17-Hour Flash Formic Acid Treatment for Control of *Varroa* Populations During Periods of High Ambient Temperature

Project No.: **08-POLL6-vanEngelsdorp Final Report**

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Objectives:

- To quantify the effectiveness of MiteAway II pads as a hot temperature short-term treatment for control of *Varroa* mites
- To quantify damage (if any) to *Varroa* mites not killed while under cappings by formic acid treatment

Interpretive Summary:

In this study, various treatments were tested for their effectiveness against *Varroa* mites both on adult bees and within brood cells. We documented a dramatic increase in the number of dead mites in infested cells, indicating that formic acid can successfully be used as a miticide for mites that are not on the adult bees. Despite this mortality, the number of *Varroa* mites found on adult bees in treated colonies increased over the treatment period. This counterintuitive finding suggests that those mites surviving treatment were somehow damaged, preventing them from re-entering the cells. A second trial was conducted in Maryland where mite levels were quantified for a longer period of time. A reduction in mite levels in colonies treated with formic acid for ~24 hours and for the labeled period of 21 days was documented. None of the treatments in trail 1 or trial 2 had an adverse affect on bees or brood.

Materials and Methods:

Trail one was conducted in Berks County, PA in August 2009. Three yards containing at least 15 colonies each were selected and colony size and mite abundance were assessed. Fifteen colonies in each yard were randomly assigned to one of 3 treatment groups; single brood chamber formic acid application, double brood chamber formic acid application, and control.

Mite away II pads were applied to the formic treated colonies for less than 24 hours. In one yard, on both the day of treatment and on the day after treatment, up to 100 worker brood cells, and up to 20 drone brood cells were uncapped and the number of live and dead mature female mites were quantified. Further mites surviving formic acid treatment were collected and stored in alcohol, prepared for Electron Microscopic examination, and examined for evidence of damage. Colony strength and mite abundance assessments were conducted on all colonies ~30days after treatment.

Trial Two was conducted at the USDA Agricultural Research Station in Beltsville, MD in August 2009. One yard containing 54 colonies had colonies assessed for strength and *Varroa* mite abundance. Colonies were then randomly assigned to one of 4 treatments; Control, ApiVar strips (Amitraz), 24-hour MiteAway II, and 21-day MiteAway II treatment. Colony strength and *Varroa* mite loads were again assessed 30 days after treatment.

Results and Discussion:

Trail One:

The amount of bees and brood in the treated colonies did not change significantly when compared to control colonies ($F_{2,24} = 0.16$; $P = 0.8562$ and $F_{2,24} = 0.16$; $P = 0.8561$ respectively).

There was a dramatic increase in the proportion *Varroa* mites that were dead in worker brood cells in treated colonies compared untreated colonies ($F_{2,12} = 9.49$; $P = 0.0034$; **Figure 1**) with treatment applied to single chamber colonies having significantly more dead mites than the control the day after experiments were initiated ($F_{2, 12} = 17.42$; $P = 0.0013$). Despite this mortality, the mean abundance of mites on adult bees in colonies in treated colonies tended to have increased over the treatment period ($F_{2,24} = 3.01$, $P = 0.0598$; **Figure 2**).

This counterintuitive finding suggests that those mites surviving treatment were somehow damaged, preventing them from reinfesting cells. To test this theory, we are presently examining *Varroa* mites that were killed by formic acid within cells with an electron microscope to see if any damage to mite sensory hairs can be seen (**Figure 3**).

