2021 USAFRI Research Project Objectives

Using Pesticide Fate Models to Guide Application Timing and Improve Alfalfa Seed Yields
USDA-ARS - Graham

Project Award: $55,107

Justification:

- Alfalfa (Medicago sativa) has the third greatest production value of any crop in the United States, and over 16,000 acres were harvested in 20201. Annual seed production of alfalfa, though no longer specifically reported by NASS, is estimated to be around 80 million pounds, with production almost exclusively in the western states2. Production of alfalfa seed relies on bee pollination to produce marketable yields, with most growers purchasing alfalfa leaf-cutting bees (Megachile rotundata, ALCB), and some in CA and AZ renting honey bees. In WA, growers in the Touchet area have also been managing alkali bees (Nomia melanderi) for over 50 years in bee beds adjacent to the seed fields3. Alkali bees are active during alfalfa bloom and readily collect alfalfa pollen, making them excellent pollinators of this crop.

- Alfalfa seed growers also must manage pest populations that can lead to yield loss. Major pests include lygus bugs (Lygus hesperus) and spider mites (Tetranychus spp.). Lygus bugs in particular can cause significant damage to the reproductive organs of alfalfa flowers, resulting in reduced seed yield. Control of major alfalfa seed production pests typically includes an insecticide spray (usually a pyrethroid or organophosphate) right before bloom, and then use of "reduced-risk" insecticide (e.g. indoxcarb, flonicamid, and sulfoxaflor) during bloom. Bloom is a particularly challenging time during which growers must balance the need for pollination and pest control, both of which are necessary to optimize yields.

- Three knowledge limitations currently restrict our ability to improve insecticide application protocols, i.e. to make them more effective against pest insects and/or less harmful to bees. Critical lack of knowledge exists around (a) insecticide loss rates from fields after application, (b) insecticide concentrations in plants that result in toxicity effects on pests and bees, and (c) pest insect activity patterns by time of day.

- To gain more information about insecticide loss curves, 2 field experiments in which insecticide concentrations are quantified on leaves after application are needed. However, these loss rates depend on the specific insecticide and formulation, time of day of application, and weather and field conditions. Due to the complex interplay of these factors, pesticide fate modeling is an ideal tool for predicting insecticide loss rates from fields under any combination of specific conditions. Co-PD Hageman's research group has developed the Pesticide Dissipation from Agricultural Land (PeDAL) model for this purpose4. Although the PeDAL model has undergone general validation with a wide array of pesticide and crop combinations, more detailed input parameters for alfalfa-specific pesticides and further validation specific to alfalfa crops is needed.

Objectives:

- The objectives of this project are to 1) measure loss rates of several common alfalfa insecticides under field conditions; 2) use results from field experiments to further optimize the PeDAL model so it can be used to predict loss rates without the need for field experiments; 3) measure daily activity patterns for key alfalfa pest insects; and 4) develop guidance for growers on timing of sprays around bloom.