The Translation of Insecticide Resistance in *Drosophila Hydei* from Organophosphates to Carbamates

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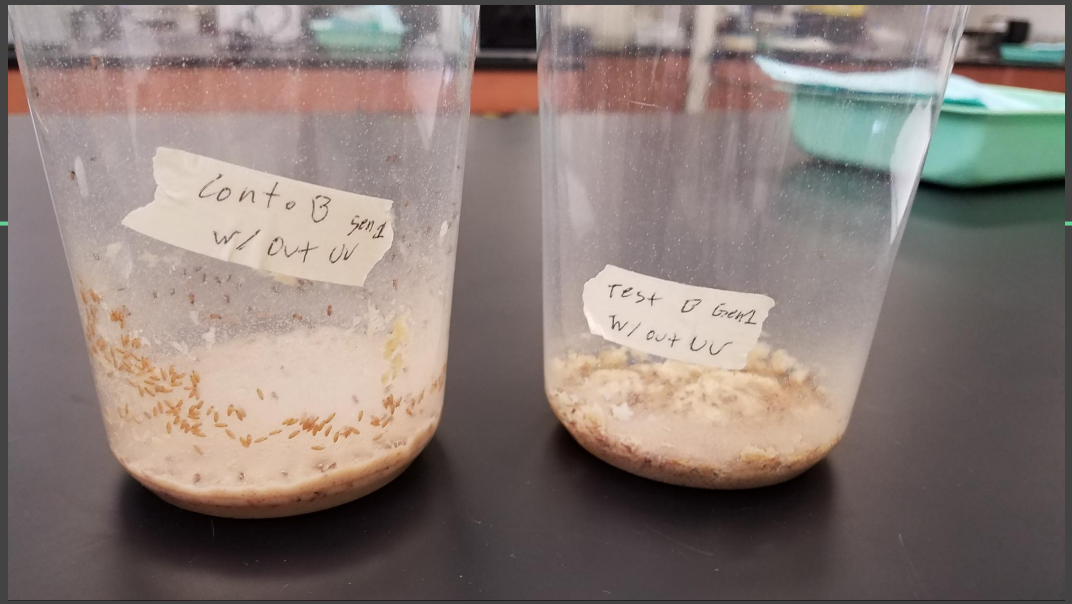


Increase in Insecticide Resistance

- There was, as of 1990, Insecticide resistance recorded in at least 504 species of insects and mites
- There was a 13% growth in resistance from 1984 to 1990
- 60 countries have reported some level of resistance to one regularly used insecticide
- 49 of those 60 have reported resistance to two or more of those insecticides

Translation of Insecticide Resistance

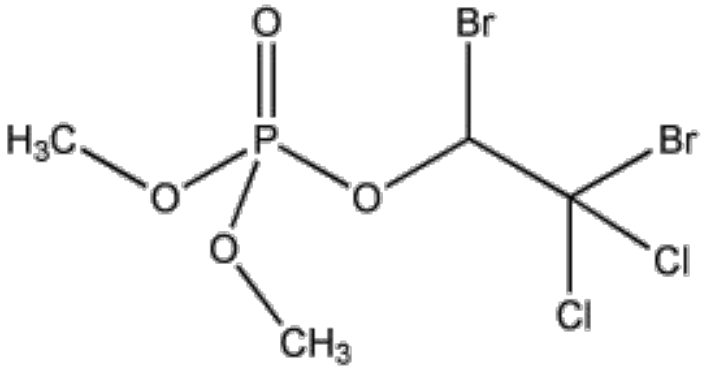
- Is the ability for a population resistant to one specific type of insecticide to gain resistant to another.
- Has been observed within insecticide classes
- Department of Entomology found that a point mutation in the gene coding for the GABAA neurotransmitter can grant Drosophila high levels of resistance to Picrotoxinin and Cyclodiene

Conditioned Resistance

- Conditioned resistance is the gradual gain of resistance in a population
- This is most common through gradual exposure, low levels of a stressor
- Generally takes longer to develop in the wild

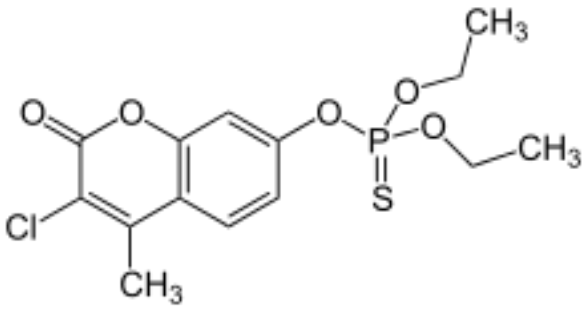
Naled/Dibrom

- Organophosphate
- Restricted use insecticide
- Used due to a fast knockdown
- Limited to no environmental persistence
- Due to its fast knockdown rate and short persistence, there is limited resistance to it.
- Acts by interfering with the activities of the enzyme cholinesterase