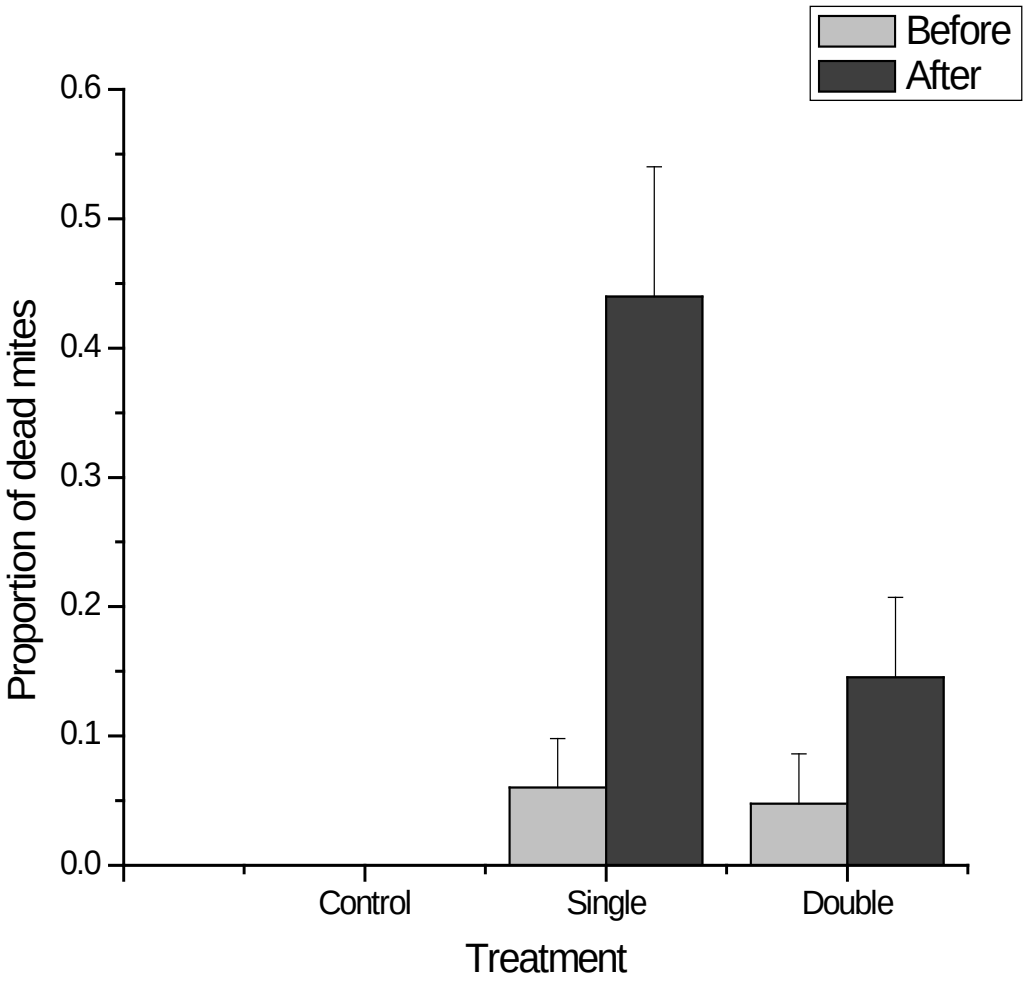

Figure 1. The proportion of *Varroa* mites in worker brood that are dead before and after no treatment or treatment with formic acid in a single or double brood chamber. The change in the proportion of dead mites in the single brood chamber was significantly different than the change in the control (P = 0.001).

