# Preliminary report to the beekeeping industry: NOD Apiary Formic Acid Flash Treatment*

An experimental test conducted by the University of Hawaii

## KEY POINTS

### FORMIC ACID

Formic acid is an organic compound that is found naturally in some animals, such as ants, and it can also be found at low levels in honey. Formic acid can be used as a bio-pesticide for *Varroa destructor* control.

### HAWAII FIELD TESTS

Under an experimental permit from the Hawaii Department of Agriculture the UH Honeybee Varroa Project tested a new formic acid treatment created by NOD Apiary Products Ltd. (Canada) in 3 apiaries located on the island of Oahu. A total of 42 hives were involved in the trial.

### NEW FORMIC ACID FORMULATION TESTED

The new formulation is designed to work at the hive's core temperature and consequently is affected less by high ambient temperatures and/or extreme temperature fluctuations.

We tested a single application of the product to the brood chamber. The product does not require hive spacers of any sort, and can be applied directly over the brood frames.

* Product currently in beta phase.

Varroa mite control poses many challenges since it is often difficult to kill the mites without affecting the bees. To effectively manage varroa, beekeepers must select treatments suitable to their climatic region, weigh in the monetary cost and the ease of application of the treatment, and finally, consider the potential long term benefits or risks that accompany the different control methods available.

The development of resistance to some of the registered compounds used to fight varroa has made beekeepers, now more than ever; consider how to manage the varroa mite problem without resorting to pesticides, and relying on an Integrated Pest Management strategy using natural acids and/or oils.

Formic acid is an organic compound that has been used as an organic miticide to control varroa. Formic acid appears to have a high degree of selectivity, when applied in the right dose, and it is more likely to kill mites rather than harm the bees. However, because the intensity of the formic acid application is affected by ambient temperature tropical areas, such as Hawaii, frequently experience temperatures much higher than recommended for formic acid products currently available.

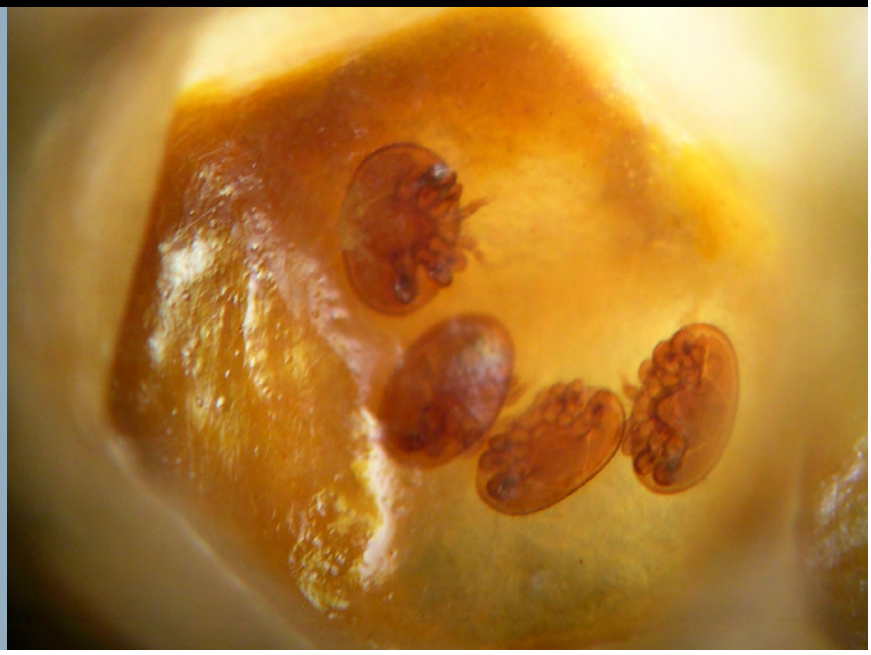
Because formic acid can be a powerful tool for varroa control, but its use in tropical climates is limited, UH was very interested when NOD Apiary Ltd. contacted us to participate in a field test of a new formulation of formic acid designed specifically for tropical climates.
This new NOD product is very appealing to us because it involves a single application and is relatively easy to deliver to the hives. The new formic acid treatment can be applied with the supers on, and without major concerns for residues, making it potentially indispensable for organic beekeeping in Hawaii.

The University of Hawaii entered into a non-disclosure agreement with NOD Apiary to test their new product in the field during July-Aug 2009. This preliminary report is a very brief summary of the most recent results we have collected on the performance of this new product. A more detailed report will be made available when it is officially registered; nevertheless, we at UH felt that the test results so far are extremely positive and that the beekeeping community should be informed of the potential benefits of this new product.

