



# CALIFORNIA STATE SCIENCE FAIR 2015 PROJECT SUMMARY

<b>Name(s)</b> <b>Gina Y. Yang</b>	<b>Project Number</b> <b>S2124</b>
<b>Project Title</b> <b>Investigating Colony Collapse Disorder: Effects of Agricultural Adjuvant on the Health of Honeybees <i>Apis mellifera</i> L.</b>	
<div><div><b>Objectives/Goals</b><p>Bee pollination accounts for about \$15 billion in added crop value and 1/3 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. After almond pollination season recently, a large bee die-off resembling CCD implicated agrochemicals in the bee deaths. In almond crops, a surfactant, called an adjuvant, is often combined with pesticides to boost their efficacy. This project investigated the effects of Dyne-Amic, an adjuvant commonly used on almond crops, on the health of honeybees. It was hypothesized that bees orally exposed to Dyne-Amic would exhibit lower food consumption, higher mortality, and learning and memory impairment.</p></div><div><b>Abstract</b><p>48 honeybees were divided into 3 groups of 16. A control group was fed with sucrose solution, while the two remaining groups were fed with different concentrations of Dyne-Amic (1% and 5%). All groups were triplicated. Bees were maintained in hoarding cages and allowed to feed ad libitum from feeders. Food consumption and mortality were recorded daily; after 3 days of feeding, proboscis extension reflex (PER) assays took place to assess olfactory associative learning and memory.</p></div><div><b>Methods/Materials</b><p>48 honeybees were divided into 3 groups of 16. A control group was fed with sucrose solution, while the two remaining groups were fed with different concentrations of Dyne-Amic (1% and 5%). All groups were triplicated. Bees were maintained in hoarding cages and allowed to feed ad libitum from feeders. Food consumption and mortality were recorded daily; after 3 days of feeding, proboscis extension reflex (PER) assays took place to assess olfactory associative learning and memory.</p></div><div><b>Results</b><p>No statistically significant differences in average food consumption between groups were observed, as confirmed by one-way ANOVA. According to Pearson chi-square test for independence, mortality in adjuvant-fed groups (1% adjuvant solution: 14.6%; 5% adjuvant solution: 16.7%) was not statistically different than mortality in control groups (10.4%). Another Pearson chi-square test was performed to examine the relationship between the learning performances of adjuvant-fed bees and controls; the number of PER responses elicited in adjuvant-fed groups was determined to be significantly lower than the number of responses in control groups, <math>p &lt; 0.05</math>.</p></div><div><b>Conclusions/Discussion</b><p>As shown by a lack of conditioned PER response, Dyne-Amic had a significant negative impact on bee learning and memory. 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 Dyne-Amic on bee learning and memory suggest that Dyne-Amic could have been a cause of the post-almond pollination bee die-off and have a link to CCD.</p></div></div>	
<b>Summary Statement</b> <p>The agricultural adjuvant Dyne-Amic was determined to cause significant learning and memory impairment in honeybees and therefore may be linked to the unexplained phenomenon Colony Collapse Disorder.</p>	
<b>Help Received</b> <p>My mentor, Ms. Fallon, provided advice and guidance. Beekeeper Alan Henninger donated live bees; my mother assisted in the purchase of materials and supervised experimentation.</p>	