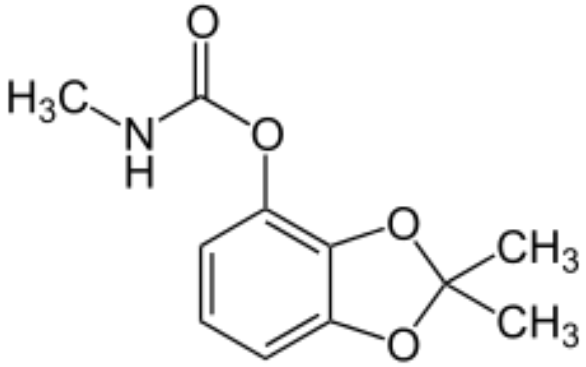
Coumaphos

- Organophosphate
- General use insecticide
- Used in a dust
- Targets mites, flies, ticks and fleas
- Highly toxic to all animals
- There is resistance
- Acts by interfering with the activities of the enzyme cholinesterase



Bendiocarb

- Carbamate
- Both restricted and General use
- Targets most insects, specifically household Pests, as well as snails and slugs
- Highly toxic to all animals
- There is resistance
- Acts by interfering with the activities of the enzyme cholinesterase



Materials

- Organophosphate Naled, now called Dibrom, Analytical Standard
- Organophosphate Coumaphos, found in 1% concentration in CoRal Livestock Dust.
- Carbamate Bendiocarb, Analytical Standard
- P200 Pipet
- P200 Pipet Tips
- Falcon Tubes

Materials (Cont.)

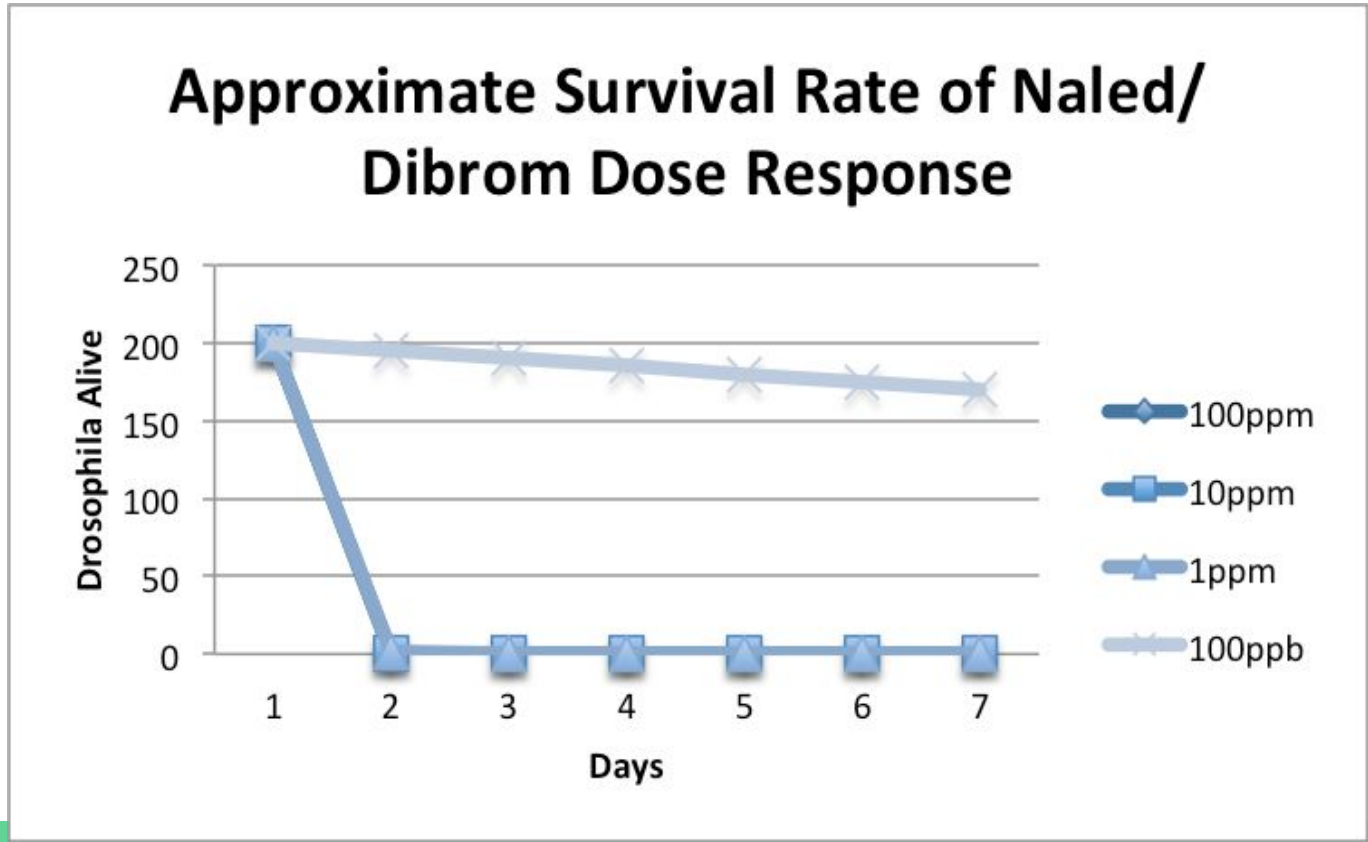
- Upwards of 2000 Flightless Drosophila Heidi
- 6 Housing Containers from Drosophila
- 4 Liters of Drosophila Instant Medium
- 3 150 ML Cylinders
- Vent-Cap Storage Flask
- 1 Low Powered UV Light
- 1 Incubator

