

# Varroa Control With Formic Acid

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*Varroa* mites were first found in Canada in 1989, they got through the quarantine zones that were set up and hit my outfit in Ontario in 1996. At the time Apistan® was the only registered product (active ingredient: fluralinate, a synthetic pyrethroid), but even then resistance had emerged as a concern. Bayer® was the intellectual property holder of the other three main known off-the-shelf acaricide active ingredients: coumaphos (an organophosphate formulated as Perizin® and CheckMite+®), Flumethrin (also a synthetic pyrethroid, formulated as Bayvarol®) and Amitraz (a formamidine, IP rights went to Arysta Life Sciences in 2005. It is formulated for use in beehives as Apivar® strips).

As president of the Ontario Beekeeper's Association I had contact with representatives from Bayer. There was little interest from Bayer to register these products for what was expected to be short effective life spans. Beekeepers were casting about for alternatives. For me, formic acid showed the most potential, the question was how to harness it effectively with minimal side effects.

In 1997 NOD Apiary Products Ltd. was formed to bring sustainable mite control products to the marketplace, and we did. 2002 was the last year any active ingredient other than formic acid, now carefully formulated and tested, was relied upon to control mites in my outfit. 2012 marked a decade of relying on Mite Away® technology. [Photos from May 4, 2012.] While other outfits often struggled with *Varroa* control during this time my bees thrived, and selling nucs or just frames of brood in the Spring was the first harvest of the year.

Within the United States and Canada the law requires pesticides to be registered. Full registrations were granted in 2005 for end-use products Mite-AwayII™, and in 2011 and 2012 for Mite Away Quick Strips® (MAQS). MAQS, with the help of the University of Hawaii researcher Dr. Ethel Villalobos and dedicated personnel in the State Department of Agriculture, was made available to the beekeepers of Hawaii earlier under a special State registration, so the organic honey production certification held by beekeepers there could be maintained.

## Varroa as a Brood Disease: Targeting *Varroa* Reproduction.

The *Varroa* mites reproduce and feed on the pupating honey bee larvae developing under the brood caps, transmitting viruses that cause deformities and weakens the bees, one by one until thousands are affected, leading to colony collapse.

When brood is present, 70 to 80% of the female mites are out of sight under the brood cap, engaged in reproduction while feeding on the honey bee larvae. His-

torically *Varroa* treatments have relied on catching the female *Varroa* between reproduction cycles, while she is out on the adult bees. This time of exposure is called the phoretic stage, and is only for the female *Varroa* as the male mites do not leave the cell.

With MAQS the formic acid molecule was made sticky. It penetrates the brood cap and is very effective at killing both male and female *Varroa* there, targeting reproduction. It is also effective at killing the phoretic *Varroa*. Therefore MAQS is effective against all stages of the *Varroa* life cycle. However, the developing bee under the cap appears to be unharmed by the treatment. By targeting *Varroa* feeding on developing bees under the brood caps, retarding virus transfer, MAQS is treating *Varroa* like the brood disease it truly is.

## What is MAQS?

MAQS is a combination of free-formic acid and slow-release formates in a saccharide gel strip, made thin enough to fit into the bee-space. The gel strip is wrapped in a specially formulated compostable wicking paper developed with BASF. It is placed on the frame top bars in the brood rearing area of the hive. No rim or any other extra equipment is required.

MAQS technology, combined with the response of the bees, provides a fumigation treatment that takes place over a seven-day period. Formic acid is naturally occurring in hive air at levels of one to five parts per million (ppm), so is part of what bees smell like. I love the warm scent of healthy bees. When the treatment is applied the formic acid levels quickly elevate until the bees gain



Pre MAQS treatment, June 8, 2011



One hour after MAQS application, same hives now bearding, June 8, 2011. 93°F.

control of the formic acid level by movement of air. It is very important that the colony has adequate access to fresh air. The bees are quite comfortable functioning at 40 ppm and even higher; amounts greater than 20 ppm are toxic to the mites. Typically the bees will hold the formic acid concentration around 40 ppm level for three to four days, before dropping off to the naturally occurring level of one to five ppm a week after application. With MAQS the bees assume control of the mites.

#### Side Effects

With MAQS all the effects are acute, there are no long-term chronic or residual effects. There is a wide range of colony responses, even in the same beeyard. Bearding behaviour is not uncommon [insert before and after photos], but many colonies, even in the same yard treated at the same time, do not. Some colonies have some initial egg and young brood loss, others do not. Some bees, including queens, that are fragile for reasons from age to disease loads, are more susceptible to formic acid vapours. In some colonies, especially where supercedure or swarming was initiated by the colony pre-treatment, mother and daughter queens may be found post treatment. Where queen cells are found pre or post treatment they should be left alone for the young queens to emerge and mate. In short, the best approach with MAQS is for the beekeeper to apply the treatment after making sure

May 4, 2012, hive unwrap 4 years MAQS.



there are good food reserves and good access to fresh air across the width of the hive, and then let the bees manage their affairs! Under warm conditions the beekeeper can validate the colony being queen-right one month after treatment as part of standard beekeeping practice. It should be noted that in the north in the Fall colonies may naturally shutdown brood-rearing for a period but there should be a healthy-sized cluster going into Winter.

Formic acid vapours are corrosive to ferrous metals, but not aluminium or most stainless steels. Some queen excluders get a white powder on them and will show rust around the edges over time. Plastic excluders are not affected; there are now some good ones available.

#### Residues??

Honey itself is naturally acidic, with formic acid being one of the naturally occurring acids making it so. When bees are treated with MAQS the level of formic acid in honey stays within naturally occurring levels. Formic acid is not lipophilic, so it will not be absorbed into the wax.

