CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Kaden Z.T. Agha

Project Number

S2301

Project Title

Investigation of the Disparity between the Abundance of Tamalia spp. Galls on Arbutus unedo and Arctostaphylos spp.

Abstract

Objectives/Goals

The purpose of this project was to investigate the disparity between abundance of Tamalia spp. galls on non-native Arbutus unedo and native Arctostaphylos spp. and explore the implications of finding Tamalia spp. on Arbutus unedo. It is hypothesized that a significantly lower number of Tamalia spp. galls per cubic meter on non-native Old World Arbutus unedo relative to native New World Arctostaphylos spp. is related to A. unedo#s susceptibility to New World fungal diseases.

Methods/Materials

The populations consisted of shrubs where Tamalia galls were found, ten Arbutus unedo individuals and seventy-four Arctostaphylos spp. individuals, with data collected regarding the species, crown volume, number of branch divisions, number of galls on three outermost branch divisions, pathogenic status, and gall contents. These data were analyzed in R to find a pathogenic agent present on all ten Arbutus unedo individuals and that was associated with lower abundance of galls in the Arctostaphylos spp. population.

Results

Of the thirty-four pathogenic agents recorded, the presence of thrip (Heliothrips haemorrhoidalis) induced sooty mold (Capnodium) was associated with a lower abundance of galls in the Arctostaphylos spp. population and was present on all Arbutus unedo individuals. The pervasive presence of Heliothrips haemorrhoidalis and the accompanying Capnodium on the A. unedo individuals are associated with the much lower number of galls per cubic meter. Other pathogenic factors that were associated with differences in gall abundance were found in the Arctostaphylos spp. population.

Conclusions/Discussion

Based on the survey results, the hypothesis was accepted. Non-native Arbutus unedo individuals appear to be more susceptible to a fungal disease spread by a New World vector than their native Arctostaphylos spp. counterparts. The presence of Tamalia on Arbutus unedo is significant, as previous literature restricts its host plants to only New World Arbutoideae, which this discovery directly contradicts. All factors associated with gall abundance that were found in the experiment are new to science.

Summary Statement

I found aphids on a plant they are not supposed to be on, found a factor that was associated with why they were much less abundant on that plant, and discuss the implications of finding aphids on that plant.

Help Received

I designed, executed, and discussed the project myself. Dr. Pam Durkee (mentor), Lisa Agha, Carrie Bretz, Kim Kiest, Scott Johnson, and Dr. Jeff Hanna helped proofread and refine my work.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Daniel S. Bruce

Project Number

S2302

Project Title

The Effects of Predation Risk on Interspecies Flight Initiation Distances

Abstract

Objectives/Goals

Birds in California salt marshes have become acclimatized to human presence and its effects remain unexamined. The objective of this study is to determine whether differences in the flight initiation distances, a measure of bird escape behavior, of salt marsh sparrows in response to human approach is correlated with predator frequency and predator species diversity.

Methods/Materials

The study observed song sparrows, white-crowned sparrows, and savannah sparrows in 3 southern California marshes: Tijuana Estuarine, Penasquitos Lagoon and San Elijo Lagoon. Flight initiation distance (FID) measurements for the 3 sparrow species were recorded using a laser range finder during 6 observation periods of 4 hours each and compared to both the average number of raptors per 30 minutes seen at each lagoon and the number of raptor species seen at each lagoon during each observation period.

Results

Penasquitos Lagoon had the most predator sightings and diversity, while no predators were observed at San Elijo Lagoon. No association was found between overall sparrow FID and predator frequency or species diversity, but a significant difference between the FID of savannah sparrow and song sparrow/white-crowned sparrow was observed. FID measurements were roughly the same for all 3 species at San Elijo Lagoon, where no predators were observed, but savannah sparrow FID were statistically greater than FID of the other sparrows at the other 2 lagoons with elevated predator presence.

Conclusions/Discussion

These findings suggest that predation unevenly affected sparrow species behavior depending on species, which may be the result of differences in local habitat preferences. Savannah sparrow reside in more exposed sections of salt marshes whereas song sparrows and white-crowned sparrows cohabit areas of denser vegetation further from the inundated marsh zones. Proximity to urban areas/humans may serve as defense mechanism against predation for these sparrow species. The correlation between sparrow response to human approach and predator frequency suggests that alterations of bird behavior to one species can alter bird behavior to other animal species/environmental conditions. Further research should be conducted on whether proximity to urban areas and/or humans is a viable defense mechanism for passerine bird species as well as other potential effects of acclimatization to human presence by birds.

Summary Statement

This study investigates wether differences in flight initiation distance (measure of bird escape behavior) of California's salt marsh sparrows to human presence is correlated with predator frequency and predator diversity in the Lagoons.

Help Received

None. I designed and performed all the experiments and field visits myself.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Brianne R. Conway

Project Number
S2303

Project Title
Animal Magnetism: A Study of the Effect of Magnetism on Planarian Regeneration Rate

Abstract

Objectives/Goals
This project was designed to determine if magnetism has an effect on the rate/speed of regeneration of planarians, and whether or not magnetism does have an effect on the regeneration rate of planarians, this project could possibly reflect the effects magnetism might have on human healing speeds. It was hypothesized that magnetism would speed up regeneration rate, and the stronger the magnets, the faster the worms would regenerate.