Dose Response Testing

- Group of 200 flies were put into media solution of 100 ppm, 10 ppm, 1 ppm, 100 ppb Naled/Dibrom, Coumaphos and Bendiocarb.
- Their survival rates were measured each day
- Done to find at which there was a 80-90% survival rate

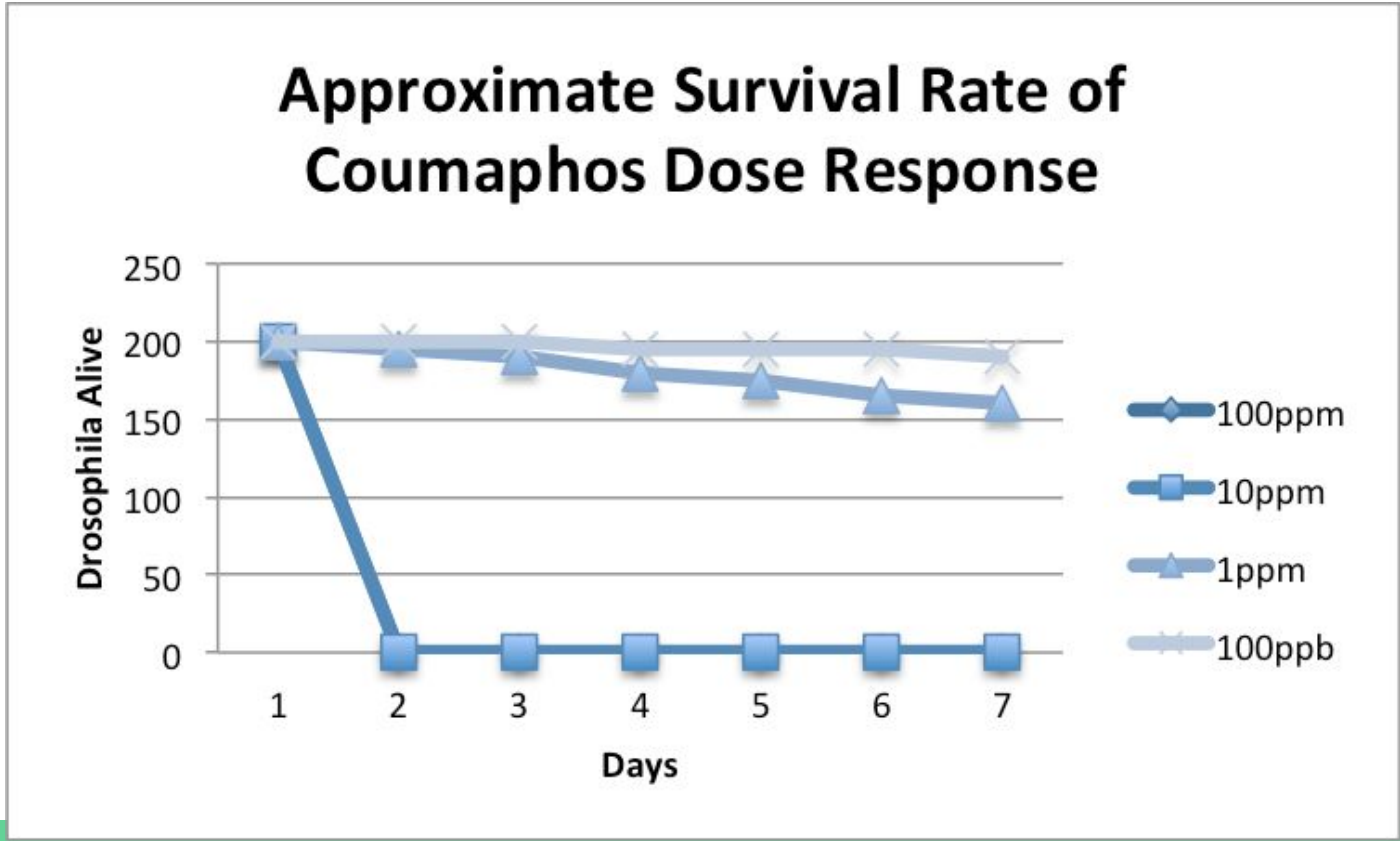
Results of Dose Response for Naled/Dibrom

- Found an approximately 80% survival rate For 100 ppb.



