National Organic Standards Board
Livestock Subcommittee Petitioned Material Proposal
Oxalic Acid
February 5, 2019

Summary of Petition for Oxalic Acid Dihydrate:

A petition for oxalic acid was received in October 2017 requesting addition to the National List at §205.603 as a treatment of varroa mites in organic beehives. This material has not been petitioned for inclusion on the National List in the past. Oxalic acid is currently labeled and approved by the EPA for use in beehives (Registration #91266-1). In 2010, the National Organic Standards Board made a recommendation on Organic Apiculture that included oxalic acid for use for control of varroa mites in honeybee hives. The recommendation was not implemented by the USDA.

Currently there are two materials on the National List that are used as pesticides to control varroa mites in honeybee hives. The National List states the following:

As topical treatment, external parasiticide or local anesthetic as applicable: §205.603 (b)(2) Formic Acid and (b)(8) Sucrose Octanoate Esters (in accordance with approved labeling).

At the NOSB October 2018 meeting, the NOSB recommended to remove sucrose octanoate esters (SOEs) from the National List. SOEs are not available for use by beekeepers, since they are no longer EPA registered. In addition, SOEs are ineffective for varroa mite control. A petition was received in December 2016 for thymol, a material that is also used for varroa mite control in honeybee hives, but this petition requested synthetic thymol be considered only for use in organic livestock footbaths. As with all materials on the National List, materials can only be used as annotated.

A petitioned material discussion document was presented at the October 2018 NOSB meeting in St. Paul, to begin gathering public comment on this material. These questions were asked:

1. Is this material needed by organic beekeepers, and why?
2. There are alternatives to this material on the National List for control of varroa mites in honeybee hives. In addition, nonsynthetic materials such as essential oils and management techniques such as brood comb trapping is used for mite control. Why are the other materials/methods insufficient for varroa mite control in organic production?

There were no substantive comments presented, other than three organizations stating there should be organic apiculture standards in place before materials are placed on the National List for this unique agricultural system. Apiculture standards were recommended by the NOSB, but the NOP has not implemented this recommendation. Organic apiculture products such as honey, beeswax, and more are only certified by a few of the accredited certifiers under the NOP.

Summary of Review:

In October 2018, a Technical Evaluation Report was received by the NOSB. Oxalic acid dihydrate (CAS number 6153-56-6 and 144-62-7) is petitioned as an alternative treatment to formic acid for varroa mites. Three EPA-approved application methods would be allowed under this petition: by solution to package bees, by solution to beehives, and by vapor treatment to beehives. Oxalic acid is naturally occurring in plants, fungi, bacteria and animals, as well as honey. Vegetables such as beet leaves,

spinach, chard, and rhubarb contain oxalic acid. It also can be produced in the human body through the metabolism of glyoxylic acid or ascorbic acid.

This material can be used in rotation with, or instead of, formic acid. Current research indicates that the amount of oxalic acid typically applied to the honeybee hive is not toxic to the bees, and is sufficient to kill varroa mites.

This material has been used for many years by hobby beekeepers, who developed methods for dispensing oxalic acid as a vapor into their hives. Recently, a more commercial method of delivery was developed to include use as a spray on bees, or trickled as a liquid into the hive, making its use available to a wider audience of beekeepers. Oxalic acid can be in direct contact with bees, at the approved levels, as well as with components of the hive in order to provide effective varroa mite control. Application in the hive is done when there is no brood present. Detailed methods of application are noted in the TR.

At the time the TR was written and received, it was noted that oxalic acid for parasite control in beehives was not allowed in all states. The Livestock Subcommittee requested further information, and it was clarified that state-level registration had not been completed.

The Subcommittee discussed whether apiculture materials should be reviewed and approved only after there are NOP apiculture standards. It was noted that the NOP currently allows for organic honeybee products to be sold with the USDA organic seal, and honeybee products are certified organic by numerous NOP accredited certifiers. All Livestock Subcommittee members support the implementation of the 2010 NOSB recommendation for organic apiculture standards.

Specific Uses of the Substance:

Oxalic acid can be applied to a hive in two ways: In a sugar syrup to be trickled between frames, and as a vapor treatment. There are numerous types of equipment, both home-made and commercially available, that provide the beekeeper the means of heating the oxalic acid and filling the hive with this vapor. In addition, oxalic acid is used to treat packaged bees before they are shipped to customers. Packaged bees with infestations of varroa mites have been a problem for beekeepers and the use of a sugar/oxalic acid syrup spray is a useful method to address this issue. Varroa mites, an invasive pest, are one of the many production problems affecting the livelihood of beekeepers.

