Project ID: 371

Senior Division

Plant Sciences

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Gr. 11

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To What Extent Does Duckweed (lemnoideae) Improve Water Quality and Raise/Lower pH in Polluted Waters?

The purpose of this experiment is to delve deeper into the role of duckweed, scientific name lemnoideae as a means of being a natural cleanser for polluted lake water as the growth of lemnoideae on water surfaces has been able to serve as a removal for pollutants to treat certain lake waters. We intend to study its usage regarding phytoremediation. The experimental lake water had a deductible impact upon the duckweed as compared the control regular water upon comparing the resulting populations of the duckweed. Additionally, the duckweed has a role in phytoremediation regarding the pH of the lake water, aiding in regulating it to a lower pH closer to 7 - the pH of regulated water. We hypothesized that the duckweed within the experimental lake water would result in a lower pH. This was correct, and the duckweed resulted in regulating (decreasing) the pH of each lake water trial and proving to have phytoremediation properties. This is because duckweed can aid in the removal of toxins and absorb heavy metals through chelation and compartmentalization (MDPI, Duckweeds for Phytoremediation of Polluted Water) and is a natural water filter. However, we also hypothesized that with the duckweed in lake water that it would grow more in population compared to the control group. This was wrong - and we can deduce that this was due to potential foreign chemicals or substances in the lake water because it is from outside and we are uninformed of the history of the lake water and what has been in it. We can assume that with the control group of regular tap water, due to it being initially cleaned and filtered water, it did not have any chemicals or substances to interfere with the duckweed population growth.

Project ID: 372

Senior Division

Plant Sciences

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To What Extent Does Eroded Soil Affect the Growth and Germination of Raphanus sativus?

This project investigates the impact of soil erosion on radish (Raphanus sativus) growth and germination. Supported by statistical analysis, our hypothesis predicting a negative effect of soil erosion on radish growth was confirmed. The non-eroded group reached an average height of 1.7704 centimeters, while the eroded group only achieved 1.2844 centimeters, indicating a significant difference of 72.5%. Analysis of average growth data revealed that the control groupmaintained a more consistent pattern, ranging from approximately 1.256 cm to 2.024 cm, compared to the experimental group, which showed wider variability, fluctuating from about 0.548 cm to 2.116 cm. Moreover, the eroded group exhibited lower germination rates than the control group. When incorporating qualitative data, such as observed germination rates, the control group consistently maintained a 100% germination rate across all trials, reinforcing the stability of optimal conditions. On the other hand, the experimental group, while showing instances of successful germination, exhibited a slightly lower average germination rate of 4 out of 5 seeds. These findings highlight the adverse effects of soil erosion on radish growth and germination, underscoring the importance of sustainable agricultural practices to mitigate soil erosion and ensure food security. Additionally, our study contributes to understanding the broader impacts of soil erosion on environmental systems and human societies.

Project ID: 373

Senior Division

Plant Sciences

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The Effect of Synthetic vs. Organic Fertilizer on Lima Bean Growth

Our research team conducted a 14-day experiment to compare the effects of synthetic and organic fertilizers on the growth of lima beans (Phaseolus lunatus). We aimed to determine which fertilizer type would yield superior outcomes in terms of plant quality and growth rate. Initially hypothesized, synthetic fertilizer was expected to promote faster growth and increased sprouting, while organic fertilizer was anticipated to produce higher-quality plants.

We distributed three lima bean seeds into individual cups across synthetic and organic fertilizer treatment groups, with five cups per fertilizer type. Additionally, a control group was established for comparison. Throughout the experiment, we meticulously monitored and recorded the growth trajectories of the lima bean plants in all three groups.

At the conclusion of the experiment, analysis revealed distinct differences in the effects of synthetic and organic fertilizers on lima bean growth. Synthetic fertilizer led to faster growth rates, with taller average plant heights and greater germination rates compared to the organic fertilizer treatment. Conversely, although the organic fertilizer group exhibited slightly slower growth, the plants demonstrated superior overall quality and sustained vitality beyond the experimental timeframe.

In summary, our findings highlight the nuanced relationship between fertilizer type and plant growth dynamics. Synthetic fertilizers offer rapid but transient growth boosts, while organic fertilizers contribute to sustained plant vigor and longevity. These insights enhance our understanding of agricultural practices for optimizing crop productivity and quality.