#### Adoption by the Industry, Testimonials.

Sustainable *Varroa* control is an on-going issue for many, due to concerns over residues and sub-lethal



California 2013, showing bottom board. (Woodworth photo)



California, Feb 2, 2013, spent MAQS strips from fall 2012 application. (Woodworth photo)

effects of other treatments. Although these issues are overcome with MAQS, treating bees with MAQS is a different approach, with an interactive response from the bees. There is a learning curve.

For the November 2012 California State Beekeepers Association Annual Meeting some members had requested that a panel of people whom had tried MAQS for a couple of years share their experiences as part of the agenda. The organizers agreed and a panel was arranged, made up of Frank Pendell from Stonyford, CA, a queen breeder and past-President of the CSBA, Bob Miller, Watsonville CA, of the CSBA Research Committee and a commercial beekeeper, and Randy Oliver, of Grass Valley CA, a commercial beekeeper and author of [www.ScientificBeekeeping.com](http://www.ScientificBeekeeping.com). From the presentations and questions asked there did not seem to be any concern over whether or not MAQS worked, the main subject of discussion was the effect on queens:

Frank Pendell shared some of his professional background and explained that, prior to using MAQS he was replacing and rebuilding over 40% of his bees every year. Treating with MAQS has reduced that, his bees are doing better and he is in better control of his queen replacement timing by using it. He also told a funny story about some spent strips. Frank likes to keep his bee yards tidy so he takes the spent strips that are removed from the hives as they work the bees, and dumps them behind the barn to compost. In the morning he was treated to the sight of wild deer, having found them in the night, eating them like candy, with the strips flapping from their mouths as they ate.

Bob Miller said that beekeepers needed to keep an eye on their queens and to be ready to replace them if they thought necessary. He had no trouble with acceptance of queens after treatment, so suggested beekeepers can just work the timing of treatment into their management practices.

Randy Oliver had been testing MAQS in various ways since 2010, and had had a lot of beekeepers calling him about it. Many callers preferred to use a single strip for a half-dose treatment (a standard dose is two strips), especially if they had permanently reduced entrances on palletized bees. Randy had not experienced queen loss issues himself, with either a full dose or a half dose, and speculated that his bees may be more use to treatment with fumigants because he had a history of using formic acid and thymol products rather than conventional products.

After questions and in summary, all members of the panel said they planned to continue to use MAQS in their outfits. They liked how the bees rebounded after treatment and the queen issues were manageable, with overall queen health and colony strength improved.

#### **Migratory beekeepers Brent and Bonnie Woodworth**

The Woodworth's keep bees in ND for the Summer, stage them in Idaho late Fall, and then take them into California in January to be prepped for the almond pollination. They were dedicated users of Mite-AwayII and were upset when the decision was made to transition to MAQS, taking Mite-AwayII out of production. In the initial use of MAQS in June of 2011 they estimated that they lost 10% of their queens and carefully kept an eye on things. As the summer progressed they had an excellent honey

crop and the bees looked great yet they were leery about a Fall treatment. However, with some experimentation in the Spring they found the bees could handle the treatment with ease by off-setting the second brood chamber back far enough for the bees to come and go the full width of the hive. The bees came through Winter very well and were power units for pollination. Last year (2012) the honey crop was down due to the environmental conditions but the bees looked good. They again had treated with MAQS in the Spring and the Fall while the bees were in ND. The bees arrived in California in January in great shape overall. Here is their frank assessment:

*February 3, 2013:*

*Some of the bees are light, so they are feeding. A couple hives on the first load had starved which is hard to believe considering how heavy the semis were when they hauled them to Idaho in November. The third load that just got there Brent was really pleased with, very few bad ones and very even in strength.*

*They have been shaking bees out of the really strong hives and evening up the few that need bees.....*

*..... All I am hearing is horror stories about losses. Major losses. The word is they will be short hives for almonds. Everyone is looking for more hives to fill their contracts and there aren't many anywhere. XXXXXX had a major loss, I heard he bought all 20,000 singles that XXXXXXXX had for sale in Florida. Many beekeepers have lost 60% of their hives. Frankly, Brent is one of the few smiling right now.*

*Katie Lee will be doing the rounds in California checking the hives again. She will be even more impressed this round.\**

*\*author's note: Katie Lee is part of the national Bee-Informed Project.*

*Bonnie added February 10, 2013:*

*I would like to state in your article that we have used formic since it became available and we have not experienced any significant losses in those seven years. We did have some minor issues with Nosema, but now we treat twice a year with Fumigillin and have not had losses of field bees since we began regular treatments.*

*Although it (this treatment regimen) is more labor intensive and more expensive than some treatments beekeepers have been relying on, the results are dependable and worth the effort and expense.*

*Other treatments may seem inexpensive, but the cost to rebuild dead colonies must be factored in. Loss of honey production is also an issue that can be overlooked. Spending six dollars to treat a hive seems negligible when you can rent that hive for \$150.00 for almond pollination. Now that the University of Minnesota has established the Bee Informed Partnership, we will have data to prove the effectiveness of MAQS. Get into a regular treatment program twice a year with MAQS and your bees will be as they should be, healthy and thriving.*

*There are many challenges to developing and bringing an effective varroacide to the marketplace. NOD Apiary Products is continuing to do research and development, and plans to have an extended shelf life formula available to the beekeepers in a couple more years. In the meantime, we will continue to share what we have learned to assist the beekeepers that want to transition to MAQS to have the healthiest and strongest colonies possible. BC*