germination time was cut in half; this saved water, time, and resources. Excrement samples far outlasted other plants, which died due to lack of re-fertilization. What I learned from this project was that using properly prepared human excrements as fertilizer has the potential to save water, time, and resources when fertilizing dead, depleted, or foreign soils during deep space exploration.

Summary Statement
Determine the efficacy of human excrement and other fertilizers in dead soil to create a nutrient rich, viable soil that can be used for a sustainable food source.

Help Received
My mother purchased supplies. My father taught me how to use Microsoft Excel.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Suchitra Dara

Project Number
J1806

Project Title
Improving Drought Tolerance with Beneficial Fungi

Abstract

Objectives/Goals
The main objective of this project was to see if commercial formulations of insect-killing fungi help plants grow in artificially created stressful drought conditions. This will identify the multipurpose role of beneficial fungi in crop production and promote sustainable agriculture, which is important for environmental and human health.

Methods/Materials
Materials used include cabbage transplants, commercial formulations of insect-killing fungi and other beneficial microbes, potting medium, plastic containers, plant lights, measuring cups, scale, pipettes, temperature data logger, and other basic supplies.

Cabbage transplants were planted in commercial potting medium in 650 ml containers. The eight treatments used in the study included three beneficial fungi, four plant enhancers, and water as control. Each treatment had 10 plants which were grown under artificial lighting. To each pot, 50 ml of water was added at the time of planting and again on 42, 50, 64, and 81 days after planting. Plant health rating was recorded at 40 and 70 days after planting on a scale of 0 to 5. Plant survival was recorded at 40, 70, and 90 days after planting. Shoot-to-root ratio was calculated after 90 days; the plants were dried to measure biomass and sent to an analytical lab for nutrient analysis. Data were subjected to statistical analysis.

Results
The beneficial fungus B. bassiana greatly improved the overall health and growth of the cabbage plants. Other insect-killing fungi also had a positive impact on some measured parameters. Other materials did not help with the plant growth and health.

Conclusions/Discussion
This is the first report of the direct impact of entomopathogenic fungi on cabbage plant growth. B. bassiana and to some extent M. brunneum had a positive impact on plant growth and health even under reduced water conditions. If they could be used to promote plant growth, improve water and nutrient absorption, withstand saline or drought conditions, increase yields in addition to their typical use as biopesticides, then they can play a critical role as holistic tools in sustainable agriculture. This also shows that plant enhancers can have a negative impact if used in the wrong conditions.

Summary Statement
This is the first report that the insect-killing fungus, Beauveria bassiana, promotes the health and growth of cabbage plants subjected to water stress, demonstrating additional uses for this beneficial fungus.

Help Received
My project advisor helped me set up and effectively monitor the study.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Marliese Y. Hegele

Project Number

J1807

Project Title

Sweeter Radishes? The Effect of Sweeteners on Radishes

Abstract

Objectives/Goals

I wanted to learn how different sweeteners affected the taste and health of radishes. My hypothesis was that the sugar and Splenda would kill the radishes; Stevia would be healthier than the other radishes and equally as healthy as the control, and that the ones with sweetened water would be sweeter than the control, but equally as sweet as one another.

Methods/Materials

I planted radish seeds in four planters. I watered them all with the same water, but one planter had white granulated cane sugar added to its water, another had Splenda added, and one had Stevia added. I watered them and took notes and pictures for 23 days. Then, I harvested the radishes, weighed them, measured their largest leaf and their roots. Finally, I had people taste them and fill out a survey.

Results

For the control plants, the average length of the biggest leaf was 8.92 cm, the average width was 4.9 cm, and the average root length was 8.13 cm. For the sugar plants, the average leaf length was 4.65 cm, the average leaf width was 2.625 cm, and the average root length was 5.729 cm. For the Splenda plants, the average leaf length was 8.76 cm, the average leaf width was 6.01 cm, and the average root length was 9.18 cm. For the Stevia plants, the average leaf length was 9.14 cm, the average leaf width was 5.55 cm, and the average root length was 8.95 cm. For the taste test, 16% of people thought only the Splenda was sweeter than the control, 16% of people thought only the Stevia was sweeter than the control, 36% of people thought both Splenda and Stevia were sweeter than the control, and 32% percent of people thought that neither were sweeter.