Project ID: 374

Senior Division

Plant Sciences

Jackson Ewert
Bonita Vista High School
Gr. 11

How Does Organic Fertilizer Affect the Growth and Germination of Radishes?

Problem: Excessive use of fertilizers in farms have caused foods to be unsafe to consume and have runoff into water sources in which they harm organisms and spread chemicals.

Why: In today's world, many people have begun to have health problems because of the infectious and harmful foods that we consume. Most of these health problems come from the overuse of fertilizers and pesticides and farms. If it is proven that fertilizers do not fertilizers do not show a significant impact to foods such as radishes, they should not be used as much in farms.

Hypothesis: I predict that the groups of radishes with fertilizer will have a higher rate of growth and germination.

Procedure: There will be five trials for control and experimental groups. There will be five radish seeds per trial. The experimental groups will have 0.2 grams of fertilizer added to them to compare the growth and germination of radishes with fertilizer versus without fertilizer.

Results: Both control and experimental groups were consistent to their averages in growth and germination. Average germination for control was 88%, average germination for experimental was 92%, average length for control was 6.92 cm, and average length for experimental was 5.86 cm.

Conclusion: Based on my results, organic fertilizer did not have a significant impact on the germination or length of the radishes which proved the hypothesis to be incorrect. In fact, the growth was superior in the control groups. The experiment has provided evidence that fertilizers should not be used as much in farms.

Project ID: 375

Senior Division

Plant Sciences

Sebastian Higuera Rodelo

Bonita Vista High School

Gr. 12

The Effects of Water Pollution on the Growth and Germination of Wheat Grass Seeds

This project examines the effect that water polluted with motor oil has on the growth and germination of wheatgrass seeds. It was hypothesized that the seeds with the polluted water would grow more slowly, not be as tall, and have a lower germination % as the ones with clean water. Six trials of 5 seeds each were recorded over ten days consisting of three control groups and three experimental groups with. The experimental groups were given 1%, 2%, and 4% mixtures of oil in water. Results indicated that the hypothesis was indeed correct, as the seeds in the control groups grew the tallest and had the highest germination %. The average growth height for all the controls were 3.9cm and had 100% germination. The experimental group with 1% oil had an average height of 2cm and 100% germination, the group with 2% oil grew to 1.2cm and had 80% germination, and the final group with 4% oil had no seeds grown at all, 0% germination. The motor oil clearly harmed the growth of the seeds as the toxic chemicals damage cell structures within the seeds and plants, making it harder for them to perform photosynthesis and cellular respiration. The oil also pollutes the soil, making it too toxic to support seed germination. Having clean water and soil ensures seeds are able to properly germinate and grow healthy.

Project ID: 376

Senior Division

Plant Sciences

Melany Ibarra
Central Union High School
Gr. 11

Ana Villegas Palacios
Central Union High School
Gr. 11

The Effects of Soil Pollution Caused by Human Impacts on Transpiration Rates of Plants

AWARDS:

CSEF Qualified

For this experiment, soil pollution will be replicated by changing the pH of soil into an acidic group and an alkaline pH group; the transpiration rates will be measured and compared using two methods; whole plant and weighing method. The change in soil pH was investigated by gathering five pots of 60 g of alkaline soil and five pots of 60 g of neutral pH soil. Ocimum basilicum was then planted in these pots and the transpiration rate was measured by comparing the initial mass and final mass (whole plant method). This resulted in a control average transpiration rate of 0.07333333 mL/hr and a -3.92% change, and the alkaline group had an average of 0.05066667 mL/hr transpiration rate and a -2.94% change. This method, the Weighting Method, includes an Ocimum basilicum plant where twelve shoots were gathered, four in each group; neutral, acidic, and alkaline; the transpiration rate was measured by comparing the initial reading (mL) and final reading (mL). Each individual shoot was placed in a 70 mL graduated cylinder with water with 2 mL of olive oil in order to cover the surface. Results showed that the control group had an average water lost of 0.2 mL/hr and a 0.5% decrease, the alkaline group had an average rate of 0.185 mL/hr and a 0.48% decrease, and the acidic group had an average rate of 0.46 mL/hr 0.79% decrease.

