Oxalic Acid Derivatives and Benzylic Alcohol Derivatives as "Non-Toxic" Acaricides Against *Varroa jacobsoni*

Project No.: **07-POLL4-LeBlanc**

Project Leader: **Dr. Blaise W. LeBlanc**
Carl Hayden Bee Research Center
2000 E. Allen Rd., BLDG 107
Tucson, AZ 85719
(520) 670-6481 ext 124
Fax: (520) 670-6493
blaise.leblanc@ars.usda.gov

Project Cooperators: Thomas Deeby, Diana Sammataro, Jenifer Finely

Objectives:

1. Synthesize OA derivatives (carboxylic ester and carboxylic amide) – Work has already begun and will commence further pending funds.
2. Study the toxicity of the compounds (OA derivatives and BA derivatives) to Varroa mites using scintillation vial assays and determine the LD-80-90 concentrations on Varroa mites.
3. Study the effects on honey bee colonies on the compounds from specific aim (2) and determine the LD-50 concentration on the bees and the mites.

Interpretive Summary:

Oxalic acid (OA) has been used successfully in Europe to control varroa mites on honeybees. In the United States, there has been a decline of the European honeybee since varroa were first noticed in Wisconsin in 1987. The ABC has considerable interest in the pollination of certain crops that are pollinated by honeybees, so there is interest in compounds that would have properties as acaricides without harmful effects to bees or humans. The mechanism of action of OA against varroa is not known, but it is believed to be attributed to acidity of this compound. One of the undesired properties of OA is that it is nephrotoxic to mammals. Therefore, using this acaracide in honeybee colonies can cause a potential introduction of OA into the food chain of humans, so there is a need for an acaricide with effectiveness similar to OA but without any toxic by products. It is possible to have OA derivatives that would have the same acidity as OA but would not have the toxicity to mammals associated with OA. Carboxylic acid derivatives such as carboxylic acid ester, amides and carboxy ketones are examples.

OA is a dicarboxylic acid and is therefore a proton donor (Brönsted acid) of about the same acid strength as difluoroacetic acid. One group of acids that has been neglected

by researchers investigating useful compounds against varroa is Lewis acids (electron pair acceptors). Methyl bromide is an example of a Lewis acid that has been used against termites as a fumigant. Lewis acids owe there effectiveness due to the carbocation that is formed from a stable leaving group. We will study the effectiveness of benzyl alcohol (BA) and selected derivatives thereof. BA is a compound that has been identified in propolis and bee pollen. In addition, it is a constituent of jasmine and hyacinth so it is naturally occurring compound and is used in spices used for human consumption. We believe that BA, or BA derivative with stronger Lewis acid potential would be likely candidates. BA derivatives would have electron donating or electron withdrawing groups. These groups have an inductive effect on the benzene ring and therefore effect the stability of the carbonation formed., and therefore, the effectiveness of the acaricide.

We will next determine the effectiveness of these compounds on varroa mites using a scintillation vial assay and on honeybees using caged bee studies. The desired effect would be to have low toxicity to bees with high morbidity to varroa. When the selected compounds are determined by these methods we will study the effects on honeybee colonies and determine the effectiveness on mites by using mite drop sticky boards.