Conclusions/Discussion

On average, the Splenda and Stevia plants were equally healthy, the control plants were slightly less healthy, and the sugar plants were the least healthy. All the sugar plants were malformed, three Stevia plants were malformed, one control plant was malformed, and one Splenda plant was malformed. Stevia had overall bigger radishes. A majority of people thought that the Splenda and/or Stevia were sweeter than the control. If I could improve or extend this experiment, I would repeat it, but in a greenhouse, have the amount of sugar be equal to the amount of the other sweeteners, instead of basing it on equal levels of sweetness, increase the amount of sweetener added to the water, grow the radishes for a longer period of time, and have more people do the taste test.

Summary Statement

My project is about testing the effect of different sweeteners on the taste and health of radishes, and finding an efficient way for farmers to sweeten their crops to increase their sales and allow them to grow and sell them out of season.

Help Received

I had no help beyond mentors and teachers available at school. I designed and performed the experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Savannah J. House

Project Number
J1808

Project Title
The Prosperous Environments of Plants: Part 2

Abstract

Objectives/Goals
My experiment was conducted to test whether plants need all elements of photosynthesis to survive and if plants can be revived after being deprived of one element. The goal is to use this information to later create a greenhouse on Mars where plants and animals use one another to survive.

Methods/Materials
I planted twelve trials of carrot seeds: nine in pots and three in plastic bags, filled three-fourths with soil, and watered 50 milliliters of water every 4 days. Three pots were control plants, three were covered with Weed Barrier to prevent sunlight access, and three were not watered. The three plastic bags had a watering system, but were sealed to limit carbon dioxide exposure. I built a canopy to cover the plants when it rained. Later, the same plants were exposed to all elements of photosynthesis, and then were not watered for 16 days to activate their survival mode. Afterward, they were watered 50-100 milliliters of water every 4 days, continuously being exposed to all elements of photosynthesis.

Results
While the plants were deprived of one element, one of the three control plants grew carrots, water deprived seeds did not sprout, and sunlight deprived seeds sprouted, but soon died. While the plants were exposed to every element of photosynthesis, all formerly water deprived plants revived, one formerly carbon dioxide deprived plant revived, formerly sunlight deprived plants did not, and neither did the control plants.

Conclusions/Discussion
After careful research and experiments, I can conclude that water is needed for a plant to grow, carbon dioxide is not necessary, and sunlight is needed after plants sprout. As well, after being deprived of water or carbon dioxide, plants can revive themselves; after being deprived of sunlight, they cannot.

Summary Statement
After careful research and experiments, I found that water is needed for a plant to grow, carbon dioxide is not necessary, and sunlight is needed after plants sprout.

Help Received
My father helped me build the canopy for my plants and my current and former teachers: Ms. Hayley Smith, Ms. Stephany Escalante, and Mr. Phil Scutari helped me with any scientific questions I had about how to do my project.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Zinnia M. Hutchinson

Project Number

J1809

Project Title

How Much Sodium Chloride Can a Cabbage Plant Withstand? The Effects of Salt (NaCl) on Plant Life

Abstract

Objectives/Goals

The objective of this project is to determine the concentration of NaCl in water that harms cabbage plants.

Methods/Materials

Shelf, fluorescent light, cabbage plants, salt, starter pots, water jugs. Dad helped screw light to shelf. Calculated percentage of NaCl for test groups saltwater solutions, Group A 0%,B 1.17%, C 2.34%, D 3.5% saltwater.Measured the sodium chloride and poured in jugs of water, then watered each plant with 15 ml of designated solutions and collected data on plant health periodically.