Project ID: 377
Senior Division
Plant Sciences

Hannah Ilko
Bonita Vista High School
Gr. 11

To What Extent Does Runoff Affect the Growth and Germination of Wheat Grass (Triticum aestivum linn)

Runoff can be harmful to the environment due to the pollution and diseases that it causes. Because of this it was not a possibility to test runoff in an ecosystem. So I decided to test the runoff with wheatgrass. The hypothesis was that the experimental plants (plants w/ runoff) would grow but not as much as the control plants (plants w/ water).

Procedure: The experiment will have 5 cups for each variable and will have 10 trials measuring the ml of liquid and mms of the plant's growth. Which is why the experiment is set up by first putting soil into both the control and experimental cups. Second is putting the seeds under the soil. Third, add water to the control variables and add runoff for the experimental variables.

Results: All of the trials grew except one (trial 3). The highest growth is trial 1 due to the control variable percentage being 100%. The wheatgrass plants grew over the 10 day experiment, but the experimental variable did not grow as the control variable. Height Average: Control variables 64.14mm and Experimental variables 31.66mm
Percent Germination average Control variables 84% Experimental variable 64% .

Conclusion: It was predicted that my experimental plants would grow but not as much as the control plants would grow. Based on the result from the five trials the percent germination for the control variables was 84% and the percent germination for the experimental variables was 64%. Which means that error bars within the graph make this data inconclusive. The average height germination for the control variables was 64.14mm and the experimental variable germination was 31.66mm. This demonstrates that even though there was more error bars on the control variables the find result were not affected overall.

Project ID: 378

Senior Division

Plant Sciences

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Victoria Takaki
Bonita Vista High School
Gr. 11

The Effect of Runoff Pollutants on Wheatgrass

AWARDS:

CSEF Qualified

In our project, we wanted to discover the effects and impact of run-off pollutants on the growth of plants. We view run-off as a natural consequence of urbanization. We decided to test four types of run-off on wheatgrass, grown in both soil and water and measure both daily growth and analyze root development at the end of our trials. Our hypothesis predicted that both our control trials, with only water, and fertilizer run-off would thrive. Our trial(s) results supported only part of our hypothesis, as predicted, our control trials, with only water, thrived and had significant measurable growth daily. Fertilizer run-off trials also grew but at a lower rate in soil than in water, but less than the control trials. The surprising discovery was that motor oil wheatgrass trials in both soil and water outperformed fertilizer trials nearing growth levels of control trials. Soap run-off wheatgrass trials grew at a lower rate, but we had measurable growth in soil and water. The only trials that had little to no growth were everything (fertilizer, motor oil, and soap) run-off solutions in soil had minimal growth, and in water, the growth was significantly impacted by the run-off pollutants as compared to single pollutant run-off. Our hypothesis about motor oil, soap, and everything run-off wheatgrass dying was proving incorrect. The root developments also helped us better understand how the runoff effects the plants, with the control looking the most healthy.

Project ID: 379

Senior Division

Plant Sciences

Haley Lytle

Bonita Vista High School

Gr. 11

To What Extent Does Salinization Affect Growth and Germination

The agriculture industry is extremely impacted by salinization in their soils. Salinization is the process by which salt contents increase in soils due to the misuse of irrigation. As the water evaporates, the salt gets left behind, causing buildup in the soils of farms; which can be detrimental to the growth of some crops. I carriedout my experiment by constructing the temporary home for my seeds by adding the different NaCl concentrated waters and paper towels into a regular plastic bag. When my experiment was fully constructed, I placed all of the bags for one trial under a plant LED light provided to me. Over the course of 10 days, I recorded the root measurements and the appearance of the seeds throughout their growth. Ultimately, it was predicted that carrot seeds would be unlikely to germinate in higher NaCl concentrated water and Radishes would have the most success in doing so. I was partially correct, missing the detail that beet seeds were more tolerant to higher salt concentrations, something I did not know.

Project ID: 380

Senior Division

Plant Sciences

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Gr. 11

Alena Ramirez
Bonita Vista High School
Gr. 11

To What Extent Do Chemicals Within Plastics Affect the Growth/Germination of Wheatgrass?

The general consensus of what is currently happening within human and or plastic pollution in today's day and age is, plastic pollution can potentially modify environments and common processes, decreasing the capacity of ecosystems to adapt to climate change, directly influencing daily life, the food generation capacity and social well-being of millions of people.

