



Science 299 Independent Research Projects

Control vs. Experimental Results of Generation 1

Metric	Control	Experimental
Total # of plants	~20	~20
Total # of flowers	~10	~20
Total # of seed pods	~10	~14
Average height of plants (inches)	~6	~5

Chemical Reaction Scheme:

O=[N]c1ccccc1C=O.CCC(=O)C>NaOH>[O-][N+](=O)c1ccccc1C(O)(C(C)=O)CO>>O=C1OC(=O)c2ccccc2n1>>O=C1OC(=O)c2ccccc2n1.O=C1OC(=O)c2ccccc2n1.O=C1OC(=O)c2ccccc2n1>O2>O=C1OC(=O)c2ccccc2n1

o-nitrobenzaldehyde + acetone → intermediate → indigo

Special thanks to the laboratory staff for facilitating or assisting with student projects:

Laboratory Managers

Dr. Mark Little (Chemistry)

Dr. Pam Bortz (Biology)

Rukaya Almustafa – Biology 299

The Effect of Eggshells (Calcium) and Nutrient-Rich Soil on Germination and Growth of Pepper Seeds

Previously, eggshells have been used as a component of fertilizer. These fertilizers have proven to increase growth compared to commercial fertilizers and have also been used as a more eco-friendly option (Skrzypczak et. al, 2022; Borges et. al, 2021). However, these studies have not shown if using only eggshells or the chemicals contained in an eggshell can promote growth. The hypothesis is that using eggshells in place of Miracle Grow-enhanced soil (Miracle Gro Seed Starting Potting Mix) will cause a similar effect on growth rate and plant health. Additionally, it was hypothesized that the pepper plants growing in soil with crushed eggshells will have a faster growth rate and better plant health than the plants growing inside of a whole eggshell. Two trials were conducted over approximately 6 weeks and 4 weeks, respectively, where pepper plants (genus *Capsicum*) were grown in soil infused with enhanced soil, eggshells (crushed or whole), or neither (control). It was found that the germination rate was significantly different between soil conditions in the first trial ($p\text{-value} < .0001$) but not in the second trial ($p\text{-value} = .0543$). When comparing plant height, the crushed egg condition started with comparatively low growth at the earlier time points but had the highest height at the end of data collection for both trails. In both trials, the crushed egg condition on average had increased plant height compared to the whole eggshell. The plants grown in Miracle-gro-infused soil had decreased height at later time points in comparison to both eggshell conditions. In conclusion, it appears that eggshells match or sometimes are more effective than commercial fertilizer. Additionally, the crushed eggshells promoted more growth than the whole eggshell.

Faculty Advisor: Donna Hoefner

Cassie Anderson – Chemistry 299

The Determination of Cranberry Juice in Cranberry-Grape Juice Manufactured by Ocean Spray® and Great Value® Brands as an Assessment of Health Benefits via UV-VIS Spectroscopy

Cranberry juice is known for its many health benefits. The fruit contains proanthocyanidins, which are a health promoting polyphenol present in plant-based foods. Cranberry juice can inhibit urinary tract infections (UTIs) by preventing harmful bacteria from sticking to the walls of the bladder and be helpful in the treatment of cardiovascular diseases by lowering blood pressure and reducing the chances of developing atherosclerosis. As a modern-day consumer, it is important to be aware of the ingredients and additives that are present in products intended for consumption. In this research, Beer's Law: $\text{Absorbance} = \epsilon b C$, and UV-Visible (UV-VIS) Spectroscopy were used to determine the percent of cranberry juice present in Ocean Spray® and Great Value® cranberry-grape juice. It was hypothesized the percentage of cranberry juice in both brands would be similar and make up 10 – 20% of the total product. Ocean Spray® pure unsweetened Cranberry Juice was used as a standard to form a calibration curve and determine the equation of the linear regression line. Using the direct relationship between absorbance values from the calibration curve and the absorbance values of the cranberry-grape juices being investigated, it was found cranberry juice made up 21.2% of the Ocean Spray® cranberry-grape juice and 27.9% of the Great Value® cranberry-grape juice. Further exploration is required using other drink varieties to determine the best brand to purchase for the highest cranberry juice content.

