

Proposed Scheduling of 65 Percent Formic Acid for the Detection and Control of Honey Bee Mites

At the request of the Canadian Association of Professional Apiculturists, the Canadian Honey Council, and the beekeeping industry, Agriculture and Agri-Food Canada, in consultation with Health Canada and Environment Canada, has recommended that the use of formic acid by beekeepers, for both the detection of Varroa mites of honeybees and for the control of tracheal and Varroa mites of honeybees, be exempt from registration and be regulated under the authority of Schedule II of the Pest Control Products Regulations (Section 5.1.c.i). In making this regulatory decision, consideration was given to the natural occurrence of this compound in honey and its use in other applications such as food flavorings. The process to amend the Pest Control Products Regulations to accommodate formic acid in Schedule II is currently in progress, and the completion of the amendment will formally sanction formic acid for use by beekeepers, under the terms and conditions set out in the schedule.

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Background

The honey bee tracheal mite (*Acarapis woodi* (Rennie)) and the Varroa mite (*Varroa jacobsoni* (Oudemans)) are honey bee pests which have recently been found in Canada.

The honey bee tracheal mite, a parasite which infests the tracheae of adult bees, is now found in most provinces of Canada. Low levels of tracheal mites apparently do not affect either honey production or the over-wintering ability of bees. However, the bee colony can be adversely affected if the mite infestation is allowed to build to high levels.

The Varroa mite is an ectoparasite of both larval and adult honey bees. In Canada, infestations of the Varroa mite have been found along the U.S. border in New Brunswick, Ontario, Manitoba and British Columbia, and at a distance from the U.S. border in Saskatchewan and Québec (single diagnoses) and southwestern Ontario (several apiaries). Varroa mite infestations decrease the vigor and honey production of a colony and can eventually kill the colony. Early diagnosis is essential for successful therapy because a colony can suddenly collapse after a latent infestation of several years without having exhibited any clinical signs.

Treatment of a hive with formic acid results in the diffusion of formic acid vapors through the hive, which can kill the honey bee mites without appreciably harming the bees. After treatment, the formic acid in the hive dissipates to normal levels. In a study conducted in British Columbia (K. Clark, 1992, B.C. Ministry of Agriculture, Fisheries and Food), hives infested with tracheal mites received three weekly treatments (30 mL/treatment) of a 65 percent formic acid solution. Approximately 95 percent mite mortality (relative to pre-treatment counts) was reported from treated hives, compared to an eight percent mortality rate for mites in an untreated bee colony. In addition, an approximate 95 percent reduction in the percentage of bees infested with tracheal mites (relative to pre-treatment counts) was observed among treated colonies two months after treatments were initiated, compared to a 41 percent reduction in the percentage of mite-infested bees found in the untreated colonies.

Although formic acid is a natural product found in nectar and the synthetic form is used as a flavoring in foods, its use for the control of mites of honey bees renders this particular application subject to the Pest Control Products Act. Formic acid has been available in Canada on a limited basis to extension and research personnel through research permits issued by the Plant Industry Directorate of Agriculture and Agri-Food Canada. Formic acid has also been used in Europe for the detection and control of Varroa mites.

Proposed Uses and Use Pattern

To prevent the contamination of marketable honey or wax by unwanted formic acid residues, formic acid is not to be applied to honey bee colonies during periods of honey production. Spring applications of formic acid must be discontinued at least two weeks before the anticipated honey flow.

To control mites, a 65 percent solution of formic acid is to be applied onto the bottom board of the hive or onto absorbent paper or paper towels (three 15-cm square napkins) placed on the bottom board or the hive top bars, at rates of 30 to 40 mL per two-storey colony or 15 to 20 mL per one-storey colony. The treatment is to be repeated three times at 5 to 7-day intervals for the control of honey bee tracheal mites, and three to six times at 1-to 4-day intervals for the control of Varroa mites. If both tracheal and Varroa mites are present, the treatment is to be repeated at 4 day intervals for a total of four to six treatments.