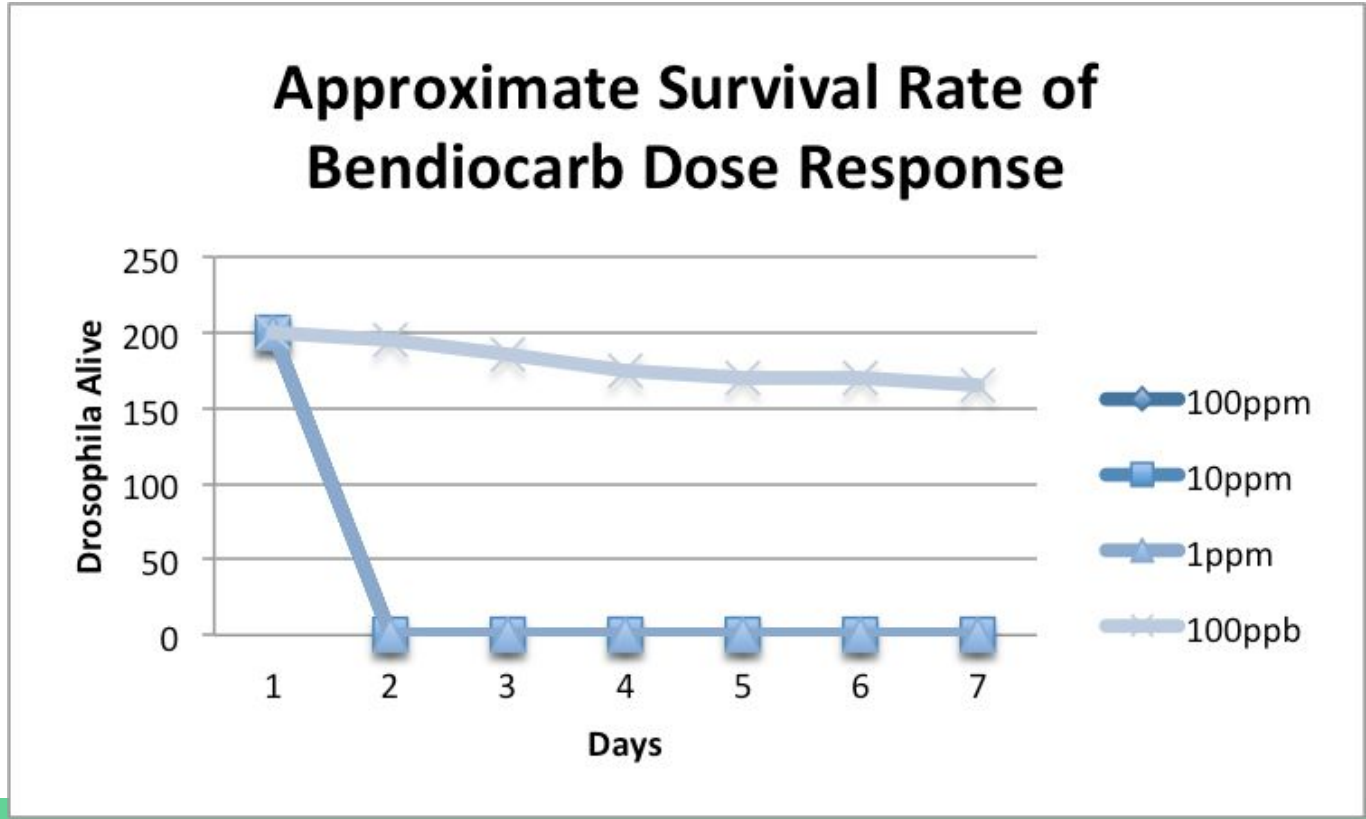
Results of Dose Response for Coumaphos

- Found an approximately 80% survival Rate at 1 ppm

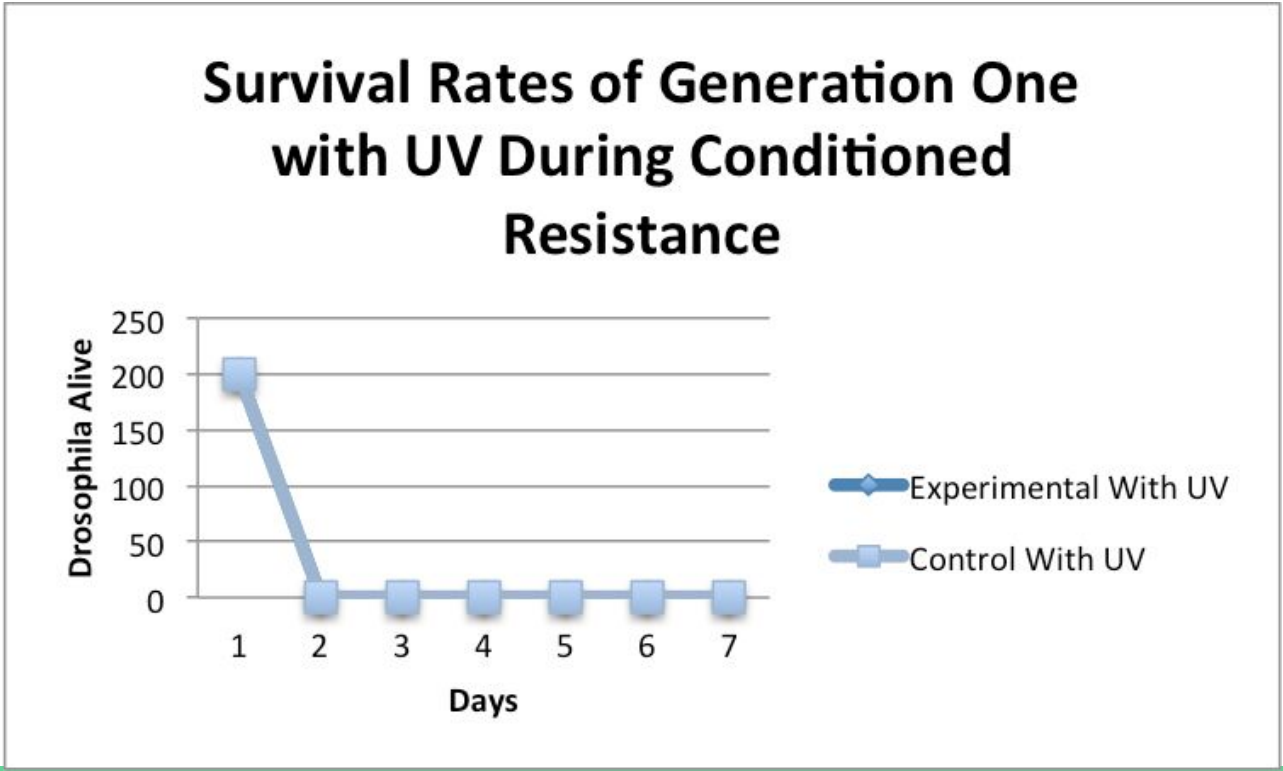


