



# CALIFORNIA STATE SCIENCE FAIR 2016 PROJECT SUMMARY

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<b>Project Title</b> <b>Investigating Colony Collapse Disorder: Effects of tau-Fluvalinate on the Health of Honeybees <i>Apis mellifera</i> L.</b>	
<b>Abstract</b> <b>Objectives/Goals</b> Bee pollination accounts for 15 billion dollars in added crop value and more than one-third of the food consumed in the U.S. For almost ten years, Colony Collapse Disorder (CCD) has been responsible for unexplained large-scale bee losses. Such large bee die-offs resembling CCD have implicated not only the deadly parasitic mite <i>Varroa destructor</i> , but also the miticides used to control it. This project investigated the effects of tau-fluvalinate, a common active ingredient found in miticides, on the health of honeybees. It was hypothesized that bees orally exposed to tau-fluvalinate would exhibit learning and memory impairment and higher mortality. <b>Methods/Materials</b> 64 honeybees were divided into 4 groups of 16. A control group was fed with sucrose solution, while the three remaining groups were fed with different concentrations of tau-fluvalinate (1%, 5%, and 10%). All groups were triplicated. Bees were kept in hoarding cages and allowed to feed ad libitum from feeders. Mortality was recorded daily, and after 3 days of feeding, proboscis extension reflex (PER) assays were conducted to assess associative learning and memory. <b>Results</b> According to Pearson chi-square test for independence, mortality in tau-fluvalinate-fed groups (1% tau-fluvalinate solution: 14.6%; 5% tau-fluvalinate: 14.6%) was not statistically different than mortality in control groups (10.4%). However, there was a statistically significant difference between mortality in groups fed with 10% tau-fluvalinate solution (27.08%) and control groups. Another Pearson chi-square test was conducted to examine the relationship between the learning performances of tau-fluvalinate-fed bees and controls; the number of PER responses elicited in all tau-fluvalinate-fed groups was determined to be significantly lower than the number of responses in control groups. <b>Conclusions/Discussion</b> As confirmed by the absence of PER responses in most miticide-fed bees, tau-fluvalinate had a detrimental impact on bee learning and memory. Such learning and memory association is vital to the foraging and homing behavior of worker bees, whose jobs 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 tau-fluvalinate on bees suggest that the widespread use of in-hive miticides could be linked to CCD.	
<b>Summary Statement</b> The miticide active ingredient tau-fluvalinate was determined to have negative effects on honeybee learning and memory and thus may be linked to the unexplained phenomenon of Colony Collapse Disorder.	
<b>Help Received</b> Beekeeper Ken McKenzie donated live bees used in the experiments; my mentor Ms. Fallon provided advice and guidance.	