

# 2011

## Recommendations for Administering Antibiotics and Acaricides to Honey Bees

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### NEW IN THIS PUBLICATION (2011): THYMOVAR TREATMENT OF VARROA

Also, view the new [Varroa Mite Monitoring Video](http://www.manitobabee.org) at [www.manitobabee.org](http://www.manitobabee.org)

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## **IMPORTANT:**

- 1. All antibiotics and acaricides should be administered to honey bee colonies according to labels and at recommended rates only.**
- 2. Never administer antibiotics and acaricides while honey supers are on the hives.**

## **ANTIBIOTICS**

### **AFB & EFB PREVENTION & CONTROL**

Antibiotics should NOT be used to cure American Foulbrood (AFB) or European Foulbrood (EFB) that is already present in a colony. Combs with visible signs of disease should be removed from the hive and either destroyed by fire or rendered. Furthermore, it is recommended that frames from infected hives, that are not showing signs of disease, be decontaminated (see Empty Super Disinfection below), or destroyed (burnt). Following removal of the diseased combs, start an antibiotic treatment. If honey is going to be harvested from the treated colony, antibiotic treatments for AFB & EFB should **stop at least 4 WEEKS before the main honey flow**. Honey or syrup stored in the colony during the antibiotic treatment period should not be used for human consumption.

In the hive, AFB that is resistant to oxytetracycline (rAFB) looks the same as AFB that is susceptible to the antibiotic. Fresh rAFB, “ropey brood” and old rAFB scale may appear on the same frame. Determination of resistance to oxytetracycline requires culturing of the bacteria in a laboratory; therefore, please submit any suspicious AFB samples to the Apiculture Office in Winnipeg for resistance testing.

Currently, oxytetracycline is the only registered antibiotic for AFB control; however other antibiotics such as tylosin have been used to help control the spread of rAFB. At this time, the use of tylosin is only permitted with the recommendation from the Provincial Apiculture office and with an Off-label Use prescription from a veterinarian.

### **OXYTETRACYCLINE Application:**

*Active ingredient: “Oxytetracycline” (Oxytetracycline hydrochloride)*

Examples of Brands Available: **Foul Brood Mix®**, **Oxytet-25-S®**, **Oxysol 62.5®**

Oxytet-25® and Oxysol 62.5® require mixing with powdered sugar prior to application. Follow the product label directions for feeding these products to honey bees (see below for Oxytet-25®).

Foul Brood Mix® is a ready-to-feed mix containing oxytetracycline, soy flour, brewer’s yeast and sucrose. Follow the product label directions for feeding this product to bees.

The following feeding recommendations for oxytetracycline are based on formulations containing 25 g of active ingredient per 454 g of product, ex: Oxytet-25®:

**Refer to product labels for instructions on specific product use.** According to the label, prepare by mixing 454 g of Oxytet-25® with 3.5 kg of icing sugar (1:8 ratio by weight). Place the mixture across the frame top bars at the front or back of the hive (i.e. over the end bars). **DO NOT** put the oxytetracycline/icing sugar mixture over the center of the hive as it may fall down

between the frames and kill unsealed brood. Given that adult bees can transmit AFB and EFB, antibiotic treatment in the spring is generally recommended even if the beekeeping equipment has had no previous disease history.

The first oxytetracycline application would generally occur within 4 days of installing the package or unpacking a wintered colony. One 454 g package will provide enough antibiotic to treat 90 spring package colonies or 45 wintered colonies.

Spring packages or small colonies should receive 14 g (1 tablespoon) of the oxytetracycline/icing sugar mixture, per colony per application, for a total 42 g per colony (i.e. 3 applications of 14 g, 4-5 days apart).

Wintered colonies should receive 28 g (2 tablespoons) of the oxytetracycline/icing sugar mixture, per colony per application, for a total of 84 g per colony (i.e. 3 x 28 g, 4-5 days apart).

**In order to prevent possible contamination of marketable honey, all oxytetracycline treatments in spring or fall must occur outside the honey production season and should stop at least 4 WEEKS before the main honey flow.** Honey or syrup stored in the colony during the antibiotic treatment period should not be used for human consumption!

