



Effects of the Addition of a Spray Adjuvant on Insecticide and Fungicide Toxicity to Adult Honey Bee Workers

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Introduction

- Pollinating beekeepers have reported observing dead adult bees and dead and malformed immature worker bees in 80,000 colonies during and after almond bloom (Flottum, 2014)
- To determine the role that almond pesticides play in the observed bee kills we sought to answer these questions:

- Which pesticides and pesticide combinations are bees most likely to be exposed to during almond bloom?
- What effect does spray exposure to the most commonly used insecticides, fungicides and a spray adjuvant, alone and in field-relevant tank mix combinations, have on adult honey bee survival?

Methods: Combinations During Bloom

- Pesticide use data for almonds were downloaded from the California Pesticide Information Portal (<http://calpip.cdpr.ca.gov/main.cfm>) for the years 2006-2017
- Insecticide, fungicide and spray adjuvant data were summarized for the blooming period, defined as February 15 – March 15, using the statistical package R (Figure 1)
- Widely used insecticides, fungicides and the most popular spray adjuvant (Dyne-Amic) were chosen for combination testing.

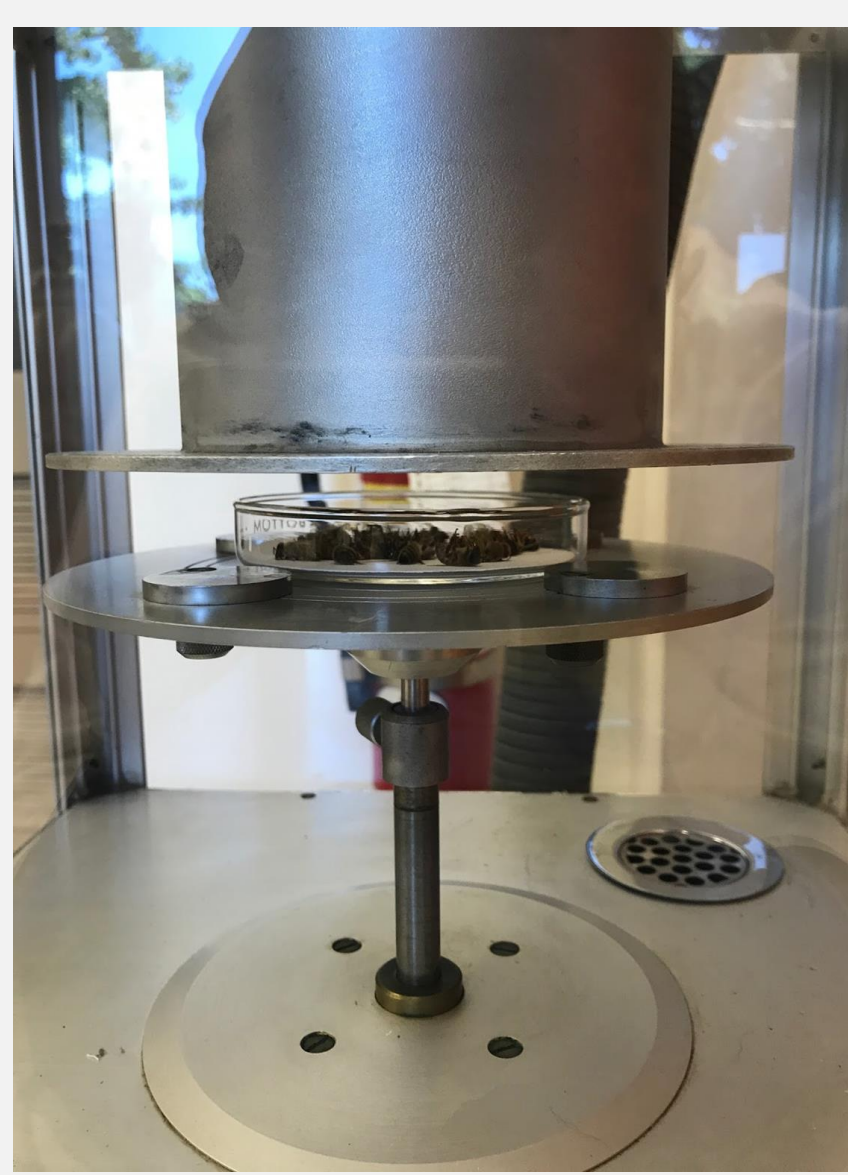
Methods: Simulated Spray Using a Potter Tower



