AGRICULTURAL RESEARCH FOUNDATION
INTERIM REPORT
FUNDING CYCLE 2017 – 2019

TITLE: Particulate pesticide formulations may contribute to exposure and residual toxicity to honey bees

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EXECUTIVE SUMMARY:

Honey bee pollination is essential for multiple Oregon crops. To coordinate pollination by honey bees with the use of crop protection products, accurate information is needed on toxicity and how long product residues continue to affect bees after spraying. Our work investigates how particulate formulations contribute to uncertainty about pesticide exposure and residual toxicity to bees. Particulate pesticide formulations use nano and micro sized particles of clay, polymers, and other materials to carry or encapsulate chemical active ingredients, which potentially cling to bees similarly to pollen. Our initial work indicates that these formulations may affect how long some pesticides remain toxic in the field, and this proposal seeks to further examine the transfer of particulate pesticides from foliage onto bees, and how long such particles stay toxic in the field and the hive. This knowledge could help reduce or prevent pesticide exposures that adversely affect colony health. To date, we have performed a portion of the experiments described in our original proposal, and expect to complete this work during summer 2018, when both honey bees and an undergraduate worker are available.

OBJECTIVES:

Our objectives are to examine several pesticides that have been associated with effects on honey bees. We are interested in these pesticides because they are formulated as particles, and have been associated with problems for bees. Our hypothesis is that particulate pesticide formulations may behave like pollen, which clings to bees and is transported back to the hive. For example, particulate formulations could alter how pesticides transfer from foliage to forager bee, how pesticide products interact, and how long pesticide residues remain in the field or in pollen stored in bee hives.

The insecticides we are examining include Beleaf, with an active ingredient of Flonicamid, which has been associated with larval toxicity in the field, and adult toxicity in the laboratory. Bravo / Chlorothalonil is a fungicide which has been associated with Colony Collapse Disorder, Warrior II/Lambda Cyhalothrin which beekeepers associate with problems for bees when they move hives into the field days after application, and Intrepid/Methoxyfenozide, which is suspected of synergistic toxicity with other products. In each case, our objectives include comparing the particulate formulation to the unformulated active ingredient.

PROCEDURES:

1. Transfer of pesticide from foliage to forager bee. After applying a field-relevant concentration to leaves, we introduce bees and collect them after one hour. We wash the bees in appropriate solvent and submit the wash to mass spectroscopy. This enables us to compare how much pesticide transfers from leaves to bees when it is formulated in particles, versus the active ingredient alone.
2. Interaction between products. Similarly, we will apply a mixture of products, and analyze whether such a mixture affects how much moves from leaf to bee. We will also use scanning electron microscopy to characterize the interaction between particles.
3. Residual toxicity and availability. We will apply formulated pesticides and active ingredients to hazelnut leaves on trees. Every few days, we will collect leaves, introduce bees, and observe toxicity, or analyze for chemical transfer to bees. This enables us to learn whether particles protect pesticide active ingredients from degradation in the environment, or extends their availability and toxicity over time.
4. Persistence in Pollen. Honey bees combine pollen and nectar, and ferment it into bee bread. The microorganisms involved are likely to also degrade pesticides that come in with pollen, a significant exposure source. We will recreate this scenario in the lab, spiking the pollen with a formulated pesticide, or its active ingredient. By analyzing the pollen after fermentation, we will learn whether pesticide particles protect pesticides from degradation during this process.

SIGNIFICANT ACCOMPLISHMENTS TO DATE:

We have completed some of the experiments on transfer of pesticides from foliage to forager bee, and residual toxicity and availability. The bulk of the work will be performed in summer 2018.

ADDITIONAL FUNDING RECEIVED DURING PROJECT TERM:

We have not received additional funding for this specific project. Funding for related projects will enable us to fund an undergraduate worker for an extended period of time, which may assist with recruitment.

FUTURE FUNDING POSSIBILITIES:

We intend to use the results of this work to apply for funding from USDA and other funding agencies.