

Human Exposure to Formic Acid from Applications for the Control of Honey Bee Tracheal Mites

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May, 1992

Summary:

The amount of human exposure to formic acid applied for the control of tracheal mites was determined by air sampling during field applications. The permissible 8 hour exposure limit for formic acid is 5 parts per million in air. Persons applying liquid 65% formic acid to absorbent materials on the top of each bee hive, using either of two methods, were found to be exposed to 1 part per million or less. The exposure of persons inspecting treated colonies was also determined, at 8, 24, and 48 hours post application, and at 1 week post application. Although air drawn from within 1 cm of the formic acid treatment paper gave readings of 12 ppm at the 8 hour point, air breathed by a person conducting a typical inspection of the hive at the 8 hour point, indicated only about 1 ppm. Readings of formic acid in air breathed by a hive inspector at 24 hour and all greater post-application periods indicated 1 ppm or less, even at the application site (absorbent paper).

The results indicate that if currently-proposed safety procedures are followed, exposure to formic acid, of persons applying the product, and of hive inspectors examining treated bee hives after 8 hours, can be expected to be well below the permissible exposure limit.

Introduction

Formic acid has been proposed as a treatment of honey bee colonies affected by damaging parasitic mites (CAPA, 1992). Efficacy and product residue appear to be acceptable (Clark and Gates, 1991). The permissible exposure limit for formic acid in air is 5 parts per million averaged over an 8 hour work shift (Van Waters and Rogers, 1990, OSHA and NIOSH, 1978). The odour threshold has been determined to be 21 ppm (May 1966) but can vary from 15 to 40 ppm. Safety procedures for the proposed use were developed in consultation with staff of the Canada Workplace Hazardous Materials Information System (WHMIS), but had not been field tested. This report presents measurements of formic acid concentrations experienced by persons applying the product in a typical field situation, and by persons inspecting bee hives which had been treated at various intervals prior to the inspection.

Materials and Methods

The appropriate concentration of formic acid (65 %) was prepared from the commercially available 85 % product; by dilution by volume (i.e. water was added to a measured volume of concentrated acid, to make a field-mix of 85/65, or 1.3 of the volume of the concentrate). No noticeable increase in temperature occurred when the water was added.

The proposed dose of formic acid (30 ml) was applied to 3 paper napkins placed on the top bars of marked bee colonies at 8 hours, 24 hours, 48 hours and 1 week prior to the time of measurement. Temperature at the site was determined using a recording thermometer. Wind conditions at the time of the air test were measured using a Dwyer No. 460 air meter. Formic acid concentration was determined using Formic Acid Dräger Tubes (67 22701 Drägerwerk Germany, expiry date Oct 1993) and No. 31 Dräger air sampler pumps. This method involves a glass tube filled with blue-violet particles which change colour to yellow on exposure to formic acid. The tube is graduated from 1 to 15 ppm, and the length of the yellow discoloration, after the pump has drawn the appropriate volume of air through the tube, indicates the exposure.

Tests of formic acid in air were taken by Mr. Dave Owens, WHMIS Coordinator and Instructor, Northern Lights College, Dawson Creek, and Mr. Doug Colter, Apiculture Specialist with Alberta Agriculture, while inspections and hive treatments were carried out by the author, and other hive treatments were carried out by partners of Van-Han

Apiaries, co-operators in the project. Air measurements were taken as follows:

Test 1: concentration experienced by a person inspecting (5 - 10 minutes) a colony treated 1 week prior to the inspection. The inspection proceeded immediately, without provision for vapours in the hive to dissipate.

Test 2: as above, colony treated 8 hours prior to the inspection.

Test 2a: air sample drawn from within 1 cm of the absorbent paper.

Test 3: as 1 above, colony treated 24 hours prior to the inspection,

Test 3a: air sample drawn from within 1 cm of the absorbent paper

Test 4: as 1 above, colony treated 48 hours prior to the inspection.

Test 5: concentration experienced by a person applying about 30 ml per colony to 20 colonies, using a 1 ounce dispensing attachment on a bottle.

Test 5a: concentration experienced by a person standing about 2 meters downwind of the application described in #5.

Test 6: concentration experienced by a person applying 30 ml per colony to 20 colonies, using 2 squirts of 15 ml each, from an ISL drench gun.

The tests took approximately one hour. Wind conditions were measured several times during the test period.

Observations

Test conditions:

Time: 3:30 to 5:00 pm May 13, 1992. Temperature 12-14 0 C. Relative humidity 46 Overcast. Temperatures over the prior week ranged from about -5 0 C to 15 0 C.

Wind: a fairly consistent, very light breeze, measuring mostly less than 250 ft per min (5 km/hr, 3 miles/hr) with occasional gusts to 800 fpm (1 5 km/hr, 1 0 miles/hr).

Formic acid concentration measurements:

Some participants reported occasional "whiffs" of the vinegar-like odour of formic acid. All readings as described above indicated less than 1 part per million formic acid in air breathed by persons applying or inspecting treated colonies 8 or more hours after treatment. At the 8 hour post treatment test (2a) air drawn from within 1 cm of the absorbent paper napkin indicated 12 ppm. The napkin was not moist, but was slightly softer than when dry, indicating that not all of the acid had yet evaporated.

Conclusions

The results indicate that, with the observance of currently-proposed safety procedures (see appendix) for the treatment of honey bee colonies, exposure to formic acid, of the applicator and of hive inspectors examining hives 8 hours or more after the treatment, can be expected to be well below the permissible exposure limit of 5 ppm.

Appendix

Proposed safety procedures for the use of formic acid in the treatment of honey bees for tracheal mites (extracted from proposed research permit label)

Warnings & Precautions:

- * Vapors can cause eye irritation. Liquid contact will be severely corrosive to eyes. Harmful if swallowed.
- * Avoid breathing vapors and contact of liquid with skin and clothing.
- * Wear boots, coveralls, chemical goggles and rubber gloves when handling.
- * Use outdoors, standing upwind of application site.
- * Avoid opening treated hive within 24 hours of application.

References

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