Faculty Advisor: Dr. Frances Rees

Kaitlyn Anderson – Chemistry 299

Efficacy of Nile Red Dye as a Tagging Mechanism for the Exploration of Microplastic (MP) Detection in Bottled Water after UV Exposure using Stereoscopic Fluorescent Microscopy

Plastic containers, such as water bottles, are a source of microplastics (MPs) under scrutiny by scientists in the last decade. Nile Red dye tagging is a technique used in studies to detect microplastics across an array of disciplines. It was recently adapted for a college level laboratory setting. In this project, experimentation was done to see if the methodology was adaptable for independent research focusing on the impact of a short UV exposure and MP presence. Reference material was created using empty plastic bottles and dyed with Nile Red to prove the dye can effectively bind to smaller plastics. Only under UV light were the particles visible. Using methanol as the dye solvent produced brighter fluorescence compared to acetone. In samples exposed to 0 hours of 350m UV light, microplastics were present, indicating that even without stressors in the bottle environment, MP presence was found. In 1 hour of exposure, MPs were still found. T-tests showed no significant increases in the amount of MPs that migrated into water. T-tests did prove

however across brands and different UV exposure that filters with pore sizes around 1.6 μ are best suited to capturing the plastics. More work is needed to determine the critical amount of UV exposure that creates significant MP levels when compared to control groups. Different literature methodology on the Nile Red dye tagging process is also worth exploring.

Faculty Advisor: Harish Subedi

Greyson Chasse – Chemistry 299

Analyzing the Natural Decomposition Rate of Degradable versus Non-Degradable Polyethylene Bags

As plastic production and usage continues to climb worldwide, we are beginning to discover more and more ways it negatively affects the world around us. Plastic polymers are considerably durable which make for an unfortunate catch as plastic items will last a long time while in use, but also once discarded. This project was conducted to study the ways plastic products degrade into our environment and the footprint plastic leaves behind. Two different variants of polyethylene, one a traditional plastic, the other a ‘degradable’ alternative, were used in this study to determine which one would deteriorate quicker, and which one would leave behind more microplastics in the soil. Two experiments were carried out to determine this. In the first, both types were buried in the ground, left to degrade, and checked at regular intervals. In the second, samples of sand were created with increasingly higher pH levels to speed up the process of molecular degradation. The samples buried in the natural environment were weighed and inspected under a microscope and the surrounding soil was filtered to find trace particles that had broken off, while the samples left in the sand were inspected with FTIR imaging to look for any signs of molecular breakdown. Unfortunately, neither test resulted in conclusive evidence of degradation, and both would require a much longer time frame to be able to witness any significant changes.

Faculty Advisor: Harish Subedi

Peter Chung – Biology 299

*The Effect of Mycorrhiza on Wisconsin Fast Plants (*Brassica rapa*) Gene Heritability*

Plants are diverse and range widely in genetic variation due to adaptive change. Factors that influence change in genetic traits can be determined using heritability studies. In this study, an experiment was conducted on Wisconsin Fast Plants (*Brassica rapa*) to determine if plant-supportive fungi can influence a parents’ trait to be inherited in their offspring. Mycorrhizae are fungi that form a mutualistic symbiosis with plants by providing extension roots for increase of nutrient absorption. Two groups of Fast Plants were tested: the control group was treated without mycorrhizal fungi, and the experimental group was treated with mycorrhizal fungi. Both groups were treated under the same conditions of light exposure, temperature, and watering. The trichome trait, fuzzy hairs that reside on the stem and petioles, were selected for in both groups. Elimination of the trichome trait was used to later determine if the second generation had inherited the parents’ trichome trait. After the first generation of plants were complete, it was examined that there was a

significance in the number of flowered plants in the experimental group than in the control group, being a 2:1 ratio. A second generation was planted and examined after two weeks. It was concluded that there were no trichomes in the second generation or offspring, which reflected the first generation or parents. In conclusion, there was a significance in the mycorrhizal fungi affecting the heritability of trichomes.