Results of Dose Response for Bendiocarb

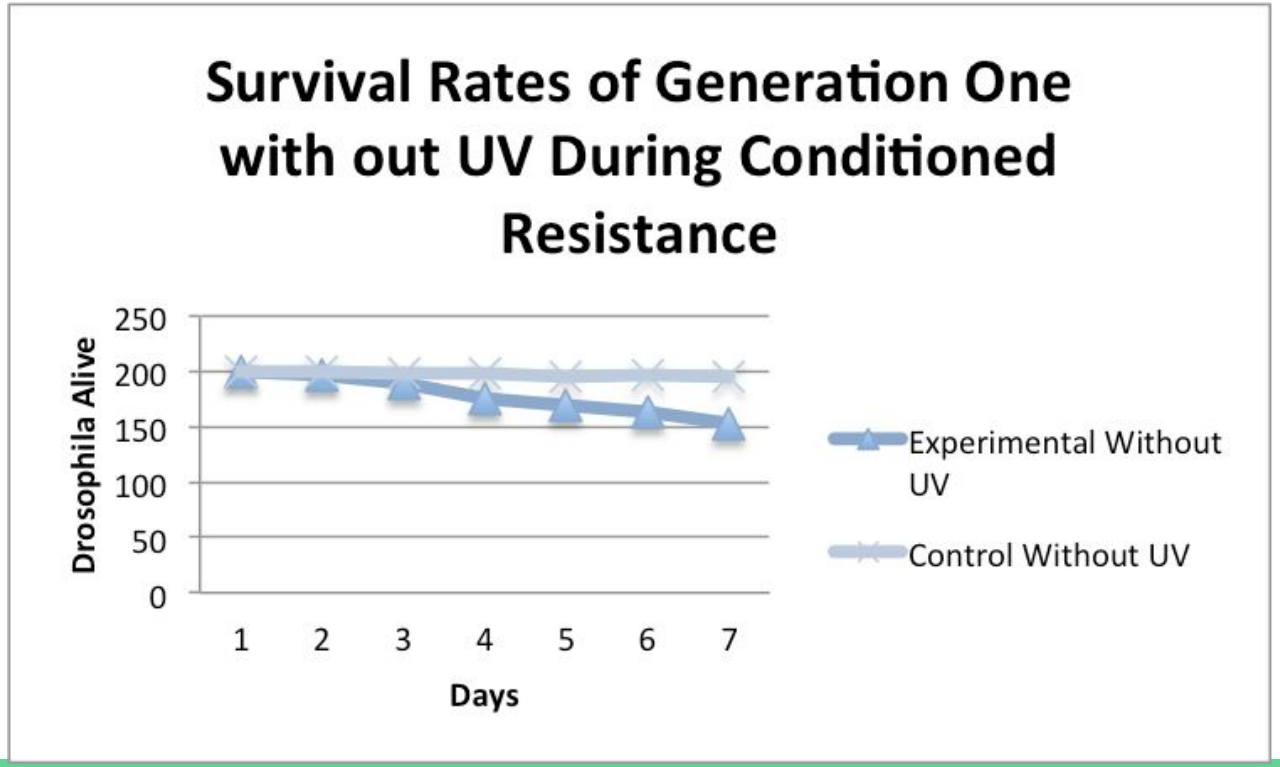
- Found an approximately 80% survival rate For 100 ppb