Results

Data on plant color and health was recorded, and it was observed that plants with the highest salt content (equal to seawater, 3.5%) went through stages of salt poisoning. This pattern occurred in all groups being watered with saltwater. The health of the plants varied directly with the amount of salt they were watered with. The plants turned blue and hardened because positive sodium ions replaced the positive potassium ions, causing nutrient deficiency. The NaCl absorbed the plants water and dehydrated them during salt poisoning. Growth was also stunted. A plant cannot withstand NaCl and will be harmed as salt content increases.

Conclusions/Discussion

The amount of saltwater that plants withstand is extremely low to none. When watering plants, water softened with NaCl is harmful. Salt dehydrates plants and poisons them in various ways. The positively charged sodium ions in NaCl replace needed positive potassium ions in the plant, the leaves turn blue from nutrient deprivation. Stunted growth begins when the endodermis in branch roots detects Abscisic acid, a hormone released when the plant detects NaCl, causing a flight response from toxins present in the soil. Plants close the stomata when salt begins to absorb water from their roots. When the stomata is closed the plant cannot uptake water or Carbon Dioxide. Salt will kill cabbage plants.

Summary Statement

NaCl is detrimental to plant health, it dehydrates them and causes a hormone release that activates defense mechanisms that kill the plant.

Help Received

My father helped me assemble the shelf and light, lent me a scale, and gave me directions on plant care. The rest of my project I completed on my own.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Viraj V. Jain

Project Number
J1810

Project Title
How to Grow the Best Drought Resistant Lawn

Abstract

Objectives/Goals
This goal of this project was to experiment with different grass seeds and soils to find the combination that grows a green lawn and stays healthy with limited water

Methods/Materials
Three different seed (Rye grass, Bermuda, and Fescue) and soil (Organic, Patio Plus and Potting) types were used to make nine unique samples. Each was given limited water (twice weekly similar to county regulations) and artificial sunlight for a period of 25 days. Height of grass blades were measured every 5 days, and the grass density was measured on day 25. Cost analysis was performed.

Results
Bermuda grass did not sprout in any of the soils. Fescue grass grew the tallest in Patio Plus soil. Organic soil and Fescue has the highest grass density. For a given size lawn, natural grass incurs less costs than artificial grass.

Conclusions/Discussion
Fescue grass seeds in Organic soil seems to be the best combination that may grow the the most dense and relatively tall in a short period of time. It is also cost-effective as compared to artificial grass.

Summary Statement
Fescue grass in Organic soil was found to be the best combination to grow a water efficient, healthy, and a cost-effective lawn

Help Received
My science teacher Mr. Newlove provided some input in my study design. My parents provided funding to purchase soils and seeds and helped review my results.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Nithika Karthikeyan

Project Number
J1811

Project Title
The Effect of Water Beads on the Crop Yield of Bok Choy

Abstract

Objectives/Goals
The objective of this experiment is to find if crops can be grown in alternative growth mediums that will consume lesser amounts of water, while maintaining high crop yield and sufficient nutrition levels. This will allow crops to be grown during a drought.

Methods/Materials
9 Bok Choy seedlings, expanded water beads, nitrogen fertilizer, soil nutrition measuring tool(Luster Leaf Rapitest), soil, iodine, starch, vitamin C tablet. Qualitatively and quantitatively observed the plants growth. Compared all of the plant growth observations using health factor(a numeric value given to visual wilting, visual color, and sizes of the leaves). Measured the amount of vitamin C in the plants and compared to see which had the best overall vitamin C concentrations.

Results
Overall, the plants in water beads only did the best in terms of health factor and vitamin C concentration. this supports the objective of my project because the plants in different mediums, even the mixture of soil and water beads, did better than the most common growth medium, soil.