Faculty Advisor: Marlena Yost

Bryant Corbin – Chemistry 299

What Experimental Design of the Synthesis of Indigo Yields the Highest Percent Yield ?

Indigo dye is a historical product that was a valuable asset throughout human history. In 1882 Adolf Von developed a synthetic process to create indigo without the need of the Indigo plant. This initial experiment has several variations. This experiment tested 5 experimental designs with 3 runs for each test to see which yielded the highest percent yield and purest synthetic indigo. 1 gram of 2-nitrobenzaldehyde was added with acetone and 1 molar sodium hydroxide. Test 5 excluded water as a catalyst. In test 4 ether was added as a wash for filtration. After the solute was filtered and dried it was weighed. To check for statistical significance a t-test was performed for both purity and percent yield. Test 5 produced the highest percent yield with an average of 0.5971 grams. Through statistical analysis neither test 1 and 2 nor test 3 and 4 had statistical significance, comparison of the purity between samples were not statistically significant. Test 5 with no water provided the greatest yield, however test 5 had the highest volume of liquid with 27.5 ml. All other tests had a volume of less than 19 ml with a trend in increasing the amount of yield as the volume of liquid increased. This conclusion requires more testing to see if the lack of water is a factor for the increase in yield or if the increase is due to the volume of liquid. One factor not checked in this experiment was the presence of impurities after filtration, oven drying is suggested to test this hypothesis.

Faculty Advisor: Frances Rees

Tom Driscoll – Biology 299

*Variance in Red Fox (*Vulpes vulpes*) Nocturnal Activity by Climate*

Despite being a common creature in four continents, the nocturnal nature of the red fox (*Vulpes vulpes*) has made it difficult to study. In the past, studies have been conducted using radio-tracking to analyze the nocturnal activity of foxes, but hasn't been repeated since the 1960's. This study seeks to use a modern trail camera to monitor the nocturnal activity of red foxes and compare how this activity changes based on the weather conditions. It was hypothesized that fox activity will decrease with increased precipitation and wind speed, as well as with lower temperatures, and will conversely increase due to lack of precipitation and wind, and with higher temperatures. By placing a motion-activated trail camera along a popular game trail for 10 weeks and collecting data daily, the study was able to gain rare insight into nocturnal fox activity. Data was collected on the

number of fox sightings recorded per night, the average temperature per night, the precipitation per night, and the average wind speed per night. A Pearson correlation coefficient was calculated for the relationship between each weather variable and fox activity, showing there to be no significant correlation between wind speed and fox activity as well as precipitation and fox activity, and showing a slight positive correlation between temperature and fox activity. These findings reject the initial hypothesis, as there was little correlation between any weather variables and fox activity. The findings differ entirely from the work of Ables and other researchers. This study was likely flawed by its poor ability to study overall fox activity as the lens of the study was limited to a single trail. More studies should be conducted over a larger area with more cameras to gain better data on the true relationship between weather variables and fox nocturnal activity.