Hypothesis: I predict that our experimental group will suffer from much less overall plant growth due to the effect of the added microplastics/ chemicals. Meanwhile, I hypothesize that our control group will see positive growth/ germination results, due to more of a natural process of photosynthesis.

Procedure: To determine if the growth will be affected, we focused on tracking the experimental groups growth. In our experiment, the group that did not use any harmful plastics was the controlled group. The controlled group was watered by standard sink water. There were two experimental groups that were used in this experiment, one was a mixture of plastic water bottles along with water and made a solution of microplastics. The second was a mixture of water with plastic straws to make another microplastic solution. For this experiment we ran 5 different trials.

Results: Control Group Average Height: 4.92cm, Control Group Germination Rate: 80%, Experimental #1 (water bottle): 1.68cm, Experimental #1 Germination Rate: 60%, Experimental #2 (plastic straw): 1.56cm, Experimental #2 Germination Rate: 60%.

Conclusion: Microplastics are commonly known to contain harmful and toxic chemicals that can potentially hinder plant cells. After the experiment concluded, our group realized that our hypothesis was correct, which was that exposure to microplastics does negatively affect plant growth and germination.

Project ID: 381

Senior Division

Plant Sciences

Maxwell Rhoades

Bonita Vista High School

Gr. 11

How Does the Presence of Pesticides Affect the Growth of Duckweed?

Problem: Runoff of pesticides from agriculture into nearby water sources is a global issue, and they have the potential to harm organisms. Since it is not the most attractive organism, most people would not care if duckweed went extinct than if a rose did, for example. It is important to value all organisms equally to prevent separation and concentration of our efforts to save them.

Hypothesis: I predict that certain samples of duckweed will fail to grow in comparison to others because of exposure to pesticides.

Procedure: There will be five trials, each with a control and experimental sample, and each sample containing 1 gram of duckweed. 1 mL of pesticide will be added to each experimental sample, allowing for the observation of growth in a non polluted vs a polluted environment.

Results: Depending on the trial, the control group could have shown more growth than the experimental, or vice versa. The highest increase in mass was of the Trial 2 Experimental sample (17%), while the least increase (or highest decrease) in mass was of the Trial 2 Control sample (-11%).

Conclusion: The overall result of the experiment was that pesticides did not have a significant effect on the growth of duckweed, proving the hypothesis to be incorrect. On average, the control groups would increase in mass by about 2.6%, while the experimental groups would increase byabout 7.8%. The data was too inconsistent to provide a conclusive answer to the hypothesis.

Project ID: 382

Senior Division

Plant Sciences

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Del Norte High School
Gr. 10

A Novel Stress Early Detection Method through Infrared Thermal Imaging Phenotyping

AWARDS:

American Academy of Pediatrics Climate Change and Health Committee - Senior Division 1st Place
CSEF Qualified

Even though plant stress is a critical factor impacting plant's health condition and impact crop yield, the current plant stress measurement involve complicated measurement systems, and crop water stress index (CWSI) not convenient for farmers to use. Could a convenient method be established to detect the plant stress condition and correlate with CWSI? Could infrared thermal imaging be used as an effective tool to detect the plant stress conditions?

Procedure: Conduct the temperature measurement and IR thermal imaging on 3 different plants (Passion Fruit, Avocado and Jasmine) Conduct statistical data analysis and ANOVA analysis, correlate with CSWI value. Analyze and Phenotype the infrared thermal image and RGB imaging in the farm and establish an imaging model for early stress detection.

Results: The normalized Infrared temperature index (NITI) has a good correlation with CWSI on three different plants (Avocado, Passion fruit and Jasmine) as well as plant health conditions. NITI of 6 correlated to CWSI at 0.3, when the NITI increased statistically with the p value 0.0. Results correlate with Avocado starting moderate drought at day 3, Passion fruit at day 10, and Jasmine starts at day 17 without watering. The field study demonstrated the thermal imaging technique and normalized index could be used for the plants in the field farm effectively.

It can be concluded that the normalized infrared thermal temperature index can be correlated with the CWSI index for the plant drought status, the infrared thermal imaging technique can detect the plant's drought stress condition effectively as a convenient tool.