Discovery of Resistance Breaking Chemistries for Varroa Mite Management

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PROJECT SUMMARY

Objectives:

- Evaluate the acute toxicity and field efficacy of standard-use acaricides to varroa mite populations
- Evaluate the metabolic and target-site mechanisms of acaricide-resistance in varroa mite populations
- Evaluate the acute toxicity and field efficacy of stilbene chemistries to acaricide-resistant varroa mite populations

Background and Discussion:

The hematophagous mite, *Varroa destructor*, is a major pest of the honey bee, *Apis mellifera*. It is considered to be a primary driver for the periodic losses of managed bee colonies in the United States. The varroa mite requires bees for food and reproduction and, in turn, elicits physiological deficiencies and vectors infectious diseases that can compromise the health status of bee colonies. If varroa mite infestations are not effectively controlled, the number of bee colonies available for crop pollination services in the apicultural and agricultural industries will continue to decline.

The varroa mite nervous system is a proven target site for standard-use acaricides, including *tau*-fluvalinate (Apistan®; pyrethroid), coumaphos (Checkmite+™; organophosphate), and amitraz (Apivar®; formamidine). These acaricides not only have adverse health effects on bee colonies, but resistance or resistance potential to these chemistries limit their use against varroa mite infestations. Therefore, acaricide resistance is considered a serious pest management challenge for the apiculture and agriculture industries and warrants a better understanding of the mechanisms that confer acaricide resistance and the development of improved chemistries for varroa mite management.

The voltage-gated chloride channels (VGCCs) are involved in the maintenance of electrical excitability in nerve and muscle membranes. The involvement of VGCCs in this critical physiological process suggests that they might be exploited as new targets for unique acaricide chemistries against varroa. A natural product stilbene, and related analogs, elicits paralytic activity by blocking arthropod VGCCs. It remains to be determined whether stilbene(s) have paralytic activity against varroa mite and, thus, provide an opportunity for the target-site discovery of unique acaricides for varroa mite management.

This research study provides a targeted approach to discover unique stilbene chemistries for the management of varroa mites that are resistant to standard-use acaricides. The investigators have monitored the reduced field efficacy of standard-use acaricides, identified the metabolic and target-site resistance mechanisms responsible for the reduced field efficacy of these acaricides, and discovered the improved field efficacy of stilbenes to the varroa mites. This information is guiding the discovery and development of unique stilbene chemistries with improved acaricidal activity for the management of acaricide-resistant varroa mites and the protection of bee colony health.

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Project Cooperators and Personnel: Dennis vanEngelsdorp, University of Maryland; Lacey Jenson, Virginia Tech

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- Poster location 9, Exhibit Hall A + B during the Almond Conference; or on the web (after January 2016) at Almonds.com/ResearchDatabase
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