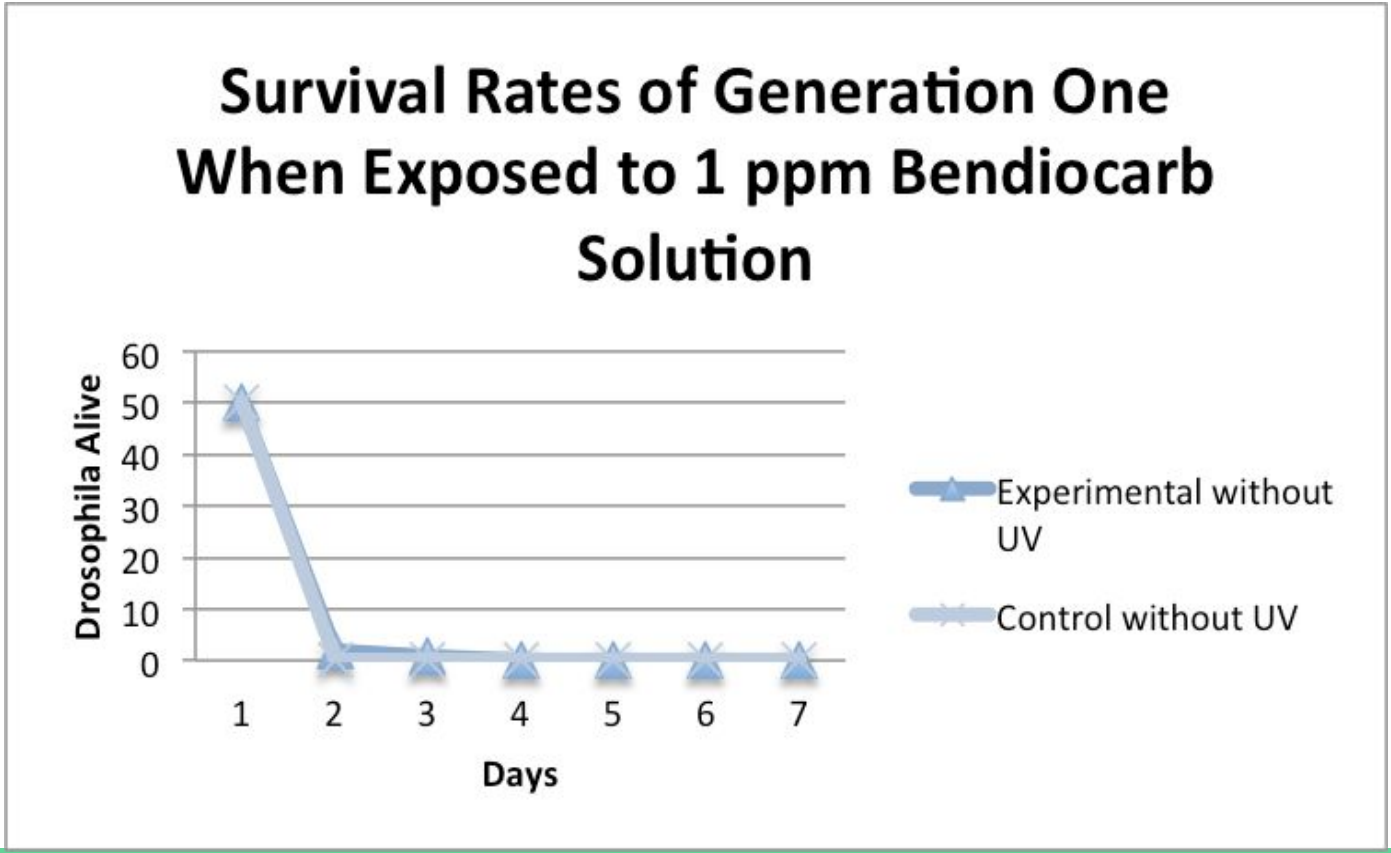
Generation One,
Conditioned Resistance with UV Radiation