The Potter Spray tower recreates bee exposure to a spray application inside the lab.

1. Twenty 3-day-old adult bees were narcotized with CO₂ and placed in a 9cm petri dish on a filter paper.

2. Bees were placed on a platform 1 m beneath the spray head.



3. The maximum application rate for almonds was scaled from lbs. or gal. per acre to mg or µl per square cm, with the area of the petri dish as the “acreage”. Insecticides and fungicides were applied at 1, 3, 10 and 30X the max field rate in 1 ml DI water. Mustang Maxx was used as a positive control.

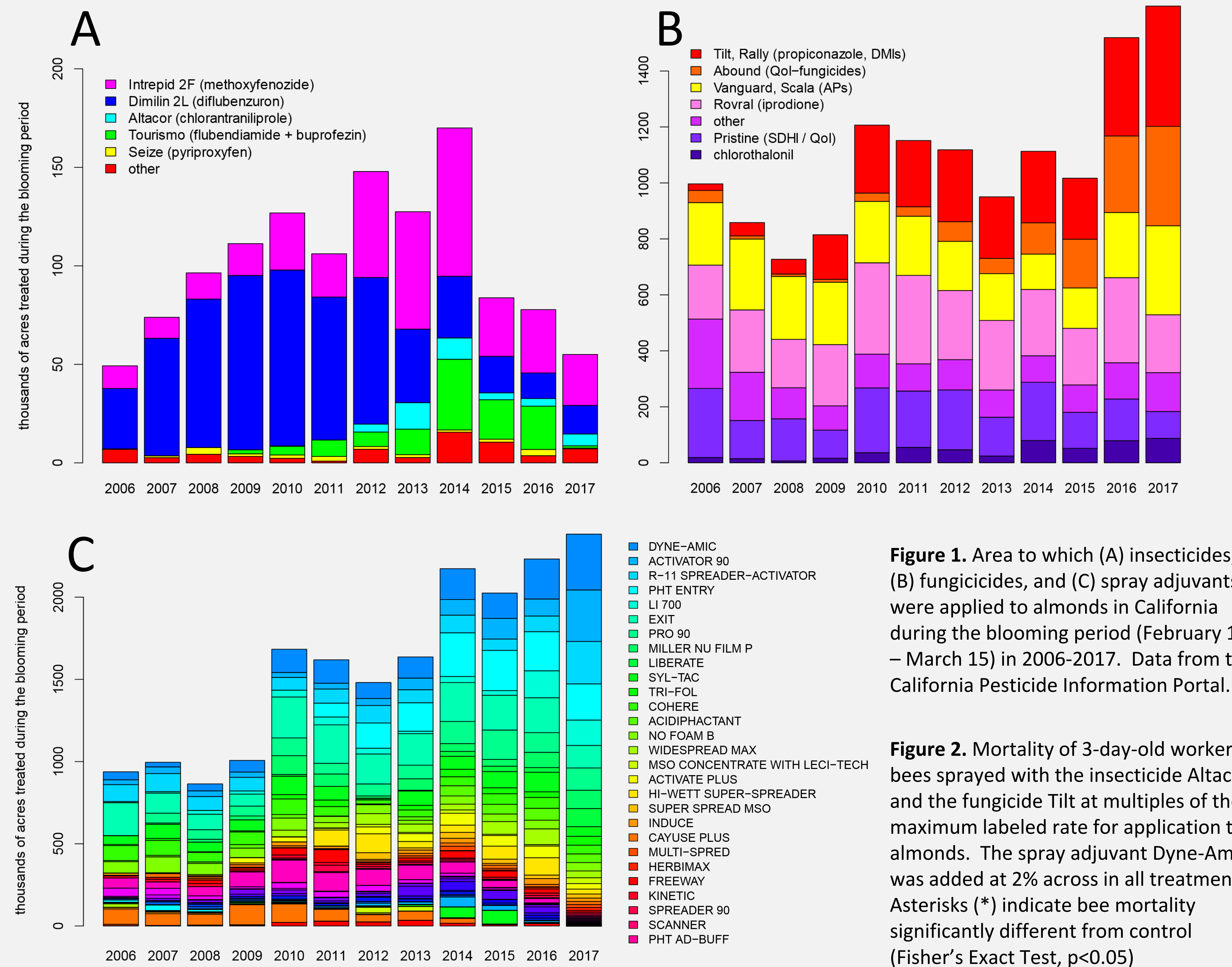
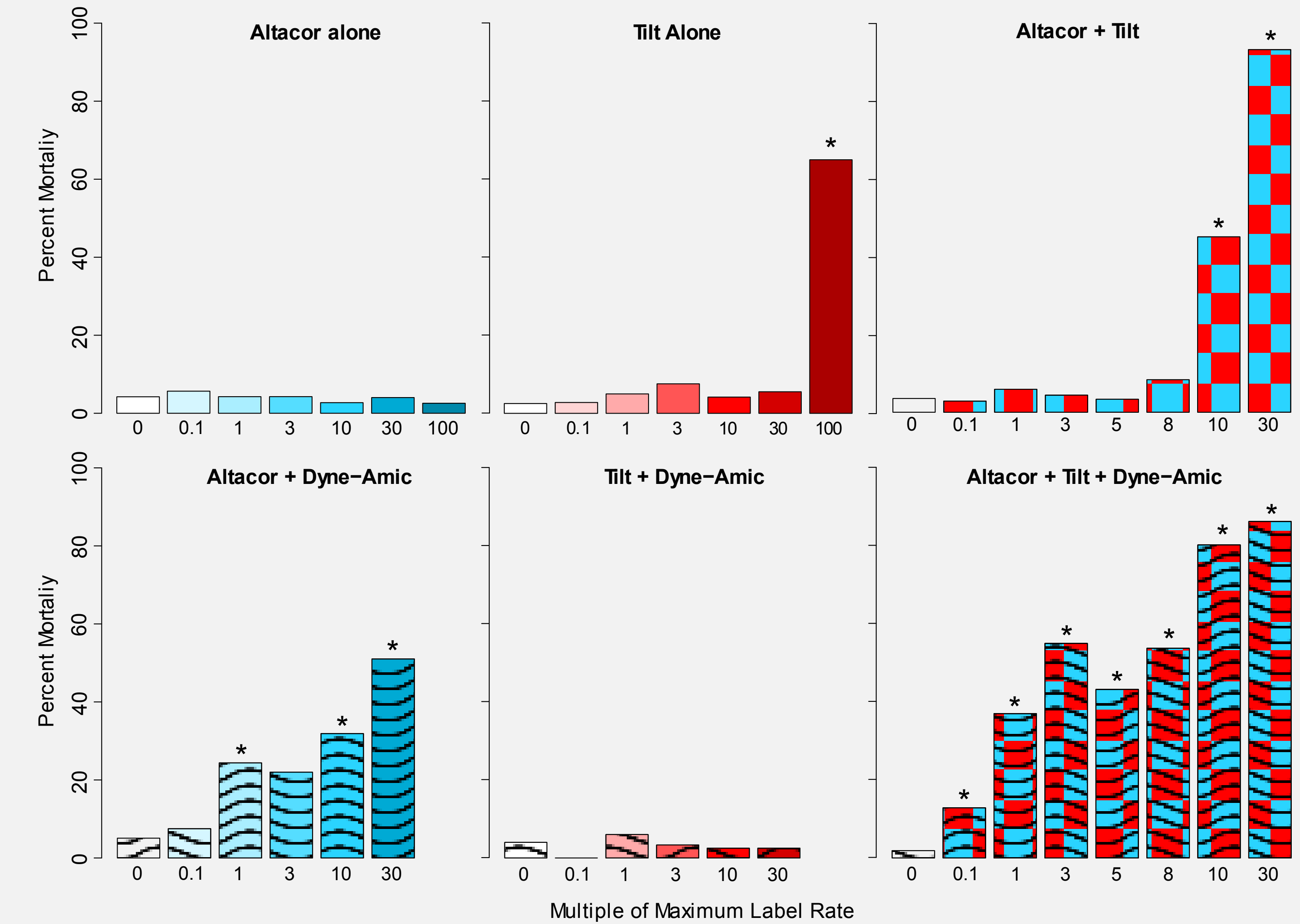