Faculty Advisor: Marlena Yost

Esperanza Escobar – Biology 299

Analyzing the Feeding Habits of Canada Geese in Contrasting Locations

Canada geese (*Branta canadensis*) are one of the most well-known birds commonly found in North America. They are highly adaptable animals that tend to live in urban, rural, and suburban communities. Their diet mainly consists of grain from fields and grass. Since Canada geese are found almost anywhere with various food options, this study was conducted to investigate how their surroundings affect their foraging behavior. Two Albemarle County, Virginia municipal parks (Chris Greene Lake and Darden Towe Park) were chosen as the rural and urban locations respectively, for the analysis. The prediction for this observational study was that the percentage of geese eating at Darden Towe Park would be lower than at Chris Greene Lake due to higher levels of disturbance in the more urban location. To conduct this study, the geese were observed at both locations every week around the same time of day and 3 observations were made at each location. The scan sampling method was used to record their behavior on a data sheet every 5 minutes for a total of 30 minutes. The data gathered from the study showed that the geese at Darden Towe Park spent more time in the water than at Chris Greene Lake. However, the difference was not statistically significant. There was a significant difference in more time spent walking/standing at Chris Greene Lake vs. Darden Towe Park ($t=4.0577, df=4, p=0.0154$) and more time spent in the water at Darden Towe Park vs. Chris Greene Lake ($t=4.5927, df=4, p=0.0101$). While the initial prediction was supported by the results, the difference was not significant. The behavior noted while conducting the observational study showed that the geese at Darden Towe Park were more territorial over food than at Chris Greene Lake. The geese at Darden Towe Park experience higher levels of human interaction and this could explain their reduced time spent eating and increased time spent in the water.

Faculty Advisor: Dr. Joanna Vondrasek

Hayat Ghazoul – Biology 299

The Effect of Environmental Conditions on Callosobruchus Maculatus Oviposition

Callosobruchus maculatus or the bean beetle is an agricultural pest that can destroy crops, affecting crop yield and income. This study investigated the impact of environmental conditions on bean beetle oviposition (egg laying): specifically, light exposure, humidity and temperature. Based on their natural habitat, it was hypothesized that bean beetle oviposition would be greatest with 24-hour light exposure, a constant temperature of 77 degrees Fahrenheit, and humid conditions. Oviposition was determined for 2 male and 2 female bean beetles in containers containing 0.5 mg (roughly 2-3) black-eyed peas under 24 hour light and dark conditions, temperatures of 40, 70 and 77 degrees Fahrenheit and various degrees of humidity. It was determined that oviposition was greatest with 24 hour dark conditions, a temperature of 77 degrees Fahrenheit and high humidity; rejecting the hypothesis, in part. Statistically significant findings included a preference for oviposition in humid over dry conditions and at a temperature of 77 degrees Fahrenheit over 40 degrees Fahrenheit and 70 degrees Fahrenheit. Although not a statistically significant finding, oviposition for the bean beetles was higher on average for the more humid condition (50.7) versus the “mid-level” humidity condition (47.7), suggesting that the bean beetles in a lab may benefit from the addition of water to their petri dish.

Faculty advisor: Virginia York

Julianna Hawkins – Geology 299

Variation in Strained Blue Ridge Skolithos

This research project addresses whether strain varies systematically across the Blue Ridge by using *Skolithos* as a marker for strain. *Skolithos* can be found in the Antietam (Erwin) Formation. *Skolithos* trace fossils were created by a surface-feeding, worm-like organism. *Skolithos* dug vertical cylindrical burrows into the sand below, leaving behind cylindrical burrows in lithified sandstone. Strain refers to the action of bedrock being squeezed from all directions, resulting in deformation of the bedrock. Strain occurs due to an orogeny, otherwise known as a mountain-building event. In the Blue Ridge, strain was caused by the Alleghenian Orogeny, which formed the Appalachian mountains. Because *Skolithos* were present in the Blue Ridge location when the Alleghenian orogeny took place, the deformation of *Skolithos* can be used to measure strain within surrounding sandstone. By measuring the long and short axes of the *Skolithos* trace fossils, an average axial ratio can be determined for a location. The more strain present at the location, the larger the resulting average axial ratio will be. *Skolithos* fossils were measured at three different locations across the western Blue Ridge: Sherando Lake, located to the south of Shenandoah National Park, Turk Mountain, and RipRap Trail, both of which are located in the Park. The long and short axes of *Skolithos* fossils were measured and recorded using calipers. An axial ratio was then found by dividing the long axis by the short axis. For each of the three sites where data was collected, all axial ratios were added together and divided by the amount of fossils measured at the corresponding location to find an average axial ratio. The results showed RipRap