To detect Varroa mites, a sticky paper covered by a 3x3 mm mesh screen is to be placed on the bottom board of the hive and either 40 mL (for two-storey colonies) or 20 mL (for one-storey colonies) of a 65 percent formic acid solution is to be applied to an absorbent paper pad placed on the screen or the hive top bars. The surface of the sticky paper must be checked for fallen mites after 24 and 72 hours.

Human Risk Assessment

Dietary Exposure

The Food Directorate of Health Canada finds that formic acid is a natural component of honey, with common natural concentrations of up to 100 ppm. Concentrations above this level have also been reported for honey derived from certain crops such as chestnut.

In view of the high background levels of formic acid in honey, the use of formic acid as a flavoring in foods, and the proposed withdrawal period of 14 days before honey flow, the Food Directorate does not object to the scheduling of 65 percent formic acid for use in bee hives. If, however, the use pattern for formic acid is altered to allow for use during honey flow, background and treated honey residue data are required for evaluation.

The U.S. Food and Drug Administration has affirmed “generally regarded as safe” status to formic acid as a direct and indirect human food ingredient. The World Health Organization has established an allowable daily intake of 0-3 mg/kg bw/day.

Occupational Exposure

The Environmental Health Directorate of Health Canada states that the data submitted for formic acid are not consistent with routine data requirements for registration of an active ingredient. However, formic acid is a well known industrial chemical with a long history of use. The available scientific literature on the toxicity of formic acid, as well as the information on human exposure, are considered adequate to conduct a risk assessment for this specific use pattern. Because the available health and safety information relates only to concentrated (>90 percent) formic acid and the scheduling proposal is for a 65 percent solution, it must be assumed for scheduling purposes that the hazards relating to a 65 percent formic acid solution will be similar to that of concentrated formic acid.

Formic acid is corrosive and volatile. The hazards associated with its use relate primarily to splash and inhalation exposure. Effects seen in industrial workers exposed to vapors include nausea (at concentrations of 15 ppm), rhinitis, cough and bronchitis. Dermal or eye contact with the liquid will result in severe burns and/or irritation. The Threshold Limit Value (TLV) set by the American Conference of Government and Industrial Hygienists (ACGIH) is 5 ppm.

Little direct information is available on the teratogenic or carcinogenic potential of formic acid. Mutagenicity studies show no evidence of genetic damage. Metabolism studies indicate that formic acid is metabolized quickly. While the toxicity of methanol is known to result from its conversion to formate in the body, formic acid is unlikely to present a similar problem because the acute toxicity presents a barrier to exposure as a result of its corrosive nature. A three-generation reproduction study in the rat conducted with formate reported no adverse effects.

Both human experience and animal studies indicate that exposure to vapors of formic acid results in damage to the respiratory tract consistent with the corrosive nature of the acid. Vapors of formic acid are easily detectable at low levels, allowing users to avoid prolonged exposure.

Based on the available information, the Environmental Health Directorate believes that formic acid may be used safely for the control of mites of honey bees, provided that appropriate safety precautions are taken.

Environmental Assessment

The Commercial Chemicals Branch of Environment Canada has examined the physicochemical properties of formic acid obtained from the open literature. Formic acid, a member of the carboxylic acid/alkanoic acid chemical family, is reported to be freely soluble in water and is considered to be a moderately strong acid ($pK_a=3.76$). The reported vapor pressure of 4.67 kPa indicates that formic acid has a significant potential to volatilize. The value given for the octanol/water partitioning coefficient of formic acid ($\log P_{oct} = -1.55$) indicates a low potential for bioaccumulation. Carbon monoxide was listed as a transformation product.

The Commercial Chemicals Branch states that the proposed use of a 65 percent solution of formic acid for the control of mites in bee colonies is unlikely to result in significant contamination of the general environment. Consequently, a major review of data on the environmental chemistry, fate and toxicology of formic acid is not required for the use pattern as stipulated in this schedule.