Figure 1. Area to which (A) insecticides, (B) fungicides, and (C) spray adjuvants were applied to almonds in California during the blooming period (February 15 – March 15) in 2006-2017. Data from the California Pesticide Information Portal.

Figure 2. Mortality of 3-day-old worker bees sprayed with the insecticide Altacor and the fungicide Tilt at multiples of the maximum labeled rate for application to almonds. The spray adjuvant Dyne-Amic was added at 2% across in all treatments. Asterisks (*) indicate bee mortality significantly different from control (Fisher's Exact Test, p<0.05)

Results: Worker mortality 48 hours after spray



	insecticide alone	Pristine (boscalid + pyraclostrobin)	Vanguard (cyprodinil)	Luna Sensation (fluopyram + trifloxystrobin)	Tilt (propiconazole)
with no spray adjuvant					
fungicide alone		> 30 X N=577	> 30 X N=400	> 30 X N=300	> 30 X N=1238
Altacor (chlorantraniliprole)	> 30 X N=1311	> 30 X N=760	> 30 X N=300	> 30 X N=296	10 X N=1575
Intrepid (methoxyfenozide)	> 30 X N=659	> 30 X N=339	> 30 X N=300	> 30 X N=300	> 30 X N=379
Mustang Maxx (zeta-cypermethrin)	1 X N=642				
with 2% Dyne-Amic spray adjuvant					
fungicide alone		30 X N=280	1 X N=499	> 30 X N=279	> 30 X N=440
Altacor (chlorantraniliprole)	1 X N=395	1 X N=600	1 X N=498	10 X N=293	0.1 X N=922
Intrepid (methoxyfenozide)	> 30 X N=201	10 X N=280	> 30 X N=299	10 X N=301	10 X N=295

Table 1. Multiples of the field application rate for insecticides, fungicides and combinations with and without addition of Dyne-Amic spray adjuvant causing a significant increase in adult bee mortality 48 h. relative to control after spray application (Fisher's Exact Test, p < 0.05 with Bonferroni correction for 157 comparisons). All combinations were tested at 1, 3, 10, and 30 X the field rate. All tests were repeated at least 3 times. The total number of bees tested (N) among all treatment levels is reported.

Conclusions

The spray adjuvant Dyne-Amic makes some insecticide, fungicide and insecticide-fungicide tank-mix applications much more toxic to adult honey bees when exposed through a spray (Figure 2, Table 1). Future work will test other adjuvant chemistries in combination with these pesticides. **Insecticides and spray adjuvants should not be used in almonds during bloom to protect bee health.**

Reference

Flottum K. CATCH THE BUZZ. What Happens In Almonds Doesn't Stay In Almonds. This Year's Devastating Bee Kill In California Hurts Apples, Cranberries, Blueberries...and Beekeepers. April 4, 2014.

Acknowledgements

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