Trail having the most deformed axial ratio, and Sherando Lake having the least deformed axial ratio. RipRap Trail had the highest average axial ratio, at 1.79; Turk Mountain had an average axial ratio of 1.54, and Sherando Lake had an average axial ratio of 1.26. This suggests that Sherando Lake *Skolithos* experienced the least amount of strain out of the three locations, while *Skolithos* in RipRap Trail experienced the most amount of deformation. The conclusions determined that the amount of strain the Antietam Formation has been subjected to varies depending on location. The three axial ratios determine that mountain-building deformed more bedrock within the Park. The data suggests less strain to the south of Shenandoah National Park, and more strain within the Park. These conclusions do support the original hypothesis, that strain across the Blue Ridge varies by location. These conclusions suggest there was more strain occurring within Shenandoah National Park than to the south.

Faculty Advisor: Callan Bentley

Ahlayshia Johnson – Biology 299

Biofilm Resistance to Antimicrobials

In the medical industry, bacterial antimicrobial resistance and biofilm formation on medical equipment continue to be a challenging problem. A biofilm is a cluster of microbial cells that adhere to surfaces of wet or moist environments. Biofilms can be made of single or multiple types of microorganisms that form colonies, polysaccharides, and different types of organic contaminants. Biofilm can initiate on sterile surfaces and will continue to grow by cell-to-cell communications to tell others to join (Divakar et al. 2019). Biofilms are typically harder to treat as antimicrobials cannot penetrate through the thick polysaccharide layers to kill all the bacteria. The bacteria that was used in this study, *Pseudomonas aeruginosa*, is a gram-negative, rod-shaped, aerobic, opportunistic pathogen and that is ubiquitous in nature. When look at the clinical side, the main people who are at risk of acquiring *P. aeruginosa* are those who are already in the hospital. *P. aeruginosa* are commonly grown on medical devices such as ventilators and catheters and is known to form biofilms. Being exposed to this pathogen can cause infections in the bloodstream, pneumonia, and urinary tract infections. Infections in surgical wounds and burns victims can be fatal (Gonzalez, M, et al 2016). For this experiment, *P. aeruginosa* biofilms will be tested for and its resistance to antimicrobials. The antimicrobials tested were Penicillin G, apple cider vinegar, and hydrogen peroxide. Biofilms were grown on plastic coverslips for 24h and submerged in each antimicrobial for 30 minutes after growth. Biofilms were stained with crystal violet and destained with an acid/alcohol solution which was then measured by optical density at 580nm. The cell density was also measured, and the ratio of OD 580/600 was calculated. The results show that penicillin and apple cider vinegar had the lowest OD580/600 measurement, indicating they were the most effective at degrading the biofilm. The hydrogen peroxide showed similar results to the control, indicating the biofilm remained intact. Overall, the data did not show a statistically significant difference between the antimicrobials and the control, showing how challenging it is to eradicate *P. aeruginosa* biofilms.

Faculty Advisor: Melinda Clark

Darrius Michie – Biology 299

*The Effects of Fluoride on Sprouting and Growth production on Wisconsin Fast Plants (*Brassica rapa*)*

A mineral that occurs naturally and is released from rocks into the air, soil, taken up by plants, and into our water supply known as Fluoride, can have negative effects on the environment. There are many species of plants that scientists have tested that can absorb more than a normal amount of metals without getting harmed, and some species of plants that can't handle as many levels of concentration of toxic chemicals. With Charlottesville water quality, the fluoride concentration is 0.75 ppm which is the right amount to not kill the plants when watering. This experiment analyzed the effects between a higher concentration level of Fluoride in tap water and regular tap water on Wisconsin Fast Plants (*Brassica rapa*). In the measurements of planting, the first six days, there were no significant effects on the plants that were taking 3 ppm of Fluoride and the control with regular tap water ($X^2=2.6$, $df=1$, $p=0.104$), and were sprouting and had normal growth rate. The fourteenth day, there started to be a significant difference between the plants with fluoride and the regular tap water plants ($X^2=10.00$, $df=1$, $p=0.001$). The F-treated plants were dying, fading in color, and had completely stopped growing. In contrast to my original hypothesis, an unexpected occurrence that a higher concentration level a Fluoride does damage the plants and is a high enough level to eventually kill the plants. More studies would have to prove if that concentration of fluoride does kill them.