Conclusions/Discussion
The three trials of my experiment revealed that the change in the growth medium of plants does change the health factor and vitamin C concentration of the plant. In conclusion, water beads provided the highest crop yield and nutritional value while conserving the amount of water used to grow the crops.

Summary Statement
As the growth medium kept increasing with the amount of water beads in them, the crop yield and vitamin C concentration increased.

Help Received
My dad helped me with the experiment partially. Other than my dad, I conducted, created, an presented the experiment by myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Hafsa Khan

Project Number
J1812

Project Title
The Antioxidant Mystery: The Effects of Antioxidants and Free Radicals on Seed Germination

Abstract

Objectives/Goals
The purpose of this experiment was to study the protective effects of antioxidants on free radical damage on radish and bean seeds. Antioxidants such as Vitamins A, E, and C were used on hydrogen peroxide which was a source of free radicals. It was hypothesized that Vitamin E would be the best against Vitamin A and E. Results indicated that Vitamin A was proven to be the best vitamin which allowed the most seed germination and protected the plant cells against free radical harm.

Methods/Materials
Radish and bean seeds, hydrogen peroxide, antioxidants (Vitamin A, E, and C). Germinated seeds to prove which vitamin allowed the most seed germination and protected cells against free radical damage.

Results
In all radish and bean seed trials, Vitamin A was the vitamin which allowed the most seed germination followed by Vitamin E, and then Vitamin C. Repeated trials were run to determine if this was accurate, and in all trials Vitamin A surpassed the other two vitamins.

Conclusions/Discussion
Repeated trials with antioxidants and free radicals on seed germination revealed that certain vitamins do prevent free radical damage on plant cells. It was concluded that Vitamin A continuously overcame Vitamins E and C in the growth of most germination and protected more plant cells against free radicals.

Summary Statement
Using antioxidants such as Vitamins A, E, and C on hydrogen peroxide as a source of free raficals, it was concluded that Vitamin A allowed the most seed germination and protected the most plant cells against free radical harm.

Help Received
I performed the experiment myself, Sr. Rogina, my science teacher and advisor, helped to organize data.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Joseph M. LeBeau

Project Number
J1813

Project Title
Does Salt Water Exposure Affect Radish Seed Germination?

Abstract

Objectives/Goals
The objective of this study is to determine what happens to germinating seeds when salt enters the soil in their environment.

Methods/Materials
Six 3x3 plastic plant cell containers, potting soil, radish seeds, dietary scale measuring up to 2lbs/907g, inch ruler, digital scale (120g x 0.01g), 2 ounce plastic syringe, pool salt, and tap water.

Results
The results of my investigation of the effect of salt-water on the germination of radish seeds showed that salt in the soil caused the seeds to struggle to grow. At the end of 3 weeks, the radish seeds tested in salt-water could not tolerate the salt-water exposure. These plants sprouted, however they failed to mature. They measured shorter and smaller in size than the control group and the foliage was yellow and light green in color. The radish seeds tested in tap water grew well. These plants had good weight, height, foliage, and showed signs they would continue to mature because of new plant growth.

Conclusions/Discussion
When salt water enters the soil, the salt draws water from the plant to itself giving the plant almost no water. I concluded that because of this the seeds could not get enough water, so they struggled to grow. The control group had a proper amount of water, so they were able to grow and mature. People that are going to grow seeds near salt-water pools or plant near a road that salt is sprinkled on, need to be aware of the location. I recommend that they plant farther away or create some type of barrier so that run-off water doesn't reach the seeds and/or plants.

Summary Statement
I exposed radish seeds to salt-water and found that it had a negative impact on their growth.