Methods/Materials
Two trials were conducted, and in trial 1 three different magnet strengths were used, while in trial 2 five different magnet strengths were used. In both trials, planarians were divided into separate groups, bisected, different groups exposed to different magnet strengths, and regeneration for all worms was measured daily. In trial 1, worms were separated into four groups with one of them being exposed to no magnets, and in trial 2, worms were separated into six groups with one group exposed to no magnets. All materials were either common household objects or obtained from a commercial source.

Results
For both trials, worms exposed to magnets regenerated faster than worms exposed to no magnets, and the stronger the magnets the worms were exposed to, the faster the worms regenerated. It was determined that magnetism speeds up the regeneration rate of planarians, and the stronger the magnets, the faster the worms will regenerate.

Conclusions/Discussion
Overall, the data supported the hypothesis. These results could possibly reflect the effect of magnetism on human healing speeds. According to these results, it could perhaps be possible that magnetism can speed up healing times for humans. This project raises the question of how magnetism speeds up the regeneration rate of planarians, and if that same concept can be applied to human wound healing.

Summary Statement
This project was designed to determine if magnetism has an effect on the regeneration rate of planarian worms.

Help Received

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Vianey Ellison; Josh Williams

Project Number

S2305

Project Title

The Impact of Increasing and Decreasing Food Sources on Hummingbird Behavior

Abstract

Objectives/Goals

The goal of our project was to study the behavior of hummingbirds at artificial feeding sources.

Methods/Materials

We setup hummingbird feeders in the first phase of the study starting from 1 to 3 and then in the second phase of the study from 8 to 1 feeders and recorded the number of successful and attacked visits to a feeder area using forty-five minute viewing periods.

Results

We found that the higher the number of feeders, the greater the number of humming birds visited both sites and that birds were still very attached to the food source and defended it while there was plenty of nectar for all.

Conclusions/Discussion

We concluded that the higher number of feeders did not prevent the hummingbirds to attack each other#s and increased source of food attracted a higher number of hummingbirds than with a smaller number of feeders.

Summary Statement

In adding and subtracting food sources from the area, we determined that number of artificial food sources was a significant factor in hummingbird behavior.

Help Received

Worked with guidance from Dr. Murielle Veniant as our mentor.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Austin R. Gaines

Project Number
S2306

Project Title
The Miracle Herb Curcumin

Abstract

Objectives/Goals
The objective of this study is to determine if the Tumeric root extract, Curcumin, can be used as an anti-oxidant and anti-inflammatory helming agent.

Methods/Materials
Microscope, Curcumin, Daphnia magna, hydrogen peroxide, sodium chloride, distilled water. The Daphnia were placed into the two different oxidizing agents, hydrogen peroxide and sodium chloride. The daphnias' heart rates were then taken under a microscope at 100x. Immediately following this the Daphnia were given a constant solution of Curcumin to act as an anti-oxidant and anti-inflammatory. The Daphnia were then again tested under the microscope to determine the effectiveness of the Curcumin.

Results
The Daphnia's heart rate dropped significantly and consistently in each possible solution when give the solution of Curcumin. The heart rate also remained constant with the control of distilled rather during the 8 minute tests. This identifies Curcumin as an anti-oxidative and anti-inflammatory healing agent.

Conclusions/Discussion
Curcumin is an anti-oxidant and anti-inflammatory healing agent and should be researched further as a potential product to use in the medical field. The project data showed that Curcumin effectively lowered heart rates of Daphnia magna indicating it may be a valuable product for humans as well.

Summary Statement
Curcumin can be used as an anti-inflammatory and anti-oxidant healing agent.

Help Received
I spoke with a naturopathic doctor about the product and its many uses.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Nosheen F. Hossain

Project Number
S2307

Project Title
The Effect of X-ray Radiation on Developmental Neurogenesis in the Species Manduca sexta

Abstract

Objectives/Goals
The objective of this project was to determine if radiation emitted by an X-ray machine had the capability to decrease the natural process of neurogenesis (growth and development of nervous tissue) in Manduca sexta.

Methods/Materials
Eight Manducas in the instar 5 larval stage were split into a control group and an X-ray group. Manducas from the X-ray group were irradiated using an X-ray machine. On day 1, two Manducas from each group were injected with bromodeoxyuridine (BrdU). After allowing them to sit in room temperature for two hours and then anesthetizing them for 20 minutes, the brains were dissected out and placed in microcentrifuge tubes filled with Carnoy's fixative solution. The processes were repeated with the four remaining Manducas on day 3. Finally, all brains were viewed under a microscope with 20x magnification.

Results
Qualitative analysis of BrdU staining on each brain indicated that there was a lower amount of staining on Manducas in the X-ray group compared to the control group for both days. The BrdU is a marker that stains newly proliferated cells from the time of injection. This signifies that radiation resulted in decreased cell growth in the brain.

