Improving Oxalic Acid Treatments for Varroa Control

Project No.: 06-POLL7-Sammataro

Project Leader: Dr. Diana Sammataro, Ph.D.
Research Entomologist
Carl Hayden Honey Bee Research Center
2000 East Allen Road
Tucson, AZ 85719
(520) 670-6380 ext. 121
FAX: (520) 670-6493
dsammataro@tucson.ars.ag.gov

Project Cooperators: Dr. A. Nanetti (Italy) and J. Finely

Interpretive Summary:

The parasitic honey bee mite, Varroa (*V. destructor*) is becoming resistant to the registered chemical fluvalinate or coumaphos treatments. The emphasis now is to find alternative compounds that will still control mites without compromising the purity of hive products. Current stuidies with organic acids showed that they can help control varroa mites. We tested Oxalic acid (OA) because it has been used successfully in Europe. Sucrocide™, a registered product for mite control, was also tested. In this experiment, we examined if OA and Sucrocide were harmful to bees in cages with and without the addition of glycerol. Glycerol was chosen because is has been shown that glycerol added to sugar solutions may act as a synergist, causing OA to become more effective. First we fed different amounts of oxalic acid in sugar syrup with and without the addition of glycerol to bees in cages. Next we sprayed similar concentrations of Sucrocide to other caged bees. In both cases we measured the amount of material eaten by bees, the number of bees killed and the number of mites that died over a seven day period. Data are still being analyzed and we will repeat the feeding experiement to test bees for detrimental effects of the material on the health of bees.

Objectives:

1. Assess glycerol additive to OA to increase mite mortality without causing bee mortality.
2. Assess same additive to Sucrocide to increase mite mortality.

Materials and Methods:

We conducted two experiments to test the toxic effects on bees and on Varroa mites with different concentrations of glycerol mixed with the two test compounds. The first test was to feed the bees and the second was to spray the bees. OA was mixed with sugar syrup in different concentrations and with either no glycerol (G) or 5% added. For the Sucrocide, both a normal dose (0.625% v/v) and a double dose were added to the sugar syrup with 0% or 5% glycerol.

Cage Studies: Bees from several colonies and of mixed ages were shaken into a container and sprayed with water to keep them from flying off. Then, using a measuring cup (1/2C), approximately 200 were placed into screened cages. The cages were then placed into a 'hot room' maintained at temperatures and humidity similar to colony conditions (32C and approximately 40% RH). A small sticky board was placed under the screens of the caged bees to catch mites. The caged bees rested for 24 hours.

Feeding Method: Once the caged bees had rested overnight they were continuously fed measured amounts and concentrations of OA + G. After another 24 hours, dead bees and mites were counted and the condition of remaining bees assessed. Vials (50ml) were provided for feeding the bees with the solutions listed in Table I and with water. The glycerol feeding was kept on *ad libitum*, along with 50ml vials of water and 10 g of pollen. Food and water were replaced as needed. Dead bee and mite counts were made over seven days. A total of eight solutions were used (see Table I) for the feeding study.

FEEDING Code	Glycerol	oxalic	Sugar
F1	0.0%	0.0%	50%
F2	5.0%	0.0%	50%
F3	0.0%	3.5%	50%
F4	5.0%	3.5%	50%
	Glycerol	**Sucrocide**	**Sugar**
F5	0.0%	1X (0.625% v/v)	50%
F6	5.0%	1X	50%
F7	0.0%	2X (1.253%)	50%
F8	5.0%	2X	50%

Table I. Feeding solutions of Oxalic, Sucrocide and glycerol.

Spraying Method: Other caged bees were also used for spraying different concentrations of OA and Sucrocide (see Table II). Dead bee and mite counts were made over seven days. A total of nine solutions were used.

SPRAYING Code	Glycerol	Oxalic Acid	Sugar
S1	0.0%	0.0%	50%
S2	5.0%	0.0%	50%
S3	0.0%	3.5%	50%
S4	5.0%	3.5%	50%
	Glycerol	**Sucrocide**	**Sugar**
S5	0.0%	0.0%	0.0%
S6	0.0%	1X (0.625% v/v)	0.0%
S7	5.0%	1X	0.0%
S8	0.0%	2X (1.253%)	0.0%
S9	5.0%	2X	0.0%

Table II. Spraying solutions of Oxalic, Sucrocide and glycerol.