Help Received
None. I researched and performed the experiments myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Hiromi Nishida; Clara Szalay

Project Number

J1814

Project Title

Artificial Hormones Disrupt Non-Competitive Root Growth Patterns In Sibling Plants

Abstract

Objectives/Goals

In our science fair project last year we learned that sibling morning glory seeds, when in close proximity to each other, restrain their outward root growth to avoid competing with one another. This year, we did further research regarding signaling, and decided to see if adding artificial hormones to the plant's water would interfere with kinship recognition. We found a commercially available source for plant hormones: Nitrozyme, a plant growth regulator, which provides cytokinins, which occur in plant roots and stimulate plant growth. Our investigative question was, "Does the amount of Nitrozyme in their water effect the outwards root growth in centimeters of nearby related and unrelated morning glory seeds?"

Methods/Materials

We tested this hypothesis by adding 3 different concentrations of Nitrozyme to both related and unrelated pairs of plants. We picked, scored, and soaked one batch of seeds from our morning glory plant and one batch from a neighbor's plant. The plants were grown in 2 sets, related and unrelated, with three rows each. One row was watered without Nitrozyme, another with a .6% concentration, and the last with a 1.3% concentration. For the first month we grew them without Nitrozyme, giving them time to germinate. Then, for the second month, we watered them with their allotted amount of water and Nitrozyme. After 8 weeks we uprooted all of the plants and measured their downward and outward root growth as well as their height.

Results

We found that while Nitrozyme did not affect the unrelated plants' root growth, related plants had greater outwards root growth, and less downward root growth. On the whole, the more Nitrozyme we gave the related plants, the lower the ratio of downward to outward root growth. This showed that Nitrozyme does not override kinship signaling by inducing plant growth in all directions as we had predicted it would. Instead, it changed the root growth patterns of the related plants.

Conclusions/Discussion

We concluded that Nitrozyme caused the plants to grow competitively, acting like unrelated plants, rather than simply growing bigger. This means that Nitrozyme made the morning glories that were related behave as if unrelated. Overall, our project demonstrates that adding chemical hormones, might not just cause plants to grow faster, but might also make them less able to respond to their environment.

Summary Statement

Artificial plant growth hormones interfere with kin recognition in nearby morning glory plants, causing sibling plants to grow their roots more competitively.

Help Received

Our parents helped with the purchase of Nitrozyme and plastic cups. And our teacher helped us by giving us guidelines on how to organize our project.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Carson E. Oliver

Project Number
J1815

Project Title
Plants Out of Soil

Abstract

Objectives/Goals
The objective of this research is to measure the growth rates of plants when grown in deferent growing systems. These systems include Hydroponics, Aquaponics and three different soils pots with different pH.

Methods/Materials
1 Gold Fish, 1 Hydroponic system, 1 Aquaponic system, Three soil pots with high, low and medium pH, 5 Green kale plants, 2 Red kale plants, cauliflour plants, !metal garden cart, plant nutrients

Results
The results following the experiment showed that the plants grown in soil spcificly the low pH had a higher amount of growth at the end of the data collection period than the plants in Hydroponics or Aquaponics. Out of the two other systems the Hydroponic system grew siginficantly better than that of the aquaponics.

Conclusions/Discussion
When all three of the varying plants were measured it was revealed that the hydroponics had a growth rate that was close to that of the soil growing, this might have ben because the nutrients were very high and the oil/water was very rich in these two systems. The aquaponic system had an extremely disappointing amount of growth and at the end of the collection period, the plants had actually decreased in size. This was due to the fish not producing the correct nutrients and this was caused by over feeding thus souring the water.

Summary Statement
When the plants were measured in each system, it was concluded that plants prefer natural soil growing in a low pH environment to growing in non traditional water based growing.

Help Received
I designed and built each system myself along with making my own synthetic nutrients and soil conditions. I was helped with the designing and maintenance process form Both Co. aquaponics. I was taught the key factors in a healthy fish tank and was provided by materials by Phil and Larry at "The

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Katrina G. Ordway

Project Number

J1816

Project Title

Effects of Quercus engelmannii on Native vs. Invasive Plant Species

Abstract

Objectives/Goals

While at a nature preserve, I encountered the Engelmann Oak, or Quercus engelmannii, an endangered native tree. Since oaks produce tannins and some produce potential allelopaths, I wondered if the leaves could be used as an organic herbicide to inhibit the growth of nonnative species. I hypothesized that the Engelmann Oak tree might be effective in inhibiting the growth of nonnative species, but not inhibit the growth of native species.