Conclusions/Discussion
The results affirmed my hypothesis that radiation inhibits neurogenesis in Manduca. During a Manduca's larvae phase, neurogenesis rapidly occurs in preparation for its pupae stage. This was observed in the control group. However, in the X-ray group, this normal pattern of growth was not detected. The findings satisfy my objective of determining radiation's effects on developmental neurogenesis. It also contributes knowledge to the field of zoology about radiation's effect on arthropodal development.

Summary Statement
By using a staining method to identify newly generated neural cells, I found that X-ray radiation inhibits cell proliferation in the species Manduca sexta.

Help Received
I conducted my research at professor Megumi Fuse's lab in San Francisco State University. I received help from a graduate student, who mentored me in conducting the experiment and aided me in putting together a procedure.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Atticus J. Humphrey

Project Number

S2308

Project Title

Bromelain Feed Supplement: Effects on Feed Conversion Rates in Poultry

Abstract

Objectives/Goals

The purpose of this project was to analyze if bromelain, which is an enzyme, has the ability to improve the feed conversion rates in Buff Orpington chickens.

Methods/Materials

The feed modification consisted of 0g bromelain for a control, a .5g concentration bromelain, and a 1.0g concentration of bromelain to feed modification. The test chickens were weighed once a week from the beginning of the study to the end of the study to track the chicken health and growth. Composite manure samples were tested for NO3, P2O5, and K2O every 2 weeks using a standard OSA1 lab analysis. The study itself lasted a total of 5 weeks.

Results

FCR results were: The control hens weighed 1228g, .5g bromelain had 1364g, and 1g bromelain had1304g of total weight at the end of week 3 of the study.

The pollution reduction results were: The control had 30.9lbs/ton of NO3, 28.6lbs/ton of P2O5, and 19.6lbs/ton of K2O. The .5g bromelain had 28.4lbs/ton of NO3, 24.3lbs/ton of P2O5, and 17.7lbs/ton K2O. The 1.0g bromelain had 33.7lbs/ton of NO3, 24.5lbs/ton of P2O5, and 17.5lbs/ton of K2O.

Conclusions/Discussion

After performing the study, the results showed that bromelain was both able to increase the chicken weight and reduce NO3, P2O5, and K2O. The .5g of bromelain showed the greatest observable weight gain overall. The .5g of bromelain also had the greatest reduction of the NO3 and the P2O5, while the 1.0g of bromelain was able to reduce K2O.

These results indicate that bromelain is a viable feed supplement when used to improve the FCR in chickens and also can reduce pollutants in the manure. By breaking down the proteins prior to digestion, the bromelain enabled the chicken to absorb more of the nutrients from the feed and waste less energy on digesting the feed itself. This consequently improved both the FCR of the chicken and decreased the pollution found in the manure.

Summary Statement

Need for food is increasing & clean water supplies decreasing, improving FCR in livestock by a feed modification such as bromelain is 1tool farmers can use to increase animal efficiency and minimize pollution produced by farming operations.

Help Received

Mr. Aalto helped me to analyze my data and Mr. Fridlund gave me lab acess.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Vivek V. Kamarshi

Project Number
S2309

Project Title
Effects of Gut Microbiota on Drosophila Models of Parkinson's Disease

Abstract

Objectives/Goals
Parkinson#s Disease (PD) is a locomotor disease characterized by toxic aggregation of the protein a-syn in neurons. Recent research: mice with a PD-causing mutation failed to exhibit symptoms of the disease when digestive-tract microbes were removed. Familial PD research is often performed in Drosophila melanogaster fruit flies, which share many PD genes with humans. To see if the fly model concurs with results from mice, I investigated locomotor activity in these flies both with and without their gut microbiota, then used this to understand the pathways underlying the disease.

Methods/Materials
Flies w/ PD mutations parkin and LRRK2 obtained from Bloomington Drosophila Stock Center with wild-type controls. Fly eggs collected and soaked in bleach solution, then added to sterile food, creating flies without gut microbiota. Flies were sorted by sex and then placed in a cylindrical vial to determine percentage that climbed up more than 8 cm, in 10 seconds. Low climbing ability indicates PD-related neurodegeneration.

Results
Nineteen percent of microbe-free, LRRK2-mutant Drosophila climbed over 8 cm, compared to only 4.6% of mutant flies with normal gut microbiota ($P < 0.0001$). However, within parkin mutants, 13% of microbe-free flies climbed over 8 cm, compared to 18% of flies with normal gut microbiota ($P=0.0245$). Data from female flies; males followed this pattern.

Conclusions/Discussion
LRRK2-mutant flies followed the pattern found in the mice study, with gut microbiota causing the locomotor activity to increase (a drop in PD symptoms) - on the other hand, this is the opposite in parkin-mutant flies. Loss of either LRRK2 and parkin causes a-syn aggregation (and thus loss of locomotion) as both are needed to lyse a-syn. However, parkin also is necessary to keep up mitochondrial health, causing debate over which way it more strongly impacts locomotor activity. Due to LRRK2 results, my experiment proves agreement between fly and mice models; however, we can also see that the mitochondrial activity of parkin is more crucial to its impact on locomotor activity than its breaking of a-syn, because parkin-mutant flies with no microbiota still had lower levels of locomotion.

