The Effect of Pyrethrins on Diversity of Mosquito Populations

Max Esposito, Timothy Hantzschel, Paul Pillitteri
West Islip High School

Introduction

- Means (1968), conducted a study about the types of mosquitoes in Suffolk County in the 1960s. The scientists used live organisms to attract mosquitoes. Some types of organisms used as lures were birds, small mammals, small reptiles and amphibians all native to Suffolk County (Means,1968).
- Pyrethroids were then used as a method of controlling these mosquito populations. Pyrethroids are synthetic forms of Pyrethrins (Davies et al., 2007). Pyrethrins are derived from the Chrysanthemum plant (*Chrysanthemum cinerafolis*) and are neurotoxic insecticides (Davies et al., 2007).
- Pyrethroids were first made usable in the time period from 1927 to 1940 and are very effective in killing insects and are not toxic to mammals or the soil (Davies et al., 2007). Now, synthetic pyrethroids are used widely to control the levels of harmful insects in the environment (Davies et al., 2007).
- In order to find which species of mosquito are being affected, we must barcode the collected samples. It is very difficult, if not impossible to identify a mosquito species by sight alone (Engahl et al., 2014).
- **Research Question: What is the Effect of Pyrethrins on Mosquito Diversity?**
- **Hypothesis:** It was hypothesized that if pyrethrins are introduced in a yard then there will be less amounts and less biodiversity of mosquitoes because the pyrethrins target the nervous system of and paralyze insects.

Methods

- In order to first capture our samples, two BG Sentinel 2 traps were used to lure in mosquitoes by using the CO_2 produced by dry ice.
- Traps were placed in areas where mosquitoes were commonly found in the backyards which was along fence lines near trees. The differing factor in the two yards was that one yard was treated with pyrethrins while the other was not.
- Once caught, the samples were frozen and then used in a process to harvest the DNA to be sequenced to determine what species it was.
- First the sample was ground up and put through processes in order to isolate the DNA from the rest of the sample.
- The sample then was put through Polymerase Chain Reaction (PCR) to make copies of the CO1 gene.
- After PCR it was put through Gel Electrophoresis to determine if copies of the gene were made.
- The next step would have been for the DNA with positive gel results to be sent to a sequencing company for sequencing to ultimately determine its species.

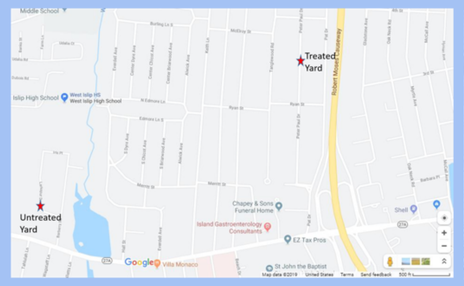

Figure 1: Sample Collection Locations in West Islip, NY, USA

Figure 2: BG Sentinel 2 mosquito trap

Figure 3: PNY-001 Full Body image

Figure 4: PNY-006 Full Body image

Results and Conclusions

- Due to the abrupt stop of school, we were not able to get all of our results through the DNA barcoding process and they were not able to be sent out for sequencing.
- One conclusion that we reached was that from observations, the amount of insects found in the untreated yard was far greater than that of the treated yard.
- It is hard to make a more meaningful conclusion without further lab-work, but this can be explored in the future.

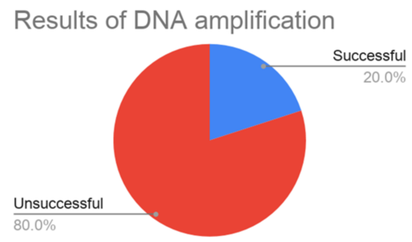

Figure 5: This graph represents the amount of samples that had the DNA successfully amplified (represented in blue).

Table: Metadata table for each sample collected and used in the experiment including DNA Extraction and PCR Results for Amplification of CO1 gene

Barcode Sample ID	Yard Type	Common Name	Collector	Time of Collection	DNA Extraction & PCR
PNY-001	Untreated	Mosquito	Paul	Night Sept. 25-26	Negative
PNY-002	Untreated	Mosquito	Paul	Night Sept. 25-26	Positive
PNY-003	Untreated	Mosquito	Paul	Night Sept 26-27	Negative
PNY-004	Untreated	Mosquito	Paul	Night Sept. 26-27	Negative
PNY-005	Untreated	Mosquito	Paul	Night Sept 27-28	Negative
PNY-006	Untreated	Mosquito	Paul	Night Sept 27-28	Negative
PNY-007	Untreated	Mosquito	Paul	Night Sept 27-28	Negative
PNY-008	Untreated	Mosquito	Paul	Night Sept 27-28	Positive
PNY-009	Untreated	Mosquito	Paul	Night Sept 27-28	Negative
PNY-010	Untreated	Mosquito	Paul	Night Sept 27-28	Positive
PNY-011	Untreated	Mosquito	Paul	Night Sept 26-27	Negative
PNY-012	Treated	Mosquito	Max	Night Sept. 25-26	Negative
PNY-013	Treated	Mosquito	Max	Night Sept. 26-27	Negative
PNY-014	Treated	Mosquito	Max	Night Oct. 1-2	Negative
PNY-015	Treated	Mosquito	Max	Night Oct 5-6	Negative
PNY-016	Treated	Mosquito	Max	Night Oct 7-8	Negative
PNY-017	Treated	Mosquito	Max	Night Oct 7-8	Negative
PNY-018	Treated	Mosquito	Max	Night Oct 7-8	Positive
PNY-019	Treated	Mosquito	Max	Night Oct 7-8	Negative
PNY-019	Treated	Mosquito	Max	Night Oct 7-8	Negative
PNY-020	Treated	Mosquito	Max	Night Sept 27-28	Negative

Future Research

In the future we would look into other insects to study, maybe some that are easier to capture as the weather turns colder, as in the fall as we ran into some issues with sample numbers decreasing with colder weather in this experiment.

References

Davies, T. G. E., Field, L. M., Usherwood, P. N. R., & Williamson, M. S. (2007). DDT, pyrethrins, pyrethroids and insect sodium channels. IUBMB life, 59(3), 151-162.

Engdahl, C., Larsson, P., Näslund, J., Bravo, M., Evander, M., Lundström, J. O., ... & Bucht, G. (2014). Identification of Swedish mosquitoes based on molecular barcoding of the COI gene and SNP analysis. Molecular Ecology Resources, 14(3), 478-488.

Means, R. G. (1968). Host preferences of mosquitoes (Diptera:Culicidae) in Suffolk County, New York. Annals of the Entomological Society of America, 61(1), 116-120.