Results and Discussion:

The parasitic honey bee mite, Varroa (*V. destructor*) is becoming resistant to the registered chemical fluvalinate or coumaphos treatments. The emphasis now is to find alternative compounds that will still control mites without compromising the purity of hive products. Our work on oxalic acid and Sucrocide (Sammataro et al. 2007 in review) demonstrated that organic acids can help control varroa mites. Oxalic acid (OA) has been used successfully in Europe to control Varroa (Charriere and Imdorf 2002, Special supplement 2005; Enzo et al. 2004; Nanetti et al. 2003; Gregorc & Planinc 2004, Aliano et al. 2006). Because OA works through contact, rather than evaporation, it needs to be applied in solution with a liquid. OA is mixed in liquid sugar syrup and is trickled on via a syringe or sprayer to wet the bees and mites. The treatments require repeated applications 7-10 days apart three times. Since the methods are very time-consuming and invasive, we studied if the addition of glycerol could improve the efficacy and treatment times of OA by extending its effectiveness.

The second compound, Sucrocide™ is a newly introduced (since 2004) product registered for Varroa control in the U.S. (AVA Chemical Ventures, Portsmouth, NH). It must be applied as a liquid so the active ingredient (sucrose octanoate esters) can come in direct contact with the bee and phoretic mites. Sucrose Octanoate Esters kill either by rapid suffocation or by removing the insects' protective coating, causing them to desiccate. Milani (2001) has suggested that glycerol added to sugar solutions may act as a synergist, causing OA to become more hygroscopic.

First we fed different amounts of oxalic acid in sugar syrup with and without the addition of glycerol. At the same time we sprayed similar concentrations of Sucrocide to other caged bees. In both cases we measured the amount of material eaten by bees, the

number of bees killed and the number of mites that died over a seven day period (see Fig. 1 and 2).

We are still analyzing data and will be repeating some of these caged bee studies now that we have new cages to use. The main problem with the old cages was a high loss of bees as a result of leaking feeders which gave us results that were difficult to interpret clearly. We are also interested in the effects on the health of the bees of the materials we used. We will do another feeding study and will collect bees for analysis.