Summary Statement
I showed that appearance of Parkinson#s Disease symptoms in fruit flies is dependent on presence of gut microbes and examined the effects of this on different Parkinson's mutations.

Help Received
I want to thank my mentor Renee Fallon (teacher at Monta Vista) for her support throughout my project and Dr. David Schneider and Michelle Lissner (Stanford) for providing me with mutant flies and equipment. Thanks also to Dr. Will Ludington (UC Berkeley) and Dr. Fumika Hamada (CCHMC) for

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Neilabjo Maitra

Project Number
S2310

Project Title
Vasodilation in Drosophila melanogaster with the Application of Various Compounds

Abstract

Objectives/Goals
A prevalent problem globally, heart disease is often caused by the constriction of blood vessels, reversible using vasodilators. One class of these vasodilators, nitrate containing compounds, were tested upon cellular, embryonic, and larval fruit flies in order to test the effectiveness of a novel nitrate ester as a vasodilator.

Methods/Materials
Wild type and Cha GFP strains of fruit flies had to be maintained in food bottles. Using an assortment of salts and sugars, artificial hemolymph was created, wild-type larvae super-glued to a glass slide, the compound in question dissolved in the artificial hemolymph applied, and the heartbeats counted. GFP eggs were collected in bottles with grape-agar plates, and analyzed under a fluorescent cell imager from Biorad with the same solutions applied. Also, the myocytes are to be isolated from the eggs, and the compounds directly applied to them.

Results
The application of the nitrate ester to the larval flies statistically significantly lowered the heart rate compared to other compounds tested. The luminosities measured by the imager had no significant statistical difference comparing the eggs which had only hemolymph applied to those with the nitrate ester.

Conclusions/Discussion
The nitrate ester, along with the isosorbide dinitrate, worked to significantly lower heart rate in the larvae, indicating vasodilation - the relaxation of myocytes allows more hemolymph to circulate with less work from the heart. These decreases are likely not due to toxic effects, seeing that the luminosities measured in the GFP eggs, regardless of compound applied, remains about constant, indicating that other factors, likely vasodilation, causes the decrease.

Summary Statement
The vasodilating effects of a novel nitrate ester were tested upon larval fruit flies and their eggs.

Help Received
Dr. Joy Goto provided me with the lab space and facilities to work on my research, giving me advice with the handling of the flies and helping me with the tissue culture. The nitrate ester was obtained from a collaborating group.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Faith M. McNeely

Project Number
S2311

Project Title
Are Fish Safe to Eat? Part 2

Abstract

Objectives/Goals
This science project aims to determine the presence of external and internal parasites on randomly selected fish samples from San Diego and San Pedro Fish markets and identifying any human health risk upon consumption.

Methods/Materials
Twenty (20) randomly selected fish samples from San Diego and San Pedro fish markets, were utilized in this study. There were 2 samples for each fish species -- Porgy (Perciformes sp.), Lane Snapper (L. synagris), Robalo (C. undecemalis), Pacific Mackerel (S. sierra), Golden Pompano (T. carolinus), Rabbit Fish (Sigarus sp.), Thread Herring (O. oglinum), Bigeye Scad (S. crumenophthalmus), Tilapia (Oreochromis sp.), Mackerel Pike (C. saira). Fish samples were carefully dissected and examined following the ICAUC (Institutional Animal Care and Use Committee) guidelines.

Results
Out of twenty (20) fish samples only one (1) or five percent (5 %) of the samples tested positive for an internal parasite. All twenty (20) fish samples examined were free from any external parasite upon gross and microscopic examination. There were 48 cyst like structures isolated from the musculature of the #Porgy A# fish sample. The isolated parasite was submitted to Fish parasitologists at Oregon State University and Cornell University for positive identification. Both fish parasitologists concluded that the cyst structures found in the muscle of one of the fish samples contained spores of the myxozoan parasite from the genus Kudoa. DNA work is ongoing to further identify the species

Conclusions/Discussion
I therefore conclude that seafood parasites are a natural component of the environment and may be viewed as an indicator of the relative health of an ecosystem. The majority of species of parasites present on and within fish are not hazardous to human health however, measures can be taken to mitigate the risks of infection. These steps involve either physically removing (completely or in part) or negating the infectivity of the parasites present. Such measures may be applied during harvesting, processing or post-processing treatment. Based on the result of the experiment one out of twenty fish samples, was positive with parasite but does not pose a health risk to humans. This project research will be continued next year on the species identification of the Myxozoan parasite, Kudoa.

Summary Statement
Based on the results of the examination of the fish samples it is safe to conclude that some fish parasites pose a health risk to humans if not properly cooked and some fish parasites does not pose a health risk to humans.

Help Received
Senior Fish Health Specialist Craig Banner, Dr. Stephen Atkinson, Associate Lab Researcher at Oregon State University, and Dr. Mani Lejeune -Cornell University

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Emily T. Nguyen

Project Number
S2312

Project Title
Effects of Dietary Supplements on Pesticide-Induced Neurodegeneration Using Taguchi Method in Dugesia tigrina

Abstract

Objectives/Goals
This experiment used malathion and carbaryl, known neurotoxicants, at a sub-lethal concentration (0.05 mg/L, approximately 1/100 of LC50) to induce neurodegeneration in Dugesia tigrina to investigate the effects of G. biloba and H. erinaceus on neuronal activity with the application of Taguchi orthogonal design array L-8 (2^7).