Faculty Advisor: Joanna Vondrasek

Jamie Page – Biology 299

Effect of Minerals Calcium and Iron on Planaria Regeneration

Planaria flatworms have the ability to reproduce asexually by means of regenerating a whole organism from a detached part. This incredible regenerative capability relies on undifferentiated cells called neoblasts, which also respond to wounds via cell proliferation and differentiation. Some similarities between planaria and vertebrates are cephalization, bilateral symmetry, and anteroposterior polarities. In addition, several genes which affect planaria regeneration share sequence homology with humans. This experiment was conducted to test the effect of common essential minerals calcium and iron on the regeneration rate of the planarian flatworm, *Dugesia dorotocephala*. Based on preliminary research which suggested iron could be toxic to planaria during regrowth, and calcium aided in wound healing of *X.laevis* frog oocysts, the hypothesis was that calcium would better aid in planaria regeneration than iron. This hypothesis was tested by exposing dissected planaria to solutions of each mineral. Cuts were made below the head, then groups of ten were placed in each respective petri dish containing solution, including one untreated spring water control, for 30 minutes. Over the following 14-day period, photos were taken, then planaria were measured for regrowth in millimeters using ImageJ software. The results revealed that calcium had a statistically significant positive effect on regeneration rate while iron had no statistical significance compared to the control. It is possible to conclude from these results that the micronutrient calcium is more essential to the regeneration process than iron.

Faculty Advisor: Melinda Clark

Ryen Pedersen – Biology 299

Efficacy of Herbicides: Bioherbicides vs RoundUp

RoundUp is a widely used, controversial herbicide known to have neurotoxic effects to humans (CostasFerreira et al., 2022). Also, there has been development of glyphosate-resistance, the main ingredient of RoundUp, making necessary research into cost-effective herbicide alternatives (Barnes, 2017). This experiment aims to address viable, safe alternative solutions to RoundUp while maintaining and providing good weed control. It was suspected that RoundUp would be more effective pre- and post-emergence than common, organic bioherbicides given the efficacy of glyphosate in weed suppression; but the alternative treatments would lead to better soybean yield (Domenghini, 2020). Contact treatment of the broad leaf *Ambrosia artemisiifolia* (common ragweed) was done with 45% clove/45% cinnamon oil solution, 20% acetic acid; diluted to 1% acetic acid solution, and RoundUp in two ways: preemergence (planted with soybean *Glycine max*) and post-emergence < 6in. Efficacy was measured by bud elimination and new bud formation (or weed regrowth post treatment). All herbicides were effective post application. However, clove/cinnamon oil was more effective at preventing new bud formation. The hypothesis was supported as RoundUp maintained the soybean yield 100% and did not require a 2nd reapplication until 12 days past the initial application, or 4 days in comparison to bioherbicides. Clove/cinnamon oil would be a good alternative however given the prevention of regrowth despite the need for reapplication at 8 days after initial treatment. RoundUp may be slightly more cost-effective, but in the long term from a health perspective and working in a garden, clove/cinnamon oil is a viable alternative. It would be beneficial to do additional trials over a longer period with differing concentrations for the bioherbicides to better measure their efficacy and effect on crop yields.