Methods/Materials

I had two parts to this project. In the wild, I documented Engelmann Oaks and recorded the air temperature and humidity, and I tested for the soil temperature, moisture, pH, and light. I used a laser rangefinder to observe and record which plants grew in a 5 meter radius from the trunk, as well as to 10 meters. I compared the results, and repeated this process for Engelmann Oaks at three sites, The Daley Ranch preserve, Lake Hodges, and public areas near the road at Lake Hodges. I encountered a branch broken off a tree in a storm on a public street near Lake Hodges. I decided to experiment. I placed crushed Engelmann Oak leaves onto the soil of five different species of native plants, and five species of nonnative plants for a total of 30 plants. I observed and recorded the results for each plant, measuring the heights and taking note of the changes that occurred.

Results

In the Engelmann Oaks# undergrowth, I documented many native plants, including Lemonade Berry, Toyon Berry, Scrub Oak; Poison Oak, White Sage, and Black Sage. In my home tests, the leaves of the Engelmann Oak greatly affected the invasive grasses and shrubs, had a moderate effect on the ground cover, and had no negative effect on the White Myoporum. The leaves stimulated the growth of native Winter Current, and the other native species had an upward growth trend.

Conclusions/Discussion

The Engelmann Oak would make a strong candidate for a natural invasive-repellent, or herbicide, in the botanical realm. The outcome supported my hypothesis, that the leaves would have a lesser effect on native plants within the Engelmann Oak#s naturally forming plant community than on invasive species. This shows that the Engelmann Oak may be more effective in inhibiting the growth of invasive and nonnative species.

Summary Statement

My project examined the effects of the Quercus engelmannii, or Engelmann Oak trees' leaves as a natural herbicide on native vs. nonnative and invasive plant species.

Help Received

My science teacher provided equipment for this project, but all testing and recording was preformed by me.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Tejal A. Patel

Project Number

J1817

Project Title

Botany Battle: Hydroponics vs. Soil

Abstract

Objectives/Goals

The purpose of this project is to see which method of plant growth will make plants grow more vigorously and healthy.

My hypothesis is that hydroponically grown plants will grow faster and more vigorously than conventionally grown plants. In my research I have discovered that nutrients are added to the water to aid in hydroponically grown plants. Based on my observations I have determined that this may be a better growing medium than soil, even though soil can be amended and fortified. For the medium to grow plants hydroponically, I am going to use Rockwool. Rockwool is a manufactured mineral fiber, and I think that this will work better than soil because soil can hold diseases and insects, whereas Rockwool will not.

Methods/Materials

Homemade hydroponics terrarium that my dad helped me make, Opaque plastic container with lid, drill, tap water, six pieces of Rockwool, plastic net containers to hold Rockwool (small size), measuring cup, disposable gloves (1 pair), potting mix (1 pound), planting pots, 3 inch (4), hand trowel or scoop, lettuce seeds (1 package), lab notebook and pencil, ruler with millimeter markings, digital scale, paper towels (1 roll), measuring cup, liquid nutrients to add to the water in the hydroponic system (4 ml Flora Micro, 5 ml Flora grow, 1 ml Flora bloom)

Results

The results for the soil method were not optimal. The average weight, in grams, was 0-1g. As for the average weight, in grams, for the hydroponics method, was 0-2g. The length, in millimeters, for both plants was close, but most of the plant's length for the hydroponics was higher.

Conclusions/Discussion

In my project, I concluded that the best method to grow healthy and vigorous plants is the hydroponic method. With the information, the plants grown hydroponically grow better than the ones grown with the soil. My soil plants look weaker and thinner and their leaves aren't that big. My hydroponic plants have big leaves and their roots are a little thicker.

