How to Apply Oxalic Acid Via Sublimation to Control Varroa

Varroa mites are parasites of honey bees. They harm colonies by weakening the bees they feed on and by spreading virus diseases. Beekeepers use several methods to control varroa, including the natural chemical oxalic acid (*OA*).

Hives are treated with *OA* by *Trickling*, *Spraying*, and *Sublimation* (also called *Vaporization*). Trickling and spraying apply *OA* in solution. In sublimation, *OA* crystals are heated with an applicator tool. The heat causes the crystals to sublimate (turn directly from solid to gas). LASI research compared these methods at several *OA* doses. Sublimation was best: effective at killing varroa at lower doses, not harmful to the bees, and not needing the hive to be opened.

Trickling. Hive is opened & oxalic acid solution poured onto the bees.

Spraying. Frames lifted, and OA solution sprayed onto bees.

Sublimation. Heated tool in hive entrance to vaporize OA crystals.

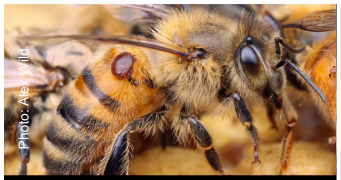
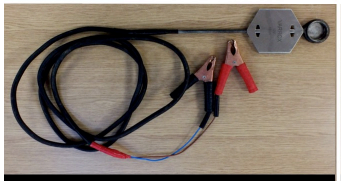


Photo: Alex Hild

Phoretic. Varroa clinging to adult bees can be killed by OA.

In Cells. Varroa in capped cells are not killed by OA application.

Mask. For safety, regulations require use of an approved mask.



Applicator Tool . Varrox M3080 sublimator, 150w, used at LASI.

Battery. This 12v lead-acid battery can power the tool for 8-9 hours.

Measure. A half teaspoon measure, 2.5ml, is almost exactly 2.25g OA.

To apply *OA* via sublimation you need: 1) applicator tool (several types are sold); 2) battery (12 volt lead-acid battery as used in cars and caravans); 3) oxalic acid (technically "oxalic acid dihydrate"); 4) mask; 5) measure (half a teaspoon of *OA* weighs c. 2.25 grams); 6) foam to temporarily seal hive entrances.

Place half teaspoon (2.0-2.5g) of *OA* into the holder at the end of the applicator. Insert applicator into hive entrance and seal entrance with foam. If the applicator is cold it will take several minutes to heat up, and then several minutes to vaporize the *OA*. If the applicator is on and hot the *OA* will start to sublimate within seconds. Make sure the applicator is in the hive before *OA* vapour is produced, so that vapour is confined to the hive. During and for up to 10-15 minutes after application, seal the hive entrance with foam.

Apply *OA* to broodless hives. If capped brood cells are present, many varroa will be in these and will not be killed by the *OA*. In the UK, December is the month with least brood. It is best to check hives immediately or a few days before application and remove or scrape out any small patches of capped brood. It is recommended to apply *OA* at outside temperatures of 4-16C.

Based on our research http://dx.doi.org/10.1080/00218839.2015.1106777 LASI recommends applying 2.0-2.5g *OA* to broodless hives in winter.

Official Regulations

In the UK, a registered *OA* product, Api-bioxal, was approved in 2015 by the Veterinary Medicines Directorate, who state "When handling the powder (both during vaporisation phase and pre-treatment phases) wear protective mask conforming to European Standard EN149 (type FFP2)". Api-bioxal is oxalic acid dihydrate (88.6% by weight), plus silica gel and glucose. The recommendation for sublimation is 2.3g Api-bioxal (= 2.04g *OA*) per hive. LASI research tested almost exactly this amount. In the USA, approval was given in 2015 by the Environmental Protection Agency who state "In addition to the standard beekeeping suit (veil, long-sleeved shirt, long pants and gloves) as personal protective equipment, a respirator and goggles are required."

Key Results of LASI Research Comparing Oxalic Acid Application Methods

* 2.25g *OA* applied to broodless winter hives via sublimation killed 97% of the varroa.
* Colonies treated with *OA* in winter via sublimation had 20% more brood in spring than those treated via trickling or spraying, or untreated control colonies.
* Sublimation is effective at killing varroa at lower doses than trickling or spraying.
* Sublimation has no negative effect on colony winter survival or bee mortality.
* The exact amount of *OA* used is not critical. 1.125g and 4.5g were also effective.

Oxalic Acid Safety

* *OA* is a natural chemical, and is found in honey and most vegetables.
* Carrots are 0.5% *OA*. One pound contains enough *OA*, 2.25g, to treat one hive.
* *OA* is toxic. It is estimated that 45g, enough to treat 20 hives, would kill if eaten.
* *OA* is more harmful if breathed in, as it affects mucous membranes.

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Life Sciences

LASI does research on honey bees & social insects, trains students, & provides outreach. This Information Sheet was written by Francis Ratnieks, Professor of Apiculture, & Hasan Al Toufailia and sponsored by the Eva Crane Trust ©2016. www.sussex.ac.uk/lasi

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