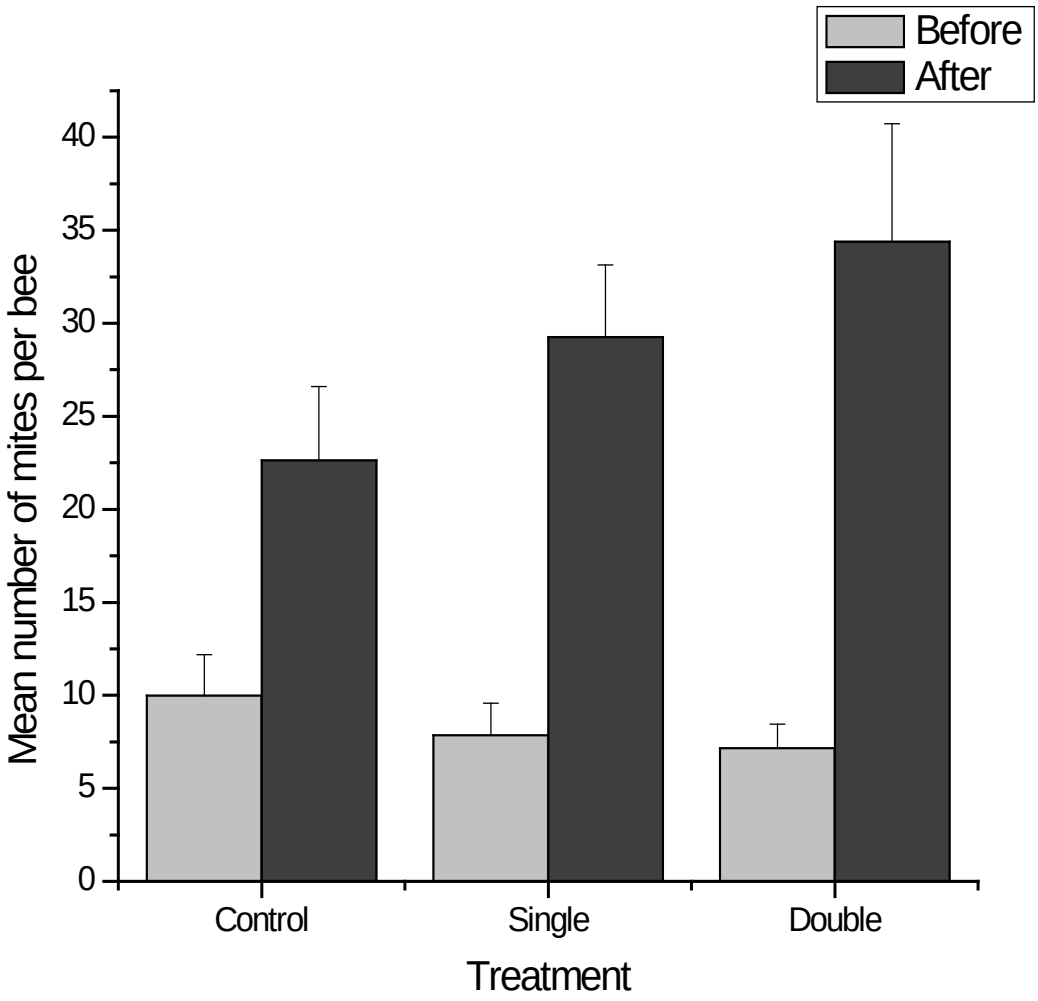

Figure 2. The mean number of *Varroa* mites in colonies that were untreated (Control) or treated with formic acid in a single or double brood chamber. The change in mean abundance in the single brood chamber was significantly different than the change in the control (P = 0.02).

Figure 3. Electron micrograph of a *Varroa* mite showing sensory hairs

Trail Two:
Further, another trial was initiated in Maryland and mite levels were quantified for a longer period of time. Treatment had a significant effect on reducing mite load in treated colonies over time ($F_{1,44}$ = 10.64; P = 0.0021; **Figure 4**).

Co v AM df =1,44; Co v FA21 df = 1,44; F = 7.95; P = 0.0072
Co v FA24 df = 1,44; F = 10.64; P = 0.0021

A reduction of mite levels in colonies treated with ApiVar ($F_{1,44}$ = 21.63; P<0.0001), formic acid for ~24 hours ($F_{1,44}$=10.64, P=0.0021) and formic acid for 21 days ($F_{1,44}$=7.95, P=0.0072) were recorded as compared to control colonies. None of the treatments had an effect on colony strength over the trial period. (Bees; $F_{1,44}$ = 0.11; P = 0.7415 and Brood $F_{1,44}$ = 0.56; P = 0.4600).