Methods/Materials
Behavioral assays were used to assess whether proper neuronal functions are maintained after toxicant exposure and after treatment with G. biloba and H. erinaceus. Neurobehavioral changes were observed before and after exposure to malathion and carbaryl with and without treatment. Phototaxis assays were conducted before and after treatments. Cognitive tests, phototaxis and chemotaxis assays, were performed at 500 and 1000 lux. The next set of experiments sought to determine the optimum concentrations and the significant contributing factors of each dietary supplement for cognitive enhancement. Three additional dietary supplements were added: P. quinquefolius, G. lucidum, and C. militaris. They were chosen based on documented effectiveness and the dosages were reformulated based on the amounts recommended for humans. The Taguchi method was employed in the cognitive test at 500 lux using Qualitek-4 software.

Results
The hypothesis stating that G. biloba and H. erinaceus will show significant neuroregenerative effects in planarians was supported by the neurobehavioral changes and phototaxis assays; however, it was not supported by the cognitive tests. The Taguchi method indicated that H. erinaceus (1), G. biloba (2), P. quinquefolius (1), G. lucidum (2), and C. militaris (1) are the optimum concentrations for the cognitive test at 500 Lux. The statistically significant contributing factors which show promising cognitive enhancing properties were P. quinquefolius, H. erinaceus, and C. militaris, but not G. biloba and G. lucidum.

Conclusions/Discussion
The treatment results showed a positive in behavior changes and Taguchi cognitive tests. This study suggests that H. erinaceus, G. biloba, and P. quinquefolius may be used in the treatment of dementia, Alzheimer#s, and other neurodegenerative diseases in human.

Summary Statement
Using specified dietary supplements to treat pesticide-induced neurodegeneration was found to have positive effects on behavior changes in Dugesia tigrina.

Help Received
Thanks to my parents and Mr. Negus and Ms. Pachon, my Science teachers, for their support. Used lab equipment at home.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Atharva Patil

Project Number
S2313

Project Title
The Effect of Down Syndrome Cell-Adhesion-Molecule Overexpression on the Visual System and Neuronal Circuitry of Xenopus

Abstract

Objectives/Goals
Recently, the novel gene DSCAM (Down Syndrome Cell Adhesion Molecule) has been identified in the DS-critical region, which is a region on chromosome 21 thought to harbor genes responsible for some of the features of Down syndrome. However, It is not well understood in vertebral studies whether or not DSCAM specifically is actually involved in the production of the Down Syndrome phenotype. Therefore, I designed a novel behavioral assay to study the effects of DSCAM overexpression on visual avoidance behavior and neuronal branching in vertebrates, variables that are commonly abnormal in organisms with Down Syndrome.

Methods/Materials
I used electroporation and transfection to mediate the transfer of DSCAM morpholinos (which downregulate production). I then tested the visual capacitance of the tadpoles in 24 hours intervals, using my unique behavioral assay. A separate set of tadpoles was imaged following injection, and the neuronal branching was analyzed in 24 hours intervals to see if there was any change in normal dendritic development.

Results
I discovered that during early development, DSCAM overexpression leads to a 60% decrease in visual performance. More importantly, imaging reveals how overexpression leads to a 59% increase in dendritic branching during arborization, despite its role as a self-avoidance promoter.

Conclusions/Discussion
I conclude that the DSCAM gene is in fact correlated with the Down Syndrome disease, as manifested through the degraded visual performance and abnormal branching.

Summary Statement
To test the effect of DSCAM gene on the visual system in an attempt to determine correlation with Down Syndrome, I measured the effect of overexpresssion on visual behavior as well as neuronal circuit development in tadpoles.

Help Received
I received great help from Professor Cohen-Cory at UCI in assisting me during tadpole injections and operating microscopy. The procedures and analysis are all my own.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Andee L. Poole

Project Number
S2314

Project Title
Identifying and Investigating the Effects of a Biological Agent in Alfalfa on Darkling Beetles

Abstract

Objectives/Goals
The objective of this study is to determine a biological agent within alfalfa that potentially attracts Darkling beetles, which are in the same family as Blister beetles. Due to their lethal toxin, the blister beetles cause serious concerns in the Midwest and Southern regions of the United States where they live. By determining if there is a factor within the alfalfa that attracts the beetles, that factor could be eliminated.

Methods/Materials
10 Darkling beetles, choice chamber, filter paper, samples of alfalfa at various stages in development and harvest. Place the desired sample of alfalfa on one side of the chamber, and leave the other side as an empty control. Place five beetles in each side of the chamber, and count the number of beetles in each side every minute, thus testing beetle preference to the various samples of alfalfa.