Formic acid and thymol, two commonly used fumigants, vary in their efficacy depending on the ambient temperature during the application. The product that we tested is expected to have a more consistent rate of release. The rate at which vapor is released is influenced more by the constant temperature of the hive than by ambient temperature.

## THE FIELD TEST
### TREATMENT GROUPS

We included in the trial a total of forty two hives of various colony strengths, the hives belonged to UH and to three local beekeeper collaborators. The experimental hives were assigned to either a control group or one of three treatment groups. The treatment groups consisted of a low dose treatment with no supers, a high dose treatment also without supers, and finally, a high dose treatment with the honey supers on.



### *Treatment groups and assessment of the hives*

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To evaluate the impact of each treatment on the colonies, we recorded the amount of brood present and the mite infestation levels via sticky boards prior to the start of the trial. Evaluation of treatment efficacy included both data on mite mortality and observations on the bee's response to the treatment.

Mite mortality after formic acid treatment was evaluated by comparing the mite fall onto sticky boards (control versus treatment) and by dissection of capped cells to observe the survival of adult and immature mites inside brood cells.

Colony response was evaluated by noting the degree of brood damage immediately after treatment, the queen presence or absence, and egg laying activity post treatment. The long term effects of the treatment will be evaluated by recording the levels of formic acid in honey before and after treatment and the overall hive strength before and after treatment.

Unlike other chemicals formic acid does not seem to accumulate in wax. Levels of formic acid in honey are still pending analysis., but the levels are expected to be very low.

***Please note:*** As seen with other fumigants, the bees respond to formic acid by initially exiting the hive and fanning. This mass exit can be alarming to observe, but during the experiment the bees re-entered the hive within twenty-four hours.

# RESULTS
## Control efficacy and colony effects

### *Efficacy of the treatment*

The mite kill within the first week of treatment surpassed our expectations. Treated colonies experienced a very large mite drop three days after product application. This initial large mite drop most likely derives from mites found on adult bees (phoretic stage) when the product was introduced to the hive.

The mite drop from the treated colonies continued to be notably higher than control colonies during the first 10 days after treatment. This prolonged increase on mite drop levels suggests that mites in capped cells were also affected by the treatment and were being removed from the hive as the new workers emerged from their cells (see sidebar).

Although the ongoing trial with NOD Apiary is about a month long, the UH team plans to continue monitoring the experimental colonies for at least three months after treatment to determine what the long term effects of this product are.

The large number mites that were eliminated with this product within the first week is extremely encouraging and should certainly improve the health of the treated colonies. The extended mite kill observed for treated colonies indicates that the mite reproductive cycle was also disrupted by the formic acid treatment. The phoretic mite kill and the reduction in mite reproductive success should help control the overall mite levels in treated colonies and reduce the impact of viral diseases transmitted via *Varroa destructor*.

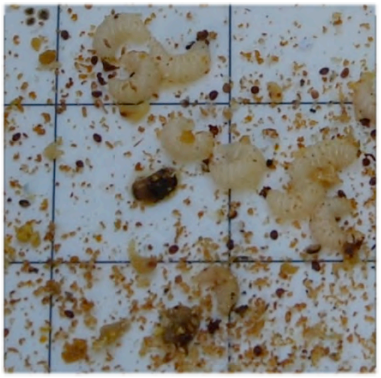
### *Mite mortality under capped cells*

Adult mites under capped cells suffered a significant mortality effect from the treatment, approximately half of the adult mites were found dead within the capped cells. Preliminary data suggest that immature mites suffered even a higher mortality, with over 90% of all young mites dying following treatment.

It is possible that the exoskeleton of the adult mites protected them from damage but that the younger stages were more susceptible to the vapors. Data on mite mortality within capped cells is rare in the literature but nonetheless, it is an important element in the control of Varroa mite populations. The University of Hawaii plans to conduct a smaller scale study of mite mortality under capped cells to address this variable.

### *Colony Effects: Brood damage and queen response*

The observed brood damaged was minimal. About 2/3 of the colonies removed a few uncapped larvae from the cells during the 3 day treatment. Bees under capped cells were apparently unharmed by the application.



A few bees that were emerging right during the application of the product were suffocated by the vapors (emerging brood burn) but the overall levels of brood disruption were negligible in all treated colonies.

The UH Honeybee Varroa Project Oahu team included Dr. Mark Wright, Dr. Ethel Villalobos, Scott Nikaido, and Tyler Ito. The NOD Apiary team included David and Mary VanderDussen. We would like to thank the beekeepers who so generously provided experimental colonies and logistical support for this trial: Dennis Takata, Rhea McWilliams, Howard McGinnis, George Hudes, and Charlie Reppun. Funding for this project was provided by the Hawaii Department of Agriculture.
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