Integrated Pest Management and Pollinator Protection on Alfalfa Produced for Seed
Washington State University - Walsh

Project Award: $35,000

Justification:

- In the recently completed *Pest and Pollinator Management Strategic Plan for Alfalfa Seed Production in the Western U.S.* industry stakeholders identified the research needs they deemed most critical. Among the highest priorities were:
  - development of Lygus control methods with minimal pollinator impact, including outside-the-box, big-picture, and area-wide approaches,
  - monitoring for pest resistance to insecticides, miticides, fungicides, and herbicides, and
  - development of recommendations for pollinator health and habitat.

  In this proposal, we detail a novel, outside-the-box method for reducing Lygus invasion of alfalfa seed fields, a means to assess resistance status of spider mite populations in alfalfa seed fields, and a novel way to increase abundance of native pollinators in alfalfa seed fields.

  Lygus bugs, *Lygus hesperus* Knight (Hemiptera: Miridae), are the key direct economic pest in alfalfa seed production. Alfalfa seed yields and economic returns are directly mediated by growers' ability to manage infestations of Lygus bugs. Pollination by leafcutting (*Megachile rotundata*) or alkali bees (*Nomia melanderi*), and, to a much lesser extent, honey bees (*Apis mellifera*), is essential for seed set in alfalfa seed production. Unfortunately, economic control of Lygus requires insecticide applications during bloom, which is the time when pollinators are actively foraging and provisioning brood, rendering the adult bees and their progeny vulnerable to insecticide exposure. Alfalfa seed growers require continued research to make informed decisions about the delicate balance between maintaining essential pollinator populations and suppressing Lygus bug and other arthropod pests including two-spotted spider mites, *Tetranychus urticae* Koch (Acari: Tetranychidae). While the registration of insecticides and miticides for the key pests of alfalfa seed (including Lygus and mites during bloom) will always be a part of the integrated pest and pollinator management program in this crop, any tactic that reduces insecticide use has the potential to play a role in a sustainable IPM strategy. Toward that end, we propose to investigate a novel mechanical (physical) method for reducing Lygus adult migration from alfalfa forage fields into alfalfa seed fields. These physical barriers have demonstrated promise in the management of Lygus in cotton production in the southwest and in the management of stink bugs in orchard systems in Washington State.

  The broad-spectrum organophosphate and pyrethroid insecticides typically used prebloom in "clean-up" programs contribute to outbreaks of *T. urticae*, and growers routinely spray acaricides during bloom to suppress pest mite populations. *T. urticae* are renowned for developing resistance to commonly used insecticides/miticides. Over the past several years, using the latest molecular-level research into mechanisms of pesticide resistance, we have developed and validated rapid and robust molecular methods for screening *T. urticae* populations for resistance to the contact miticides bifenazate and bifenthrin and the ovicidal acaricides hexythiozox, etoxazole, and clofentazine. We have worked extensively on abamectin as well, but the direct mechanism (or specific molecular markers) associated with increased tolerance/ resistance to abamectin has eluded us. In 2017 we will complete RNA sequencing of T. urticae from hop yards and mint fields. If funded, we will initiate a program in alfalfa seed fields in 2018. This will give us a powerful tool in determining the mechanisms

spider mites use toward resisting poisoning by acaricides. We propose to evaluate, through field trials, laboratory bioassays, and molecular genetics, the resistance status of spider mites infesting alfalfa seed fields with respect to the abamectin, bifenazate, etoxazole, hexythiozox, and propargite.

While alfalfa leafcutting bees and alkali bees are acknowledged to be the key pollinators in alfalfa produced for seed, the contribution of endemic, unmanaged "wild" bees is largely unappreciated. We completed surveys of bee abundance and diversity within several irrigated cropping systems including alfalfa produced for seed in 2012 and 2013. An interesting result of these surveys was that while nectar and pollen resources are a factor in pollinator species richness, diversity, and overall abundance, the second most important factor is nesting sites. We have observed that the greatest abundance of soil-dwelling halictid bees has been in clean cultivated areas (either mechanically or by herbicide application) with water sources that facilitate nesting sites. In south central Washington, the water source has been drip irrigation. We have determined that providing drip irrigation to soils creates a goldilocks zone for specific native halictid ground-nesting bees. Jordan (2014) determined that several species of halictids (*Agapostemon texanus* Say, *A. femoratus*, and *A. virscens*) were collectively among the most abundant group of macro-bees, accounting for over 30% of the bees detected in fields of alfalfa produced for seed in Walla Walla, WA. Jordan also detailed that abundance was statistically equivalent in transect studies that compared the abundance of bees from the field edge to 25 m into the field in increments of 5 m. These three species of bees are large for halictids—equivalent in size to alfalfa leafcutting bees. Furthermore, we have observed *Agapostemon* spp. trip alfalfa blossoms when foraging. All of these factors, taken together, lead us to believe that these bees are contributing to pollination services in fields of alfalfa produced for seed. We received partial funding to initiate a study into a novel method for enhancing populations of soil-nesting bees in 2017, but budget shortfalls at USDA-ARS led to a 43% budget cut from our request. Consequently, we are requesting funding from NAFA to pursue this objective.

Objectives:

- The objectives of this project are to 1) Test selected field populations of spider mites from a representative sample of alfalfa seed fields and compare their dose response curves to acaricide-naïve populations and mite populations from other crops including hops and peppermint; 2) Expand robust molecular diagnostics to predict acaricide resistance in the field, and 3) Test a novel method for enhancing populations of soil-nesting bees by identifying the species and quantifying the change in bee emergence rate achieved by irrigating soil at field margins.