Summary Statement

Hydroponically grown plants will grow faster and more vigorously than conventionally grown plants.

Help Received

My Dad helped me construct a homemade hydroponics terrarium.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Mona L. Patterson

Project Number
J1818

Project Title
How Do Plants React to Different Types of Greywater?

Abstract

Objectives/Goals
My experiment began with two questions. First, can grey water be used to water landscape plants? Secondly, I wanted to know if there was a difference in the growth of plants watered with grey water that used eco friendly laundry detergent versus grey water that used non eco friendly laundry detergent.

Methods/Materials
I planted three 1-inch tall by 1-inch wide plants in the same plastic pots using the same potting soil. I watered the plants once a week over eight weeks. I watered the plants with the rinse water from our washing machine that contained eco-friendly and non-eco-friendly laundry detergents. I also watered a control plant with regular tap water. I measured each plant once a week for 8-weeks, took notes on the growth patterns of the plants, and documented my research with photographs.
I ran two trials of my experiment. The first trial was in the fall and the second was in the spring. I wanted to make sure that any difference in sunlight didn't affect the outcome and wanted to make sure the results were similar.

Results
I learned that the plants watered with tap water and eco friendly grey water grew the best in both trials. The plant watered with tap water was slightly larger and fuller in the second trial, but the eco friendly grey water plant was larger and fuller in the first trial. Both plants stayed green, flowered and had regular weekly growth. So, to my first question, I can safely conclude that plants can be watered with grey water and thrive.

The real difference was the growth of the plant watered with non- eco friendly detergent grey water. This plant in both trials did not grow as large as the other plants, had a lot of yellowing in the leaves, and dropped its flower buds. The plants watered with non eco friendly grey water grew only one third the size of the other plants. As such, there is a real difference in how different detergent types affect the usability of grey water.

Conclusions/Discussion
In conclusion we can definitely re-use the grey water from our laundry in our gardens providing we use eco friendly detergents in the wash. Grey water using non eco friendly detergents adversely affects plant growth. Non eco friendly detergents contain salts that build up in the soil over time. These salts change the soil PH making the soil more alkaline. Therefore, using Eco Friendly detergent in any laundry where we want to reuse the rinse water will be a must!

Summary Statement
I found that plant growth is affected differently by grey water which contains Eco Friendly and Non Eco Friendly laundry detergents.

Help Received
None. I designed and performed the experiment myself.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Aylin G. Salahifar

Project Number
J1819

Project Title
The Detrimental Impact of Food Remnants on Plant Development

Abstract

Objectives/Goals
The objective of this study was to investigate the effects of feeding plants different types of processed food solutions.

Methods/Materials
Purchased Cyclamen flowers for 3 separate trials. Each trial consisted of 4 Cyclamen flowers. One received a sugar solution, the second one a potato chip solution, the third flower a chocolate mixture, and the last only tap water. Plant height data and other developmental factors were recorded over 3 trails and displayed in data notebooks and graphs.

Results
The sugar nourished plant responded the most adversely to its solution. The potato chip plant showed the second most amount of detrimental effects, while the chocolate plant showed the third most. The control plant on the other hand was the healthiest plant and significantly grew during the experiment. Results were obtained according to quantitative height data and senescence diagrams.

Conclusions/Discussion
In conclusion, my hypothesis was proven to be correct. Each junk food nourished plant displayed some malign effect. For example: The sucrose in the sugar solution delayed flowering time, and the potato chip solution dried the plant through the process of Osmosis. We can use this information to our benefit. In a real world application, if you are a farmer who is wishing to increase his yield in a shorter period of time, fertilizing your crops with sucrose supplements wouldn't be something in your interest. However, if you are a florist looking to delay a Chrysanthemum's bloom until Christmas, sucrose supplements might be a cheap way to preserve your plants until a desired time.