Numerous chemical varroa mite treatments have been used over the years in nonorganic operations. Many of these treatments are no longer effective due to the development of resistance by the varroa mite. Formic acid has been used for many years in honey bee hives, with no varroa mite resistance. It is considered unlikely that resistance will occur. Similar to formic acid, it is unlikely that varroa mites will develop resistance to oxalic acid.

Approved Legal Uses of the Substance:

Oxalic acid has been used against varroa mites since the early 1980s. Oxalic acid is allowed under the Canadian Organic Standards as follows:

- CAN/CGSB-32.310-2015 Clause 6.6.10: *"The use of veterinary medicinal substances shall comply with the following: (a) if no alternative treatments or management practices exist, veterinary biologics, including vaccines, parasiticides or the therapeutic use of synthetic medications may*

be administered, provided that 408 *such medications are permitted by this standard and Table 5.3 of CAN/CGSB-32.311 or are required by law."*

- CAN/CGSB 32.311-2015 Table 5.3: Healthcare products and productions aids as follows: "*Oxalic acid: For mite control in honeybee colonies"*

The EU regulation has this annotation:

- EC No 889/2008: Chapter 2 (Livestock production): Section 4 (Disease prevention and veterinary treatment), Article 25 (Specific rules on disease prevention and veterinary treatment in beekeeping): *"6. Formic acid, lactic acid, acetic acid and oxalic acid as well as menthol, thymol, eucalyptol or camphor may be used in cases of infestation with Varroa destructor."*

It is allowed under Codex Alimentarius and well as IFOAM standards. Japan does not have apiculture standards and oxalic acid is not present on their list of approved materials. As of the writing of this proposal, oxalic acid is currently registered for use in beehives by the EPA in all but one state, California.

Action of the Substance:

The mode of action of this substance is not clearly understood, but it appears to be attributed to its acidity (pH near 0.9). Oxalic acid will cross the exoskeleton of the mites in a few hours of application and cause death. Oxalic acid vapor can enter the mite through the soft pads of its feet, enter the mite's blood stream and kill it. When mites parasitize and suck on the bee, it can kill the mite through this method as well. There is no clear research to determine if one or all of these are the main modes of action.

Manufacture:

Oxalic acid is a dicarboxylic acid, which is in a crystalline form when solid, but loses this structure when dissolved in water. Commercial oxalic acid is produced through a variety of chemical reactions that include oxidation of carbohydrates or alkenes as well as synthesis from carbon monoxide and water. Oxalic acid crystals are produced through precipitation of the crystals from the mother liquor. Oxalic acid can also be produced through microbial fermentation of products such as citric acid, but these are not the typical method for commercial production.

Category 1: Classification

1. **For CROP use: Is the substance _____ Non-synthetic or __x__ Synthetic?**
   Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources? [OFPA §6502(21)] If so, describe, using NOP 5033-1 as a guide.

   Oxalic acid dihydrate is produced through a chemical process as described above under "manufacture".

2. **For CROPS: Reference to appropriate OFPA category:**
   Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: [§6517(c)(1)(B)(i)]; copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock parasiticides and medicines and production aids including netting, tree wraps

and seals, insect traps, sticky barriers, row covers, and equipment cleansers; or (ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern?

Oxalic acid is a livestock parasiticide.

Category 2: Adverse Impacts

1. **What is the potential for the substance to have detrimental chemical interactions with other materials used in organic farming systems? [§6518(m)(1)]**

   There are no issues with chemical interactions when using other materials used in organic farming systems. The use is limited to direct contact on honeybees either in packages or in the hive. Both oxalic and formic acid can be toxic to honeybees, if used above the recommended rates.

2. **What is the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment? [§6518(m)(2)]**

   Oxalic acid is naturally occurring in the environment, has low persistence and no potential for accumulation in the food chain. It readily biodegrades both under anaerobic and aerobic conditions. Oxalic acid will not volatilize at room temperature nor concentrate in aquatic organisms and breaks down readily in surface waters and soil surfaces. It degrades into carbon dioxide and water. Oxalic acid is a naturally occurring component of honey. Research has shown no increase of oxalic acid in honey, beeswax or bees after an oxalic acid treatment.

3. **Describe the probability of environmental contamination during manufacture, use, misuse or disposal of such substance? [§6518(m)(3)]**

   There are no concerns of environmental contamination during manufacture or disposal. The amount used for honeybees is fairly small and does not add to concentrations of greenhouse gases in the atmosphere, and would not have widespread negative impact due to its biodegradability. Misuse of higher-than-recommended concentrations of oxalic acid could result in killing honeybees.

