Police arrested two kids yesterday, one was drinking battery acid, the other was eating fireworks. They charged one and let the other one off.

-- Tommy Cooper

The "suits" in Washington generated a lot of excitement in March by approving a new varroa treatment, oxalic acid dihydrate. There were many things that made this approval interesting, not the least of which was that it wasn't pursued by a manufacturer. Instead, the application was submitted by the US Department of Agriculture in response to President Obama's initiative on pollinator health. The approval gave the EPA the chance to demonstrate acquiescence to Obama's directive to "expedite review of registration applications for new products targeting pests harmful to pollinators."

What is it?

Oxalic acid is a naturally-occurring chemical that is found in fairly high concentrations in a variety of plants, vegetables and even honey. Spinach is loaded with it (0.97%) while parsley has almost twice as much (1.7%). A calcium sponge, oxalic acid readily combines with calcium to form calcium oxalate crystals. These crystals are unpleasant to taste and in certain foods cause characteristic swelling of the tongue and kidney stones. In high enough doses, oxalic acid can interfere with a creature's normal calcium channels that are necessary for nerve and muscle action. Through all this, oxalic acid acts as a plant's home-grown herbivore repellent.

Even though it is "natural", oxalic acid is an extremely strong acid, ten thousand times stronger than acetic acid at the same concentration. It can seriously burn skin, eyes and lungs if handled carelessly. EPA puts it in Toxicity Category I, the most toxic rating.

History as a pesticide

Oxalic acid was first approved as a pesticide, for use as a disinfectant and sanitizer, in 1957. It was approved for re-registration in 1992, but the registrants voluntarily cancelled their registrations in 1994. Since then it has been commonly available for nonpesticidal purposes; it is known as "wood bleach" in hardware stores.

Oxalis (aka wood sorrel, sourgrass, false clover), one of the many plants that naturally contain oxalic acid.

In Europe, Canada, New Zealand and elsewhere, oxalic acid is approved and has been used for many years as a treatment for varroa mites. Many beekeepers in the United States have been using it illegally for this purpose and have been pushing for EPA approval. One of the obvious stumbling blocks has been that no manufacturer has been willing to sponsor the expensive and liability-invoking approval process. The American Beekeeping Federation considered sponsorship but with Obama's directive, USDA stepped in and became the sponsor-of-record.

Under NAFTA cooperative rules, USDA was able to piggy-back on the extensive safety and efficacy studies that were used to support Canada's approval of oxalic acid as a miticide and so didn't have to replicate the research. The basic science, environmental impact and human exposure information was already in place from the old, expired registrations in 1957 and 1992. So basically all that USDA had to do was compile the supportive documentation and submit the paperwork to EPA.

Directions for legal use

The EPA label, which is the law and must be followed, allows three different modes of

application: drip via a syringe, vaporizing using a heat wand device and spraying. The vaporizers that I have seen look like long-handled spatulas; oxalic acid dihydrate crystals are placed on the flat end and a cord on the other end is attached to a car battery. The official application directions for each method are copied below:

Oxalic acid is used to treat colonies during low brood periods, packages, or swarms. This product can also be used as a "clean up" Varroa treatment following the application of a different acaricide where Varroa infestations continue to be problematic.

SOLUTION METHOD:
NOTE: *To completely dissolve Oxalic Acid Dihydrate, use warm syrup.*

- *Dissolve 35 g of Oxalic Acid Dihydrate in 1 liter of 1:1 sugar: water (weight:volume). Smoke bees down from the top bars.*
- *With a syringe or an applicator, trickle 5 ml of this solution directly onto the bees in each occupied bee space in each brood box. The maximum dose is 50 ml per colony whether bees are in nucs, single, or multiple brood chambers. Under certain unfavorable conditions (e.g., weak colonies, unfavorable overwintering conditions), this application methods may cause some bee mortality or overwintering bee loss.*

VAPORIZER METHOD:

- *Apply only to outdoor colonies with a restricted lower hive entrance. Seal all upper hive entrances and cracks with tape to avoid escape of Oxalic Acid vapor. Smoke bees up from the bottom board, Place 1.0 g per brood chamber of Oxalic Acid Dihydrate powder into vaporizer. Follow the vaporizer manufacturer's directions for use. Insert the vaporizer apparatus through the bottom entrance. Apply heat until all Oxalic Acid has sublimated.*

SPRAYING PACKAGE BEES:

- *Ensure bees are clustered before applying oxalic acid (for example store in cool dark location 24 hours before application).*
- *Spray broodless package bees with a 1:1 sugar:water solution at least 2 hours before spraying with oxalic acid. This allows bees to fill honey stomachs with sugar water reducing ingestion of oxalic acid.*
- *Mix a 2.8% oxalic acid solution by dissolving 35 g of Oxalic Acid Dihydrate in 1 liter of 1:1 sugar:water (weight:volume).*
- *Evenly apply 3.0 mL of 2.8% oxalic acid solution per 1,000 bees using a pump sprayer or battery powered sprayer (for example, a typical 2 lb package contains approximately 7,000 bees which requires 21 mL of solution). Apply solution evenly on both sides of the package.*
- *Store bees in a cool darkened room for 72 hours before hiving.*

Usage restrictions include:

- *Use only in late fall or early spring when little or no brood is present. Oxalic Acid Dihydrate might damage bee brood. Oxalic Acid Dihydrate will not control Varroa mites in capped brood.*
- *Do not use when honey supers are in place to prevent contamination of marketable honey.*

Oxalic acid dihydrate comes with a "Danger" warning signal. It should not be ingested or inhaled and can cause irreversible damage to the eye. Applicators of either the spray or vaporization methods should wear appropriate protective gear, including goggles, respirators, long-sleeve shirts and gloves.

Benefits

I have not used oxalic acid yet and I do not personally know anyone who has. However beekeeper-scientist Randy Oliver has written a series of articles on his research with it (the latest is here) and he reports that it is very effective in knocking down mites. I can see why a California beekeeper such as Mr. Oliver would find a quick, one-shot, late-season treatment useful just ahead of the build-up for February almond pollination.

Another reason that commercial beekeepers like oxalic acid is that it is extremely cheap. Even Brushy Mountain's legal, official beekeeper's version amounts to only 50 cents per hive using the spray method (not counting the cost of the sugar syrup) and 17 cents for the vaporizer method. This is far less than, for example, ApiGuard's cost of about $7 per hive for a full treatment. If someone were to buy unapproved oxalic acid and illegally use it rather

than the official pesticide-grade stuff, their cost would fall to less than 2 cents per hive. If you had 5,000 hives needing treatment, what would you do?

Is it for me?

Before everyone rushes out to dump oxalic acid on their bees, there are several key points that we should consider here in Piedmont North Carolina.

First and foremost, oxalic acid treatment is only indicated during periods when there isn't any brood. The main reason for this is that the treatment is a one-shot deal and it doesn't affect mites underneath pupae cappings. If sealed brood is present, mites will emerge soon after the treatment has been done and the colony will once again be mite-infested. So treating broodless colonies is the only effective way to cleanse the hive of mites when using oxalic acid. (In contrast, the thymol treatments [ApiGuard and ApiLife Var] continually kill mites for several weeks so mites under cappings are killed when they finally emerge. The formic acid treatment [MiteAway Quick Strips] kills phoretic mites and mites under cappings.)

Our established colonies are only broodless for a short period around December/early January, if at all. If you check the calendar, you'll see that is also when the temperature is relatively cold. The surest way to kill bees in the winter is to get them wet in cold weather. They can easily handle cold, but wet plus cold equals dead bees.

Related to the timing issue is that my goal is to overwinter healthy bees in order to have the best possible chance for a highly productive spring. To do that, I want the nurse bees that raise my overwintering bees to be healthy. That means that I must have, to the extent possible, reduced the number of varroa mites in the hive to insignificant levels before those developing nurse bees pupate. Therefore my ideal target is to apply an effective miticide in mid to late August, early September at the latest. Waiting until December means that I would be getting rid of varroa on already-damaged overwintering bees.

Also note that oxalic acid can be rough on brood, causing brood loss. That is a secondary reason that it is recommended for broodless periods.

My thoughts

It seems to me that oxalic acid will be a useful item to have in the bottom of my toolkit for certain situations. For example, it sounds ideal for cleansing a captured swarm before I hive it. However because it only works well on broodless colonies, I don't think it will have value for me for treating established hives.

All that being said, I would be very interested to hear from beekeepers who have experience with oxalic acid. What factors made it your choice? Did it work well for you? How did it compare to other treatments? What advice do you have for others?

Whatever treatment you choose to use, please do *something* to control varroa mites. Our highly mobile bees are part of a larger bee community that extends for several miles around our personal bee yard, and each of those communities overlaps in patchwork fashion so we are all connected. Any one person's actions or failure to act with respect to controlling pests has repercussions on us all, in the same way that a single child with head lice, left to run amok, can cause an entire school to become infested. See previous articles on other treatment options and the need for action:
Know thy enemy (June 2015)
How might we smite mites? (August 2014)
Blood-sucking baby killers are after your bees (September 2013)

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