**Other methods of administering Oxytetracycline (NOT PREFERRED):**

- a) Oxytetracycline and sugar syrup – Oxytetracycline breaks down in sugar syrup, especially when exposed to ultra-violet rays (ex: sunlight). Therefore, feeding outside in glass jars, i.e. boardman feeders, is NOT PREFERRED. Note that approximately half of the antibiotic activity is lost by about 8 days post preparation (when kept at 30°C and out of light).
- b) Oxytetracycline Extender Patties – This method involves incorporating oxytetracycline into a soft patty made of shortening (ex: Crisco®) and sugar. In this preparation, the antibiotic remains stable over a long period of time.

This method of administering oxytetracycline is NOT PREFERRED for the following reasons:

- i. weak honey bee colonies often will not consume the extender patty and therefore will not benefit from the antibiotic treatment
- ii. leaving extender patties on colonies during the nectar flow may result in antibiotics being found in extracted honey
- iii. this type of antibiotic application may facilitate the development of antibiotic resistance in the bacteria

**Empty Super DISINFECTION:**

Empty supers with frames exposed to irradiation (ex: electron beam irradiation) treatment have been shown to be effective for disinfecting AFB-contaminated supers. Pollen for bees may also be treated. For more information contact Acsion Industries at 204-753-2255, or contact Rhéal or David. Acsion Industries is located in Pinawa, Manitoba.

## NOSEMA DISEASE PREVENTION

The following recommendations are for treating Nosema disease caused by Nosema apis; however another species of Nosema, Nosema ceranae has also been found in Manitoba. Current research suggests that both species of Nosema respond to antibiotic treatment but that more information is needed to determine if modifications to the Fumagilin-B® label will be required for the effective control of both species. Please note that the information below is based on the current recommendations found on the Fumagilin-B® label (Medivet Pharmaceuticals DIN 02231180 (21 mg/g)).

**FUMAGILLIN Application: Brand available: Fumagilin-B®**

*Active ingredient: “Fumagillin” (Bicyclohexylammonium fumagillin)*

Fumagillin is available in a variety of container sizes, depending on the brand name; therefore always follow the product’s label recommendations. As a general guideline, 1.0 g of fumagillin will provide enough antibiotic for treatment of approximately 10 spring package colonies or 5 wintered colonies. **Refer to product labels for instructions on specific product use.**

*Important:* Medicated syrup is best prepared at a concentration of 25 mg Fumagillin base per liter of syrup, usually a 2:1 syrup (two parts of sugar to one part of water). The water may be warm (20-50°C).

<b>Fumagillin Preparation by Bottle Size</b>	<b>Will Provide One Treatment For:</b>
Mix 0.5 g (small bottle) in 20 L of syrup	6 spring packages or 3 wintered colonies
Mix 2.0 g (medium bottle) in 80 L of syrup	21 spring packages or 11 wintered colonies
Mix 9.5 g (large bottle) in 380 L of syrup	100 spring packages or 50 wintered colonies

**Colonies infected with NOSEMA should be treated with known amounts of fumagillin in sugar syrup, according to time of year and colony size/type, as follows:**

**FALL TREATMENT:** After all honey supers have been removed, feed medicated syrup at the following rates (see above for Fumagillin Preparation):

- For each 2 chamber colony (approx. 30,000 bees): 7-8 L treated syrup (approx. 2 gal)
- For each 1 chamber colony (approx. 18,000 bees): 4 L treated syrup (approx. 1 gal)
- For each 5 frame colony (approx. 12,000 bees): 3 L treated syrup (approx. ¾ gal)

**SPRING TREATMENT:** In the spring when colonies are stressed due to inclement weather conditions, mite infestation, other disease factors, or intensive spring management, feed medicated syrup at the following rates (see above for Fumagillin Preparation):

- For each 2 chamber colony (approx. 20,000 bees): 3-4 L treated syrup (approx. 1 gal)
- For each 1 chamber colony (approx. 12,000 bees): 2 L treated syrup (approx. ½ gal)
- For each 5 frame colony (approx. 8,000 bees): 1-2 L treated syrup (approx. ½ gal)
- For each package colony: 1-2 L treated syrup (approx. ½ gal)

Treatment with fumagillin, which may be necessary in the **LATE WINTER** (February-March), should follow the regime for **SPRING TREATMENT** (as described above). Prior to fall feeding of colonies, it may be advisable to have combs 2, 5, 7 and 9 empty in the second brood chamber for storage of the medicated syrup.