Regulation of Formic Acid

At the request of the Canadian Association of Professional Apiculturists, the Canadian Honey Council, and the beekeeping industry, Agriculture and Agri-Food Canada has recommended that the use of formic acid by beekeepers, for both the detection of Varroa mites of honey bees and for the control of tracheal and Varroa mites of honey bees, be exempt from registration and be regulated under the

authority of Schedule II of the Pest Control Products Regulations (Section 5.1.c.i). In making this regulatory decision, consideration was given to the natural occurrence of this compound in honey and its use in other applications such as food flavorings (scheduling requirements for formic acid outlined in Appendix I). Agriculture and Agri-Food Canada has not received adequate data to assess the efficacy of formic acid for honey bee mite control. However, the beekeeping industry is prepared to accept the level of efficacy indicated by preliminary data, despite reports that the efficacy achieved with formic acid treatments is inconsistent because of the volatility of formic acid and the variability of the environment where it is used.

The Food Directorate of Health Canada has no special requirements for the use of formic acid in bee hives and does not object to the scheduling of this compound under the authority of the Pest Control Products Regulations, provided that the formic acid is not used during honey flow. Moreover, the Food Directorate would consider the use of formic acid during honey flow, if required, upon receipt of additional supporting residue data. The Environmental Health Directorate of Health Canada and the Commercial Chemicals Branch of Environment Canada also do not object to the use of a 65 percent solution of formic acid for the control of mites in bee colonies provided that appropriate safety precautions are taken. Safe handling procedures for the use of formic acid for the detection or control of mites of honey bees are provided in the model label (Appendix I). These procedures have been developed in cooperation with the Canadian Association of Professional Apiculturists, the Canadian Honey Council, Health Canada, and Environment Canada.

The completion of the amendment to regulate this particular use of formic acid under the authority of Schedule II will formally sanction 65 percent formic acid for use by beekeepers for the detection and control of Varroa mites and for the control of tracheal mites, under the terms and conditions set out in the schedule. The process to amend the Pest Control Products Regulations to accommodate formic acid in Schedule II is currently in progress.

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Scheduling Requirements for 65 Percent Formic Acid

I. Quality of Formic Acid

The quality of formic acid used will be certified as conforming to the American Chemical Society Specifications (Seventh Edition, 1986).

II. Labelling of 65 Percent Formic Acid Products

The 65 percent formic acid solution must be in a container which has a label consisting of a principal display panel and at least one secondary display panel. The label must conform to the model label presented at the end of this appendix. For containers larger than 5 litres, where the possibility exists that formic acid from these containers will be poured into smaller containers by beekeepers for their own use in an apiary operation, copies of the label information must be provided at the point of sale with instructions that these copies accompany any containers subsequently used to contain formic acid.

PRINCIPAL DISPLAY PANEL

(BRAND NAME) **FORMIC ACID**

For Treatment of Honey Bees Infested with
Varroa or Tracheal Mites

For Detection of Varroa Mites in Honey Bee Colonies

COMMERCIAL

DANGER - CORROSIVE TO SKIN AND EYES



**SCHEDULED UNDER THE AUTHORITY OF THE
PEST CONTROL PRODUCTS ACT**

READ THE LABEL BEFORE USING

KEEP OUT OF REACH OF CHILDREN

GUARANTEE: Formic Acid.....65% (in water)

Supplier's Postal Address

NET CONTENTS:

SECONDARY DISPLAY PANEL

PRECAUTIONS: KEEP OUT OF REACH OF CHILDREN. Corrosive to eyes and skin by direct contact or by exposure to vapors. Harmful or fatal if swallowed. Potential skin sensitizer. Do not get in eyes, on skin or on clothing. Do not breathe vapors. Wear goggles or face shield and chemically-resistant gloves, apron and boots when handling liquid formic acid. Work outdoors, and always stand upwind of the use location. If a strong vinegar odour is encountered, area should be evacuated until vapors have dissipated. While using, do not eat, drink, or smoke. Wash skin thoroughly with soap and water after handling. Remove clothing immediately if contaminated by splash or spill. Store and wash contaminated clothing separately from household laundry. To prevent accidental exposure, post appropriate signs to prevent opening of treated hives within 24 hours of application. Do not contaminate water supply, ponds, lakes or streams with this product. Formic acid will disturb colony activities and may, within one day of application, result in queen rejection or a slight increase in bee mortality, especially at temperatures above 30°C.