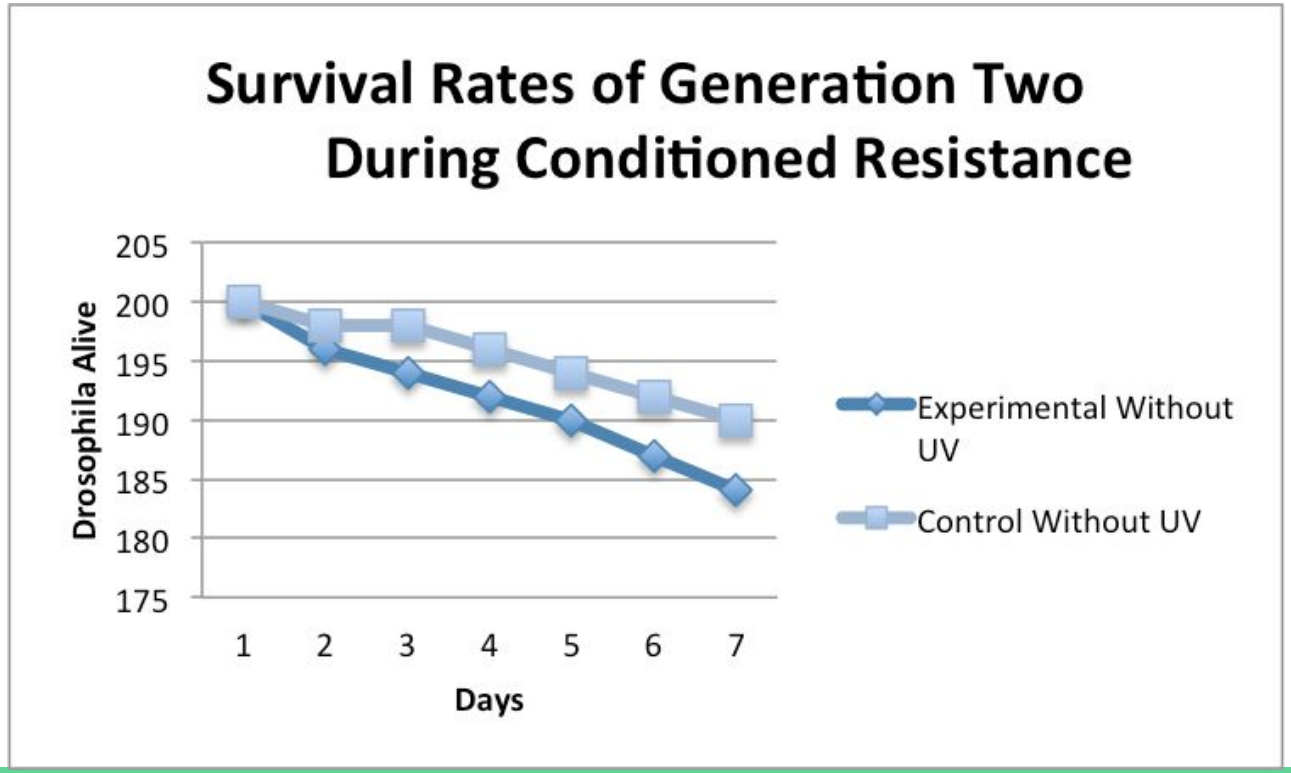
Generation One,
Conditioned Resistance Without UV Radiation