4. **Discuss the effect of the substance on human health. [§6517 (c)(1)(A)(i); §6517 (c)(2)(A)(i); §6518(m)(4)].**

   Since it is an acid, it is considered very hazardous in cases of skin contact, eye contact, ingestion or inhalation. Handling instructions include use of protective equipment, such as long sleeves and pants, chemical resistant gloves, goggles and a respirator. This material has also been sold as the active ingredient for bleaching wood or polishing metal. Trade magazines have noted that a pad containing oxalic acid may be developed, similar to formic acid currently used in honey bee hives. This method of dispersal offers a safer alternative than handling the oxalic acid crystals as a liquid or vapor.

5. **Discuss any effects the substance may have on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. [§6518(m)(5)]**

   The potential for varroa mite resistance is very low, and has not occurred with formic acid, which has been used more pervasively and for a longer time period than oxalic acid. Having two acids that can be used in rotation is a good strategy to lessen the potential for resistance. There is some concern that oxalic acid could build up on the brood wax in a hive, and cause some damage to developing bees. It appears small amounts can persist in wax for up to six months. This material biodegrades readily on the soil surface and if used properly, will not be in contact with soil.

6. **Are there any adverse impacts on biodiversity? (§205.200)**

   Since oxalic acid is naturally occurring in the environment and this use is limited to the physical location where bees are congregated, hives and cages, there does not appear to be any negative effects on biodiversity. This material effects only the targeted pest, varroa mites.

Category 3: Alternatives/Compatibility

1. **Are there alternatives to using the substance? Evaluate alternative practices as well as non-synthetic and synthetic available materials. [§6518(m)(6)]**

   Formic acid is currently on the National List as approved for external parasite control for honeybees. Thymol, the natural essential oil (vs. the synthetic form), is also used to control varroa mite in organic operations. Menthol has been used to control tracheal mites, but there is no specific literature detailing menthol's single use effectiveness against varroa. Peppermint and eucalyptus essential oils are exempted from EPA registration and along with menthol, are the ingredients in a widely used product to control varroa mite, Api Life Var, produced in Italy. Hop beta acids are also EPA registered for use to control varroa mites, but since it volatilizes readily, numerous applications are needed for effective treatment. Neem oil has been found effective, but resulted in a significant loss of honey bee brood, there are no EPA registered neem-based formulations for varroa mite. Acetic, citric, costic and lactic acids have been studied, with little to some effectiveness found. Coating honeybees with powdered sugar has also been used, since the bees then groom themselves and the mites drop off. This needs multiple applications. Physical methods of varroa mite management are also used by many beekeepers including the use of screened bottom boards which allow mites to fall through and then they cannot then crawl back up into the hive. Drone comb traps are also used. Drone cells are more attractive to mites, and they tend to use these cells more readily. Removal of the drone comb throughout the brood season, before the larvae hatch, can significantly lower the numbers of varroa mite in a hive. Use of an acid vapor or spray, drone comb and screened bottom boards are typically used together, to improve the effectiveness over the use of just one or two of these activities.

2. **In balancing the responses to the criteria above, is the substance compatible with a system of sustainable agriculture? [§6518(m)(7)]**

   Since oxalic acid is naturally occurring in the environment as well as in honey, and its use has little to no negative environmental impact, its use is not considered damaging to the ecosystem. In the past decade or so, beekeepers have been dealing with numerous

environmental and invasive pest problems, significantly lessening the populations of honeybees around the world. Oxalic acid is another useful tool in the toolbox to be used in rotation with formic and natural essential oils to lessen the destruction caused by varroa mites. Physical activities contribute to varroa mite control as well and are part of an overall integrated pest management system. Honeybees are well known as an important pollinator of many of our foods, and providing another environmentally benign tool to beekeepers will be useful to the small, but growing number of organic beekeepers. The main negative aspect of this material is the need for safety precautions. Humans handling this acid should protect their skin and respiratory systems by using protective equipment.

Classification Motion:

Motion to classify oxalic acid dihydrate as a synthetic substance
Motion by: Harriet Behar
Seconded by: Ashley Swaffar
Yes: 6 No: 0 Abstain: 0 Absent: 0 Recuse: 0

National List Motion:

Motion to add oxalic acid dihydrate to §205.603(b) "as topical treatment, external parasiticide or local anesthetic as applicable" with the annotation "For use as a pesticide solely for apiculture."
Motion by: Harriet Behar
Seconded by: Ashley Swaffar
Yes: 5 No: 1 Abstain: 0 Absent: 0 Recuse: 0

Approved by Scott Rice, Livestock Subcommittee Chair, to transmit to NOP February 5, 2019