\*RESEARCH HAS SHOWN THAT Oxytetracycline & Fumagillin MAY BE FED SAFELY AT THE SAME TIME PROVIDED THE DOSAGES DO NOT EXCEED THE RECOMMENDED RATES\*

## **VARROA MITE DETECTION & CONTROL (Varroa destructor)**

### **Rotating Treatments & Integrated Pest Management (IPM) Strategy Comments:**

It's recommended that beekeepers monitor for varroa and rotate acaricides to decrease the risk of treatment-resistance and contamination of wax and honey by high-residual acaricides. The following acaricides Apistan®, CheckMite+™, Apivar®, Thymovar, Formic Acid, and Oxalic Acid are available for varroa mite control and should be used according to instructions on their packaging. In order to minimize the risk of developing treatment-resistant mites, it is important that beekeepers try to avoid consecutive treatments (i.e. spring & fall) using the same product.

Placement of a screen (3 mm x 3 mm mesh, or "No. 8 mesh") over the bottomboard, to separate fallen mites from bees and reduce mite re-entry into the colony, may help reduce varroa infestation. "Screen bottomboards", as they are often called, **do not significantly reduce varroa populations on their own**; however, in combination with acaricides or genetically-resistant (ex: HYGIENIC) bees, have been found to be of some benefit. **Cultural control methods, as well as genetically-resistant bees, help control varroa year-round not just during spring and fall.** A screen-bottomboard can also facilitate the detection of varroa in a hive (see below) although an alcohol varroa-wash of bees from the brood area is more consistently accurate. It's important to note that having a screen over the bottomboard that restricts honey bee access can result in a buildup of wax and pollen debris on the bottomboard. If the debris is not removed by the beekeeper on a regular basis, scavenger pests such as wax moth that feed on this debris may become more of a problem.

Honey bee colonies should be monitored for varroa on a regular basis, preferably in the spring and fall, to determine infestation levels relative to economic thresholds, and to ensure that previous control procedures have been effective. In the spring build up period, it's recommended varroa levels should be maintained below 1% (i.e. 1 mite per 100 adult bees). In the fall period, it's recommended varroa levels should be maintained at 1-3% or less with significant brood present (ex: early fall), and less than 10% when there is little brood (ex: late fall). The decrease in brood and subsequent movement of mites onto adult bees accounts for the higher threshold in the fall period. **Note that this varroa threshold information assumes honey bee tracheal mite levels are at or near zero, and that colony health is dependent on more than just mite levels. Mite levels may increase due to the development of resistance to control products, improper application of treatment, or re-infestation from a neighboring apiary.** To discuss specific recommendations regarding combinations of varroa mite, honey bee tracheal mite and possibly other honey bee disease, please contact the Apiculture office. A video on **how to monitor for varroa mite** can be viewed on the website of the Manitoba Beekeepers' Association (MBA) at [www.manitobabee.org](http://www.manitobabee.org).

**In-Field Detection & Sampling of Varroa, 2 methods:** A. Varroa-wash (e.g. bucket or shaker method), and B. Natural fall. Generally speaking, sampling for varroa from 5 hives in a bee yard of 30 hives should give a good idea of varroa infestation in that yard, but more hives will strengthen results.

**A.** Scoop 200-300 bees from **brood area frames**, into a container with a screened lid, and shake the container in windshield washing fluid (blue) or soapy water for several minutes, to dislodge the mites from the bees. Sampling from the brood area is important for accuracy, consistency and to reduce variability. To calculate approximate percent infestation level, count the number of dislodged mites, divide by the number of bees in the cup, and multiply by 100 (see above for spring and fall thresholds).