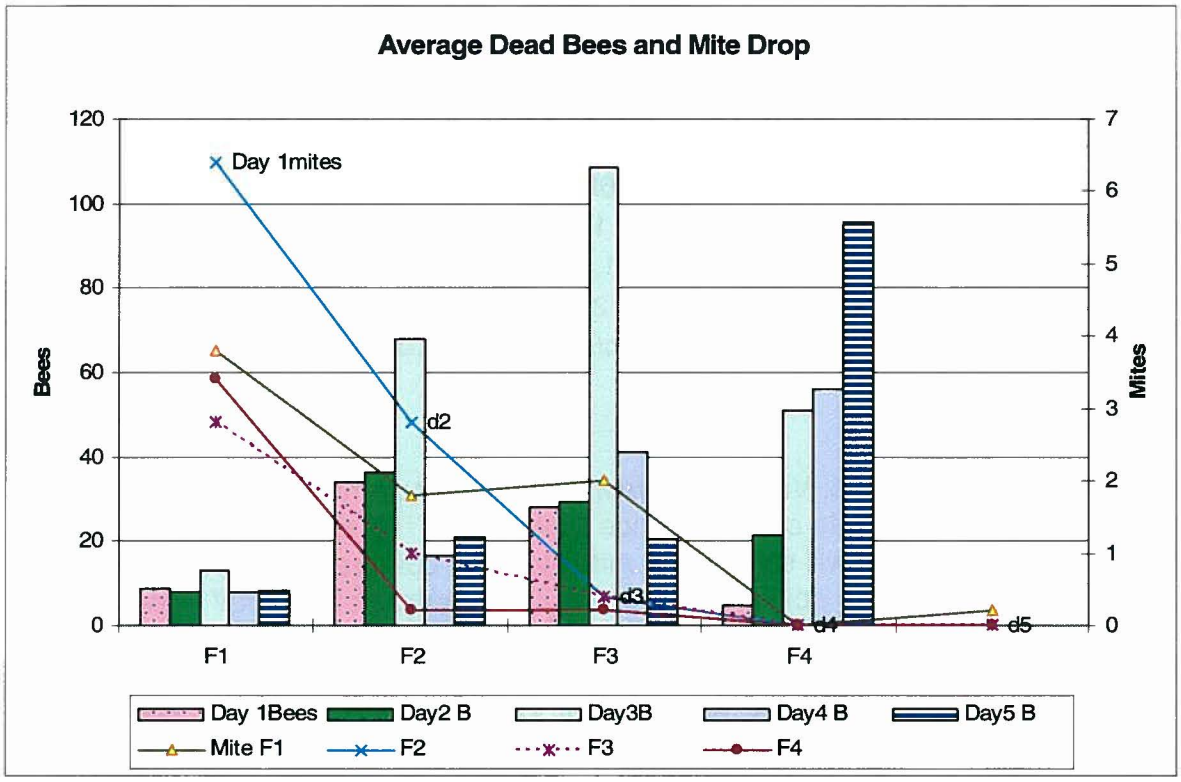

Fig. 1. Average dead bees and mite drop during the Feeding Trials.

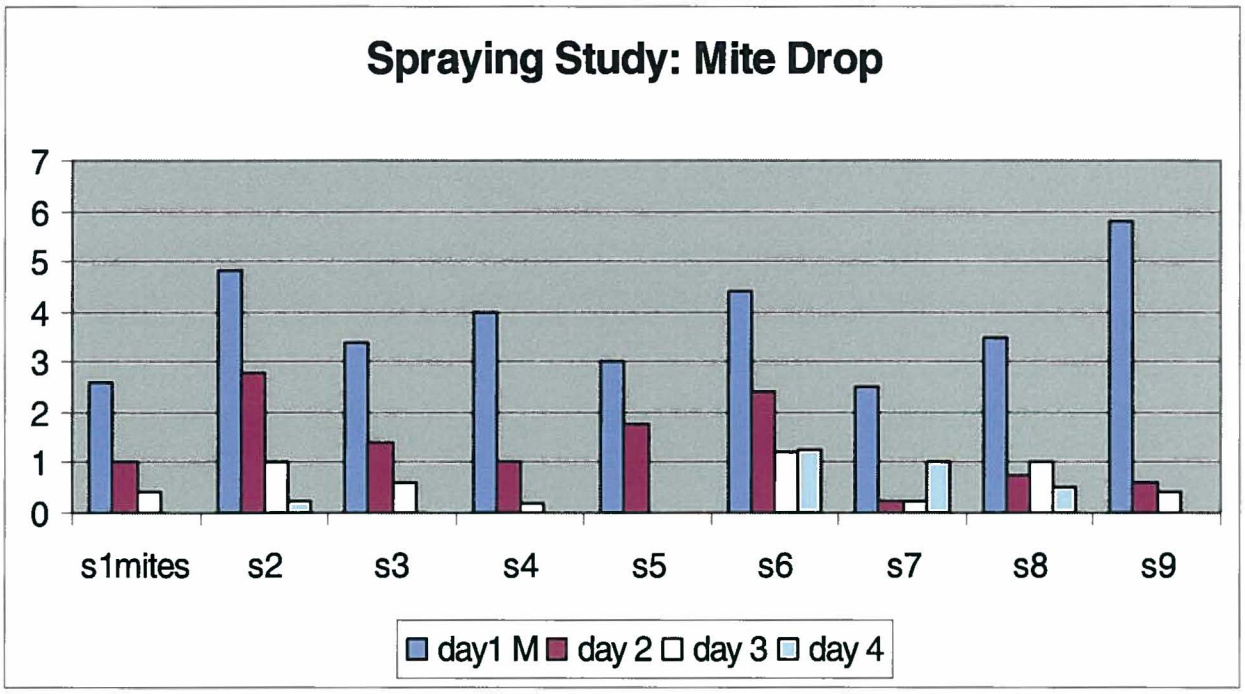

Fig. 2. Average mite drop by treatment (Spraying) by day. Data are still being analyzed.

Recent Publications:

Diana Sammataro and Jennifer Finely. 2007. Comparing Oxalic Acid and Sucrocide™ Treatments for Varroa Control under Desert Conditions. *J. Economic Entomology*. In Review.

Diana Sammataro, Jennifer Finely, Antonio Nanetti and John Skinner. 2007. Comparing Oxalic Acid and Sucrocide™ Treatments for Varroa Control under Three Different Climates Conditions. *Amer. Bee J.* In Review.