Results
The data collected for beetle preference was analyzed through the use of a Chi squared test. The test was calculated between beetle preference for the control chamber and beetle preference for the particular alfalfa sample. Then those numbers were compared to critical values for a 95% confidence interval and to each other, and it was determined that beetles prefer dry mature leaves and stems over fresh immature leaves and stems and dry immature shoots.

Conclusions/Discussion
Darkling beetle attraction to dry mature leaves and stems indicates that there is a change that occurs in the alfalfa plants as they grow and mature until they are old enough to be harvested. As alfalfa plants mature, the amounts of lignin within those plants increases because it is an organic compound that provides structural support for the plant. The amount of pectin, another organic compound, is also abnormally high in alfalfa plants when compared to other forages. This being said, it is likely that beetle attraction is due to the amounts of lignin and pectin within the alfalfa plants.

Summary Statement
I tested the preference of Darkling beetles to alfalfa plants at various stages of development to determine if there is a biological agent in the plants that attracts those beetles.

Help Received
My AP biology teacher helped to design the experiment and read my papers.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Rujuta S. Sathe

Project Number

S2315

Project Title

Using PQQ Mitochondrial Biogenesis as a Therapeutic Approach towards the Treatment for Neurodegenerative Disease (ALS)

Abstract

Objectives/Goals

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease caused by the reactive oxygen species released by neurons mitochondria when they are damaged by a high Ca2+ influx. This high influx leads to glutamate aggregation in the neurons which contributes to motor neuron death and muscular paralysis. Today, there is no effective treatment for ALS and current therapies simply reduce symptoms and slow disease progression. My approach towards treating ALS involves using PQQ mitochondrial biogenesis to generate new mitochondria which the neurons can use to repair any damage done to the cell and to prevent further degeneration.

Methods/Materials

My experimentation involved infecting C.elegans with Sodium Selenite in order to model ALS. I created 15.5, 30, and 45 microMolar solutions of PQQ chemical and each dosage was then pipetted onto separate Petri dishes containing C.elegans induced with the ALS disease. Data was recorded over a period of 5 days of treatment using DinoLite microscope and WormLab software.

Results

The ALS induced C.elegan locomotion was analyzed after treatment with PQQ in order to determine effectiveness of PQQ treatment on ALS. Center points, Speed, Reversals, and Omega Bends were measured. As concentration of PQQ increased from 15.5 to 45 microMolar, speed increased to 135 um/sec, which was close to the 142 um/sec speed of healthy C.elegans. Reversals decreased successively from 26 to 5 reversals, Omega Bends increased from 0 to 5 omega bends, and Center Point scattering increased from 25 to 85 units along x-axis. The increase in Speed, Center Points, Omega Bends and the decrease in Reversals indicates improvement in mobility and reversed paralysis.

Conclusions/Discussion

The experimental results support my hypothesis as the C.elegans induced with the ALS disease, when treated with PQQ, had an improvement in locomotion and decreased paralysis. Treatment with the most effective concentration of 45 microMolar PQQ , led to a percent recovery of 89.6 which proves that PQQ treatment is successful at reversing the effects induced by ALS, unlike current treatment options which just slow disease progression. Overall, this research shows that mitochondrial biogenesis is a feasible and effective treatment option for ALS and that future therapies should target the same signal transduction pathway as PQQ in order to activate mitochondrial biogenesis in degenerated neurons of an ALS patient.

Summary Statement

This project has demonstrated the effectiveness of PQQ mitochondrial biogenesis as a treatment for ALS.

Help Received

My mentor, Mrs.Fallon, provided laboratory space, equipment, and guidance. I independently conducted research, formulated a novel approach, and gathered and analyzed the data.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Rory C. Simpson

Project Number
S2316

Project Title
Planarian Vision: Investigating Negative Phototaxis in Planaria Undergoing Regeneration to Analyze Sensory Functionality

Abstract

Objectives/Goals
The visual system of a planarian is relatively rudimentary, allowing for them to perceive incoming light and move away accordingly in a response known as negative phototaxis. The project was intending to describe the nature of planarian sensory regeneration through the redevelopment of the negative phototaxis in the flatworms.

Methods/Materials
Groups of 3 planaria of the species Dugesia dorotocephala were dissected transversely at either the medial, anterior, or posterior regions. Placed tail regions in a rectangular container divided lengthwise into 4 equal quadrants with a constant light source and the time they spent in each quadrant was measured during a period of 3 minutes. Assay repeated regularly until the planaria had redeveloped their sense of photoreception at about nine days. Examined planaria under a microscope for evidence of visual morphology and stages of redevelopment.

Results
After the first few days of blastema formation and limited movement, the earliest evidence of pigment cells of the planarian eyespots and negative phototaxis were found in the planaria severed at the midsection by the fourth day. The seventh day saw a considerable increase in the sensitivity of the response as the planaria rapidly moved towards darker regions of the container. The planaria cut at the posterior took longer for phototaxis to become apparent despite similar rates of physical anatomical development with the other sections. A majority had redeveloped full sensory perception and phototaxis by the ninth day and had distinctive eyespots indicative of fully regenerated planaria.