TIME OF APPLICATION: Do not use when honey supers are in place to prevent contamination of marketable honey or wax by unwanted residues. Use when outside temperatures are 10° to 30°C and leave hive entrances fully open. In spring, treatment must be discontinued at least two weeks before the anticipated honey flow. Treatment may be applied in fall after the honey crop has been removed.

DIRECTIONS FOR USE:

For Two-Storey Colonies (bees covering eight to 20 full-size Langstroth frames or equivalent):

For Control of Tracheal Mites: Apply 30 to 40 mL of 65 percent formic acid onto the bottom board or onto absorbent paper or paper towels (three 15 cm square napkins) placed on the bottom board or hive top bars. Re-apply at five to seven day intervals for a total of three treatments. The absorbent paper pad remaining after the first treatment can be used again for subsequent treatments, or may be replaced with another pad.

For Control of Varroa Mites: Apply 30 to 40 mL of 65 percent formic acid onto the bottom board or onto absorbent paper placed on the bottom board or hive top bars (top bar applications may be less effective for Varroa mite). Re-apply at 1 to 4-day intervals for a total of three to six treatments.

For Control of both Tracheal and Varroa Mites: Apply 30 to 40 mL of 65 percent formic acid onto the bottom board or onto absorbent paper placed on the bottom board or hive top bars (top bar applications may be less effective for Varroa mite). Re-apply at 4 day intervals for a total of four to six treatments.

For Detection of Varroa Mites: Place a sticky paper covered by a 3x3 mm mesh screen on the bottom board. Apply 40 mL of 65 percent formic acid to an absorbent paper pad placed on the screen or hive top bars. Check the surface of the sticky paper for fallen mites after 24 hours, and again after three days, when the paper can be removed.

For One-Storey Colonies (bees covering four to 10 full-size Langstroth frames or equivalent): Apply half the amounts indicated above, using the same method and timing.

FIRST AID:

IF ON SKIN: Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water. If chemical burn develops, cover area with a sterile, dry dressing and bandage securely. Contact a physician immediately.

IF IN EYES: Wash eyes immediately with large amounts of water. Cover with sterile bandages. Contact a physician immediately.

IF INGESTED: Do **not** induce vomiting. Drink large quantities of water or milk. If vomiting occurs, administer fluids repeatedly. Never give anything by mouth to an unconscious person. Contact a physician or Poison Control Centre immediately. Take container or product name with you to the hospital emergency department or physician.

IF INHALED: Remove victim to a safe, uncontaminated area. If breathing has stopped, clear airway and start artificial respiration. Never give anything by mouth to an unconscious person. Get immediate medical attention. Take container or product name with you to the hospital emergency department or physician.

STORAGE: Store in original container in a cool, dry, well-ventilated area. Use caution when opening the container, especially in warm weather, as pressure may have built up. Avoid heat, sparks and open flames. Store away from sulphuric acid and oxidizing materials. Formic acid vapors are heavier than air, and may collect in low places, or flow to an ignition source and flash back.

DISPOSAL: Absorbent pads containing formic acid should be disposed of according to provincial instructions. For information on the disposal of unused, unwanted or damaged product and the cleanup of spills, contact the regional office of Environmental Protection, Environment Canada. Follow provincial instructions for any required cleaning of the formic acid container prior to its disposal. Dispose of the container in accordance with provincial requirements.

NOTICE TO USER: This control product is to be used only in accordance with the directions on this label. It is an offense under the Pest Control Products Act to use a control product under unsafe conditions.