



**CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY**

Name(s) Gina Y. Yang	Project Number S2213
Project Title Investigating Colony Collapse Disorder: Synergistic Effects of In-hive Miticides on the Health of Honeybees <i>A. mellifera</i>	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals Bee pollination accounts for \$15 billion in added crop value and 1/3 of the food consumed in the U.S. Yet for more than ten years, Colony Collapse Disorder (CCD) has been responsible for unexplained large-scale bee losses. These bee die-offs have implicated not only the deadly parasitic mite <i>Varroa destructor</i>, but also the miticides used to control it. This project investigated the separate and synergistic effects of tau-fluvalinate and thymol, two common miticides, on the health of honeybees. It was hypothesized that bees orally exposed to these two miticides, especially when in conjunction, would exhibit learning and memory impairment and higher mortality.</p> <p>Methods/Materials 150 honeybees were divided into 10 groups of 15. A control group was fed with sucrose solution, while other groups were fed with different concentrations of miticide as follows (1%, 3%, and 5% concentrations of fluvalinate and thymol in conjunction, and the 6 other groups fed with the miticides but separately). All groups were triplicated. Bees were maintained in hoarding cages and allowed to feed ad libitum from feeders. Mortality was recorded daily; after 3 days of feeding, proboscis extension reflex (PER) assays took place to assess olfactory associative learning and memory.</p> <p>Results According to Pearson chi-square test, mortality in all miticide-fed groups, except for those fed with 5% and 10% of fluvalinate/thymol solution, was not statistically different than mortality in control groups. Another Pearson chi-square test was conducted to examine the relationship between the learning performances of miticide-fed bees and controls; the number of PER responses elicited in all miticide-fed groups, except for those fed with 1% thymol solution, was determined to be significantly lower than the number of responses in control groups.</p> <p>Conclusions/Discussion As shown by a lack of conditioned PER response, both miticides had a significant negative impact on bee learning and memory, and both fed in conjunction had an even greater negative impact overall on the bees' health. Olfactory learning and memory association are vital to foraging and homing behavior, which are crucial to colony food supply. Learning impairment in workers would therefore have serious implications for the health of colonies. Thus, the negative effects of miticides on bee learning and memory suggest that their widespread use in hives may have a role in causing CCD.</p>	
Summary Statement The miticides tau-fluvalinate and thymol were determined to have negative effects on honeybee learning and memory, and thus they may be linked to the unexplained honeybee disappearance known as Colony Collapse Disorder.	
Help Received My mentor, Ms. Fallon, provided advice and guidance. Beekeeper Wendy Towner donated live bees; my mother assisted in the purchase of materials and supervised experimentation.	