Conclusions/Discussion
The study reveals how the presence of visual structures such as pigment cups and photoreceptors in the planaria does not result in the return of phototaxis, but rather indicates the early stages in its redevelopment. There was a distinctive decrease in phototaxis amongst the flatworms which were initially cut at the posterior even though the locations of cuts on separate planaria did not impact the rates of regeneration. The delay of the response may be due to the continued development of axonal connections to the cerebral ganglia, though the optic chiasma had already formed. The response appears to not be entirely mediated by the visual system, but by higher integrative functions which return during brain redevelopment.

Summary Statement
Through the investigation of planaria during regeneration, the project demonstrates that the functional recovery of behavioral responses to light does not directly coincide with the initial physical development of visual morphology.

Help Received
Dr. Shauna Bennett assisted in the general care of the planaria and gave guidance in developing a viable experiment. All of the research done for the study was conducted at TheLab, a public biology facility. My mom helped in driving and gathering necessary materials.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Melissa K. Vinluan

Project Number
S2317

Project Title
The Illustration of Mutualistic Relations in Marine Biology: The Continuation

Abstract

Objectives/Goals
The objective of this experiment is to attempt to cultivate a symbiotic relationship between goldfish and an elodea plant, and observe which kind it is. Determine how such symbiosis can be utilized to impact and help improve society.

Methods/Materials
Four one gallon fish bowls, nine comet goldfish, four elodea plants, fish flakes, a ruler, a weighing scale, colored gravel, water conditioner, and water. I used the weighing scale and ruler to measure the growth of the elodea plants.

Results
The growth percentage of bowl D's elodea was 16.96% higher than bowl A's elodea growth percentage. As the number of fish progressively rose, the growth the elodea also grew efficaciously. While Bowl D's elodea was longer than Bowl C's, bowl C's was dramatically longer than Bowl B's, while B's was longer than A's

Conclusions/Discussion
The 70 day experiment illustrated that there is in fact a presence of a symbiotic relationship between elodea plants and comet goldfish. The relationship was determined to be mutualistic, as the goldfish provide the plant with a fertilizer of nitrites and nitrates in its feces and the plant provides the fish with food and oxygenated water. Such a mutualistic relationship can be utilized in aquaculture and aquoponics to help increase the production of agriculture.

Summary Statement
As illustrated in the 70 day experimentation, I discovered a mutualistic symbiotic relationship in a fishbowl between elodea plants and comet goldfish, and proved how such a relationship could help increase agricultural production.

Help Received
My parents helped purchase the vertebrates and other materials, and my AP Biology teacher provided a scale. Other than that, I worked alone.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Insun Won

Project Number

S2318

Project Title

Effect of Varying Food Concentrations on Purple Urchin (Strongylocentrotus purpuratus) Larvae Development

Abstract

Objectives/Goals

This project was designed to determine the effects of varying concentrations of phytoplankton on the larval arm to body ratio of Strongylocentrotus purpuratus, which is essential for the urchin to stay upright in the water column. It was hypothesized that a smaller concentration of food for the larvae would lead to a larger arm to body ratio, as noted in similar experiments in this organism.

Methods/Materials

Sea urchins were chemically induced to spawn for this experiment. On the third day post-fertilization, the blastula were thinned out into approximately equal quantities and were placed in treatment groups (food concentration of 0, 1000, 3000, 10000, 30000 cells/mL). The food given was Isochrysis galbana paste. On the 13th day, photos of five randomly selected individuals per treatment were taken. Then, using image analysis, the larval arm and body lengths were measured.

Results

Generally, there is a negative correlation between the concentration of food and the arm to body ratio of S. purpuratus larvae. Surprisingly, the arm to body ratio of the starved condition was smaller than the ratio for the condition with 1000 cells/mL. The analyzed data showed that there were significant differences between treatments, signifying that an increased quantity of food leads to a smaller ratio.

Conclusions/Discussion

The results supported my hypothesis that a larger concentration of food would lead to a smaller arm to body length ratio. Knowing the effects of the changing food quantities on the urchin larvae is important when the future of phytoplankton densities and distributions is uncertain.

Summary Statement

As found by the varying arm to body ratios in urchins, I found that urchin larvae have significantly shorter arms when fed greater quantities of food.

Help Received

I received help with spawning urchins with syringes at Cabrillo Marine Aquarium. Dr.Darrow and other aquarium staff helped supervise my project, but I designed and experimented on my own.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Alan Wu

Project Number
S2319

Project Title
Grape Skin Powder Exhibits Potential Protective Benefit in a Drosophila Parkinson's Disease Model

Abstract

Objectives/Goals
The objective of this study is to investigate the potential beneficial effect of grape skin on Parkinson#s disease by incorporating grape skin powder into the daily food intake of a Drosophila Melanogaster model of Parkinson's disease.