Summary Statement
I deduced that processed food solutions will cause detrimental effects on Cyclamen flowers, including delayed flowering times (e.g. sugar nourished plant), and withering through the process of Osmosis(e.g. chip nourished plant).

Help Received
My father and mother aided me in the design of my experiment, though I conducted all research and work alone. Mr. Lampard, my Synopsys mentor, guided me through analyzing my data and advised me to use a senescence diagram.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Rhitishah Yuva Raju

Project Number

J1820

Project Title

Plants, Photons, Phototropism: How Does Light and Color Affect Plant Growth?

Abstract

Objectives/Goals

My hypothesis is: If, a plant is exposed to the right light, right color, and right color temperature (kelvin), then, the growth of the plant will accelerate because, light and color affect growth. My goal is to see which light type (CFL or LED), Kelvin (2700 or 5000), and Color (red,blue, green) causes the three plants that I am experimenting with (spinach, sunflower, and okra) to grow at its best pace.

Methods/Materials

I set up my lab area first, planted my plants, conducted my different experiments, watered the plants, and took the measurements of plant growth daily for 25 days. I did 2 trials.

The materials I used for Scientific Data Collection were Footcandles Meter (Minolta T-10), Moisture Control Meter, Soil Thermometer, Data Collection Sheet, Electronic Thermometer, Electronic Balance. The other materials I used were 12 cardboard boxes, Two long strip of wood, CFL 5000 light bulb(3), LED 5000 light bulb(3), Measuring Cup, CFL 2700 light bulb (3), LED 5000 light bulb (3), 12 clamp lights, Ruler,Pen, and Red, Blue, and Green Color filters.

Results

Different types of lights (CFL and LED) affect plant growth differently. Furthermore, color temperature (Kelvin: 2700 and 5000) is especially important while growing plants. You need the right color, light type, and color temperature (Kelvin) for a plant to grow at the best pace. Different plants need a different combination of these three things to grow at their best pace. For example, spinach grows best with the color green, LED lights, and with a Kelvin of 2700. Sunflower grows best with the color red, light type of LED, and with a Kelvin of 2700. Okra grows best with the color blue, CFL lights, and a Kelvin of 5000. The lights and color that I have tested in my study all have a positive impact to plant growth compared to natural light. However, with the right combinations of color, light type, and color temperature (Kelvin) a plant will grow at its best pace.

Conclusions/Discussion

My research has never been done before. It changes the way the farmers, specifically vertical farmers, grow their crops. It speeds up the process of growth for plants without having to use GMO#s. My research also goes for a variety of plants, leafy plants(spinach), green seed pods(okra), and seeds (sunflower).

Summary Statement

I experimented the plant growth of three different types of plants (spinach, sunflower, and okra) with the independent variables of Light Type (CFL and LED),Kelvin (2700 and 5000) and Color (Red, Blue, Green)and found the best combinations.

Help Received

Sacramento Municipal Utility District lent me use their lighting room and they lent me a foot candle meter for my research.

CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)
Tomas D. Zumkeller

Project Number
J1821

Project Title
Investigating the Effects of Magnetic Forces on Plant Germination and Growth

Abstract

Objectives/Goals
Determine if varying strengths of magnetic forces affect radish seed germination rate and growth.

Methods/Materials
Using 5 groups of test tubes, each contained radish seeds and varying strengths of magnets attached. Each test tube was monitored to determine if the magnetic force affected seed germination and plant growth.

Results
The evidence of this experiment determined that varying strengths of magnetic force did not affect seed germination rate. The evidence also demonstrated that exposure to varying degrees of magnetic force did not affect plant growth rate.

Conclusions/Discussion
This investigation could be beneficial in determining how if any magnetic forces from the earths natural soil could affect crop production in the farming industry,

Summary Statement
I showed that varying strengths of magnetic force when applied to radish seeds does not affect their germination rate or growth rate.

Help Received