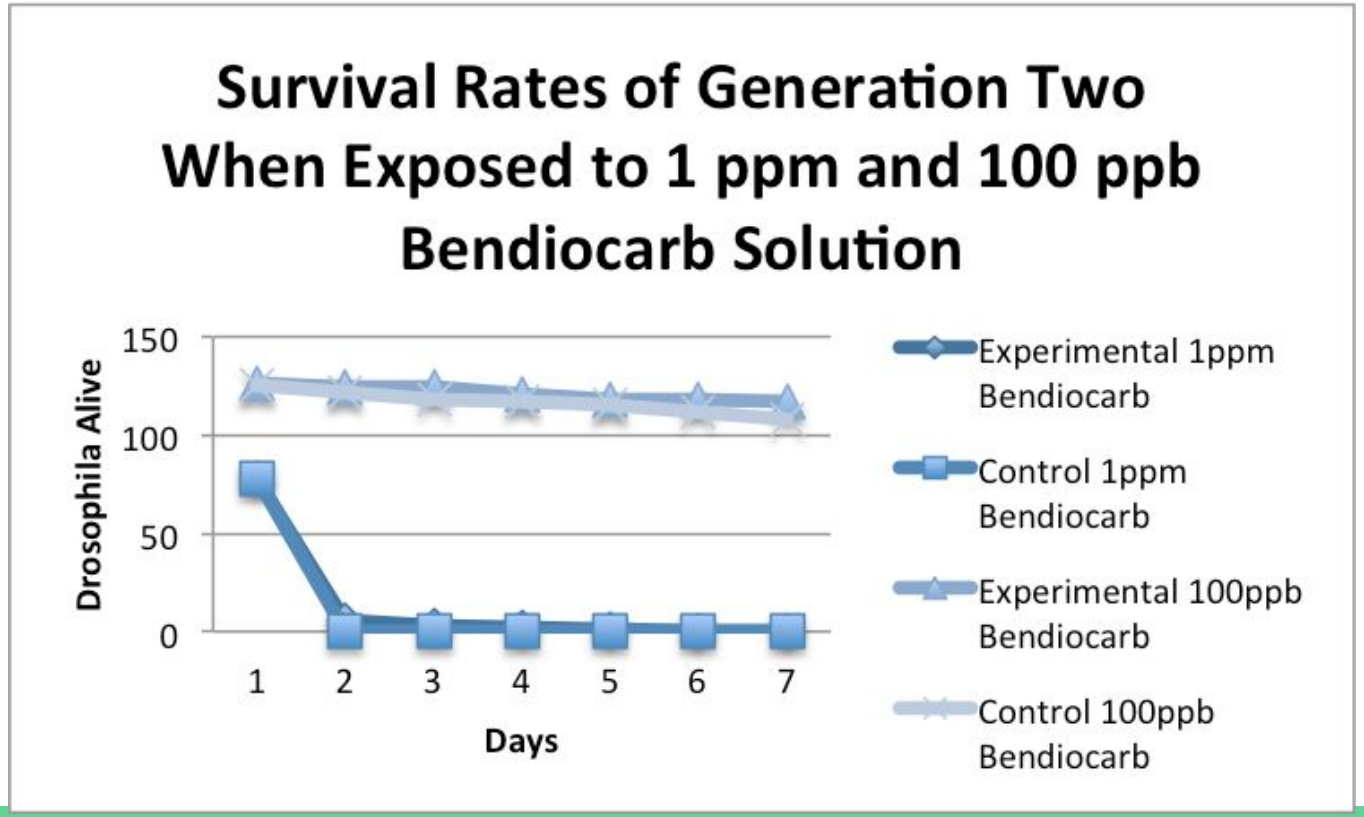
Resistance of Generation One



Generation Two, Conditioned Resistance



Results for Generation Two



Results

- There was a small increase in resistance levels from generation one, to generation two. This resistance increase was most apparent in the final test of 100 ppb.

- Generation One survival rates when exposed to 1 ppm Bendiocarb without UV: P=.97

- Generation Two survival rates when exposed to 100 ppb Bendiocarb: P= .91

- Generation Two survival rates when exposed to 1 ppm Bendiocarb: P= .11

Discussion

- There was a small increase in resistance levels
- There was a possible translation, which is more likely than the P values indicate
- When Exposed to 1 ppm Bendiocarb there was a 2% increase in survival rate from the control, as well as all previous tests

Conclusion

- The Null Hypothesis must be rejected
- There is a positive correlation between the generations and the resistance levels
- Insecticides should not be used nearly as frequently as they are

Further Work

- Complete the experiment with the projected 10 generations
- Determine the exact mutation in the two two AChE genes controlling the production the enzyme cholinesterase, which is in either (ace-1) or (ace-2).
- Test to determine whether resistance can be translated in other classes of insecticides

References

Brogdon, W. (1998). Insecticide Resistance and Vector Control.Emerging Infectious Diseases, 4(4), 605-613. doi:10.3201/eid0404.980410

Georghiou, G. P. (1990). Overview of Insecticide Resistance. ACS Symposium Series Managing Resistance to Agrochemicals, 18-41. doi:10.1021/bk-1990-0421.ch002

Edi, C. V., Koudou, B. G., Jones, C. M., Weetman, D., & Ranson, H. (2012). Multiple-Insecticide Resistance in Anopheles gambiae Mosquitoes, Southern Côte d'Ivoire. Emerging Infectious Diseases,18(9), 1508-1511. doi:10.3201/eid1809.120262

Nansen, C., Baissac, O., Nansen, M., Powis, K., & Baker, G. (2016). Behavioral Avoidance - Will Physiological Insecticide Resistance Level of Insect Strains Affect Their Oviposition and Movement Responses?PLOS ONE PLoS ONE, 11(3). doi:10.1371/journal.pone.0149994

Resistance and Its Management - Department of Entomology. (2004, January). Retrieved October 19, 2016, from http://ento.psu.edu/extension/factsheets/resistance

WHO | Q&A on the Global plan for insecticide resistance ... (n.d.). Retrieved October 19, 2016, from http://www.who.int/malaria/media/insecticide_resistance_management_qa/en/

Yamaguchi, H., Yoshino, K., & Kido, A. (2002). Termite resistance and wood-penetrability of chemically modified tannin and tannin-copper complexes as wood preservatives. Journal of Wood Science, 48(4), 331-337. doi:10.1007/bf00831356

Ffrench-Constant, R. H., Rocheleau, T. A., Steichen, J. C., & Chalmers, A. E. (1993). A point mutation in a Drosophila GABA receptor confers insecticide resistance. Nature, 363(6428), 449-451. doi:10.1038/363449a0

Acknowledgements

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