Methods/Materials
Grape Skin Powder
Fly strains: Wt and PINK1B9 flies were raised according to standard procedures.
Life span analysis: 2 types of flies were used: wild type (WT, W-/Y; MHC/+) and mutant PINK1 (B9/Y; MHC/+). The flies of the same type/same age were randomized to bottles of either standard food, or food plus grape skin powder. All bottles were renewed every 3 days to maintain a healthy environment, and the number of surviving flies was recorded until there were none left.
Mitochondrial morphology analysis: Flies were fed with different food for one week. Thorax was removed by dissection, and indirect fly muscle was examined using mitoGFP by live imaging.
Abnormal wing posture analysis: PINK1 fly eggs were laid in tubes with different food and the newly born flies were fed with fresh food every 2-3 days. After a week, the number of normal and abnormal wing flies were counted.
LC3 Western Blot: UAS-LC3-GFP was expressed in the muscle of flies with the indicated genetic background, and the level of autophagy was determined by Western Blot using anti-GFP antibody.

Results
Grape skin powder not only rescued abnormal wing posture in the PINK1 mutant flies, but also prolonged the lifespan of the mutant flies. I further showed that grape skin powder was able to partially rescue the abnormal mitochondrial aggregation phenotype through induction of autophagy in these mutant flies.

Conclusions/Discussion
The study suggested grape skin powder has potential neuroprotective benefit on Parkinson's disease through autophagy activation to mediate the mitochondria function.

Summary Statement
I showed that grape skin powder exhibits potential protective benefit in a Drosophila Parkinson#s Disease model through mediating mitochonrial function..

Help Received
I got help in scientific discussion and some experimental design, fluorescence microscopy, from Dr. Zhihao Wu in the Dept. of Pathology at Stanford University.

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

Ken X. Zhou

Project Number

S2320

Project Title

Metabolic Study of Ginsenoside Rb1 in Brine Shrimp (Artemia salina)

Abstract

Objectives/Goals

The metabolism of brine shrimp was studied to determine if it was a valid organism for ginsenoside study. If brine shrimp are capable of metabolizing ginsenosides, they could be a better organism for ginsenoside study than humans, mice, or zebrafish.

Methods/Materials

Ginsenoside Rb1, ginsenoside Rd, and ginsenoside Rg3 were obtained from Cayman Chemical. Brine shrimp were availiable in the school laboratory. Brine shrimp were cultured from eggs and treated with ginsenoside Rb1. After treatment, brine shrimp were centrifuged, supernatant was removed and prepared for HPLC analysis. Brine shrimp was homogenized and also prepared for analysis. HPLC was conducted using a Hewlett-Packard Series 1100 HPLC machine.

Results

Peaks for the metabolites ginsenoside Rb1 and Rg3 did not appear in the chromatogram for any of the sample concentrations.

Conclusions/Discussion

Brine shrimp may or may not be able to metabolize ginsenosides, but the ginsenoside concentration was not enough to definitively determine whether or not it was metabolized. There was no peak for ginsenoside Rd or Rg3 in the chromatogram in HPLC analysis so it is not likely that brine shrimp may metabolize ginsenosides.

Summary Statement

Ginsenoside Rb1, an active ingredient in ginseng that has many medicinal benefits, was studied in brine shrimp to see if it could be metabolized.

Help Received

Dr. Nikki Malhotra, Dr. Yun Lan, Dr. Gregory Cauchon

CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Rhitishah Yuva Raju

Project Number
S2399

Project Title
Saving the Delta by Managing the Natural Ecosystem of Marshland: Sustaining the Population of Eurytemora affinis

Abstract

Objectives/Goals
My project focuses on increasing population of zooplankton(copepods) in the San Francisco Delta to sustain native fish species in these marshes. The delta has been facing issues due to agricultural use and hydraulic mining during the gold rush. Currently, there is a new initiative to restore the marshes, however there are many unanswered factors. One of the biggest questions is: How do we feed the fish in the marshes? What do we feed the fish? And how much do we feed the fish? My project aims to find the right amount of algae or leachates (depending on the results) to feed the copepods (zooplankton). This will increase the growth of the copepods for the fish to feed on, increasing the fish population because the fish have more food to feed on. With a small population of copepods other organisms (fish) will die because they do not have enough food. Zooplankton is at the bottom of the food chain meaning that a lot of other animals and organisms feed on. Without copepods we would not be fully restoring marshes as they are a crucial part to the marsh habitat. I will be feeding the copepods leachates from the marshes and algae. Then, I will be able to compare both of my results against each other and determine what type of food to feed the zooplankton and how much.

Methods/Materials
My methods were as followed: I started with a preliminary experiment to gain background knowledge, then I did my main growth experiment (2 trials) , and finally I did my fecundity experiment (2 trials). The materials I selected were Algae, Tule, Brazilian Waterweed, and Cattail. Additionally, I used a mortar and pestle, De-ionized water, and the latest industry graphing software.

Results
The hypothesis of this experiment was not disproven. Meaning that, the algae provided and sustained the copepods the best. In regards to the mortality rate, we can observe that the presence of algae helped sustain the copepods. On the other hand, the detritus/leachates had the highest mortality rate.

Conclusions/Discussion
Keeping in mind that the algae does the best, an open water environment where the algae can thrive will be the most beneficial to the restoration of the delta and the sustainability of the copepods and their predators (fish).

Summary Statement
My project is about restoring the marshes in the delta by improving the sustainability of zooplankton (or copepods) through various food sources.

Help Received
I worked in multiple lab environments.