Faculty Advisor: Virginia York

Taylor Peterson – Geology 299

Dating the Edinburg Formation Using Silicified Trilobites Ostracods

To better understand the present day, the past must be examined. In geology, there are several methods for determining the timing of rock units' formation. For sedimentary rocks, the standard method for determining depositional age is to use time-limited fossils known as "index fossils." In the Edinburg Formation, a limestone + shale package from the Shenandoah Valley, correlation with neighboring units suggest it was deposited during the Ordovician period (485 to 443 million years ago). But start of the first phase of the Appalachian mountain-building, the Taconian Orogeny, was coincident with the deposition of the Edinburg Formation, and so it would be useful to get a better age on the Edinburg. In this study, I used the occurrence of silicified arthropod fossils from the Edinburg Formation to better constrain its age. Rock samples were collected from Edinburg outcrops near Strasburg and brought to the chemistry lab where they were dissolved in hydrochloric acid. The residual sediment was filtered with gravity filtration to remove the majority of the acid solution. After the filtration, the sediment was washed in deionized water in a separate beaker. To neutralize the remaining sediment and water, calcium carbonate was

added. The remaining material was then sieved, to separate the rock and clay from the arthropod fossils. The material caught in the sieves was then examined under a microscope, where fossils were removed. The fossils were examined and visually identified with an invertebrate paleontology reference text. The geologic range (span between origination and extinction; as determined by published studies of strata elsewhere) of each organism were plotted on a geologic timescale, to search for the time of overlap. This overlap was within the Upper Ordovician epoch: the Katian age, that ranged from 453 to 445 million years ago. This more precise deposition age better constrains the inception of the Taconian Orogeny and the closure of the Iapetus Ocean.

Faculty Advisor: Callan Bentley

Kosar Rashedi – Biology 299

Effects of Mint, Rosemary, and Insecticide on Cricket Activity and Survival

This experiment was to determine if rosemary and mint can replace chemical insecticide sprays by assessing cricket activity and survival rate. It was hypothesized that the crickets exposed to insect spray would die before crickets exposed to mint and rosemary plants. Additionally, cricket activity is expected to be decreased by all treatments, such that crickets exposed to mint and rosemary might be a deterrent for insects around homes, providing an alternative to insecticides. It is expected that rosemary would have a stronger effect than mint in decreasing cricket activity. After examining this experiment and performing it for two weeks and a half, data indicate that exposure to mint and rosemary plants showed similar trends with regard to crickets dying. However, rosemary plant exposure resulted in a slightly higher rate of dying compared to mint. When comparing insecticide, this significantly increases cricket rate of dying compared to all groups as expected. Interestingly crickets exposed to insecticide stayed alive longer than expected. Rosemary seemed to be the better natural option with a higher rate of death compared to mint but is not significantly different from the control group. With respect to activity, crickets exposed to insecticide were the least active. Crickets exposed to rosemary and mint had comparable activity relative to control.

Faculty Advisor Dr. Donna Hoefner

Balkees Rekik – Biology 299

Comparative Study on the Growth and Development of Brassica rapa Plants Using Tap, Boiled, and Microwaved Water

The method used to heat water can affect its chemical and physical properties, which may have consequences for plant growth. Boiling and microwaving are two commonly used methods for heating water, and they are often used interchangeably in households for making tea and other purposes. This experiment aims to investigate the effects of boiled and microwaved water on the growth of *Brassica rapa* plants. Three Styrofoam boxes were planted with standard seeds of the *Brassica rapa* and irrigated with boiled water, microwaved water that was microwaved for 6 minutes, tap water as a control. These plants' growth was monitored over the span of 6 weeks, with height as the only variable studied. Based on the observations and results, there was enough evidence to support the hypothesis that the water heating method has a significant impact on plant growth. The results showed that the plants watered with microwaved water were shorter and were

more likely to die indicating a severe negative impact on plant growth (average height = 2.76 cm). Meanwhile, the plants watered with boiled water were taller than the microwave treatment (average height = 3.5 cm) but still did not achieve optimal growth compared to those irrigated with tap water (the control) (average height = 4.22 cm). The plan was to harvest the seeds produced by the first generation and plant them to observe the growth of generation 2 to have more concrete data, but no seeds were harvested by any of the plants. A second trial was conducted, and the results were slightly different. At week 1 in the second trial, the average height of the control was shorter than the average height of the boiled, which was a reversal of the first trial's results. More research has to be done in order to find the reason behind this small change in growth.

Faculty Advisor Dr. Joanna Vondrasek

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