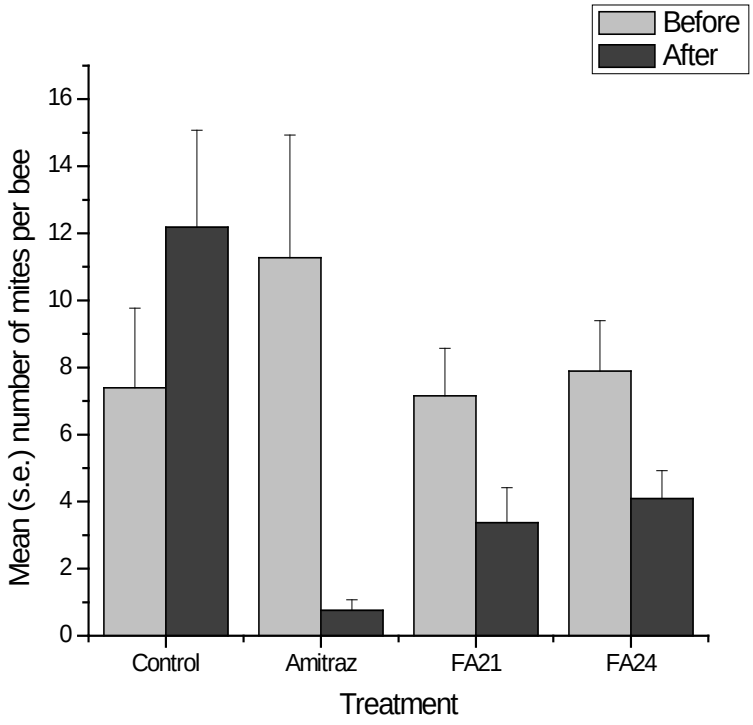

Figure 4. Mean number of *Varroa* mites per bee before and after no treatment (control), treatment with Amitraz, or treatment with formic acid for 21 (FA21) or 24 days (FA24). The change in the mean abundance of mites in all three treatments was significantly different from the change in the control (P < 0.01).

Conclusion:

Mite Away II applied at hot temperatures is an effective *Varroa* mite control product that does not cause significant damage to honey bee colonies. Further work refining its effectiveness should be conducted.

Research Effort Recent Publications:

none

References Related to this Research:

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Calderon, R. A., R. A. Ortiz, H. G. Arce, J. W. v. Veen, and J. Quan. 2000. Effectiveness of formic acid on *Varroa* mortality in capped brood cells of Africanized honey bees. Journal of Apicultural Research 39: 177-179.

Calis, J. N. M., W. J. Boot, J. Beetsma, J. H. P. M. v. d. Eijnde, A. d. Ruijter, and J. J. M. v. d. Steen. 1999. Effective biotechnical control of *Varroa*: applying knowledge on brood cell invasion to trap honey bee parasites in drone brood. Journal of Apicultural Research 38: 49-61.

Fries, I. 1989. Short-interval treatments with formic acid for control of *Varroa jacobsoni* in honey bee (*Apis mellifera*) colonies in cold climates. Swedish Journal of Agricultural Research 19: 213-216.

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Flash Formic Acid Treatment for the Control of *Varroa* Populations

Project No.: **08-POLL6-van Engelsdorp** **Interim Report**

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Objectives:

To test the efficacy of flash formic acid treatment for the control of *varroa* mites at high temperatures.

Interpretive Summary:

Organizational delays prevented the initiation of this study last year, and the trials associated with this project are set to begin this coming summer. We have made contacts with NOD industries to test a product that, should our findings be positive, be brought to the market in the next year. Preliminary trials suggest the product is effective and does not harm colony strength or queen condition.

Materials and Methods:

Apiaries with *varroa* levels will be set up in Maryland and Pennsylvania in July and August respectively. Colony strength metrics will be taken before treatment and mite levels quantified. Treatment application will occur on colonies with and without honey supers. Mite levels will be assessed before and after treatment. Mite viability under capped brood cells will also be assessed. Damage of mites will be explored using an electron microscope.

Results and Discussion:

No results are presently available

Recent Publications:

No publications of this work are presently available.