**B.** Using a screen bottomboard, place a sticky board (sticky side up) into the space between the screen and floor of the bottomboard. Sticky boards are commercially available or can be made using a sticky spreadable substance, such as a thin layer of Tanglefoot on white

cardboard, plastic or similar media. As a general guideline of natural varroa mite drop during brooding periods; 1 varroa mite per 24-hr suggests an infestation level of at least 1%, whereas natural mite drop of 30-40 mites per 24-hr period suggests an infestation level of approximately 5% -- Note that natural varroa mite drop is affected by a number of factors including weather and genetics. **It is for this reason that monitoring should occur over several days (i.e. 2-3 days) and that the average daily mite drop be calculated by dividing the number of mites by the number of days the sticky boards have been in the hive.**

**APISTAN Application: Brand name Apistan® anti-Varroa mite strips**

*Active ingredient: 10% Fluvalinate (fluvalinate-tau)*

**FOR CONTROL OF VARROA MITES**

LABEL: [http://pr-rp.hc-sc.gc.ca/1\\_1/pr\\_web.ve1?p\\_ukid=2941](http://pr-rp.hc-sc.gc.ca/1_1/pr_web.ve1?p_ukid=2941)

At this time, varroa resistance to Apistan® is widespread in the province; therefore when using this product, control may be inadequate or variable & close monitoring is critical.

**WEAR CHEMICAL-RESISTANT GLOVES WHEN HANDLING THE STRIPS.**

Just before application, remove the required number of strips from the pouch. Unused strips should remain in the original package.

**Refer to product labels for instructions on specific product use.** Use 1 strip for each 5 combs of bees in each brood chamber (Langstroth deep frames or equivalent in other sizes). Hang the strips in separate spaces between the combs as near the center of the bee/brood cluster as possible. If two brood chambers are used for the brood nest, hang the strips in both the top and bottom brood chambers. For best chemical distribution, use the strips when daytime high temperatures are at least 10°C.

Hives may be treated in the spring before the honey flow and/or in the Fall after the honey flow. Do not treat when honey supers are on the hives. Place the strips in the hives for up to 42 days (6 weeks). According to the label, honey supers may be placed on colonies after the strips are removed.

**CHECKMITE Application: Brand name CheckMite+™ Beehive Pest Control Strip**

*Active ingredient: 10% Coumaphos*

**FOR CONTROL OF VARROA MITES**

LABEL: [http://pr-rp.hc-sc.gc.ca/1\\_1/pr\\_web.ve1?p\\_ukid=3874](http://pr-rp.hc-sc.gc.ca/1_1/pr_web.ve1?p_ukid=3874)

At this time, varroa resistance to CheckMite+™ is widespread in the province; therefore when using this product, control may be inadequate or variable & close monitoring is critical.

**WEAR CHEMICAL-RESISTANT GLOVES WHEN HANDLING THE STRIPS.**

Just before application, remove the required number of strips from the pouch. Unused strips should remain in the original package.

**Refer to product labels for instructions on specific product use.** Use 1 strip for each 5 combs of bees in each brood chamber (Langstroth deep frames or equivalent in other sizes). Hang the strips in separate spaces between the combs as near the center of the bee/brood cluster as possible. If two brood chambers are used for the brood nest, hang the strips in both the top and bottom brood chambers. For best chemical distribution, use the strips when daytime high temperatures are at least 10°C.

Hives may be treated in the spring before the honey flow and/or in the Fall after the honey flow. Treatment must be **removed at least 2 WEEKS before the honey flow.** Place the strips in the hives for 42 days (6 weeks) **up to a maximum of 45 days. It is not recommended to use coumaphos more than once a year.**

**It is IMPORTANT NOT to leave coumaphos strips in hives beyond the recommended treatment period as damage to colonies may occur.**

**APIVAR Application: Brand name Apivar®**

***Active ingredient: 3.3% Amitraz***

FOR CONTROL OF VARROA MITES

LABEL: [http://pr-rp.hc-sc.gc.ca/1\\_1/pr\\_web.ve1?p\\_ukid=15405](http://pr-rp.hc-sc.gc.ca/1_1/pr_web.ve1?p_ukid=15405)

**Apivar® has been granted Emergency Registration by the Pest Management Regulatory Agency (PMRA) from July 1, 2010 to June 30, 2011.**

All sales of Apivar® are final; therefore any unused strips beyond the **June 30, 2011** deadline have no monetary value, cannot be returned for refund and cannot be used beyond the registration deadline date. Any beekeeper that uses illegal products or formulations can be prosecuted by PMRA according the Pest Control Products Act.

**Refer to product labels for instructions on specific product use.** To control varroa mite, remove honey supers before application of Apivar®. Use 2 Apivar® strips per brood chamber. Separate the double strip and hang each strip between two comb frames inside the brood area or the bee cluster, with a minimum distance of 2 frames between strips. Suspend Apivar® strips in the brood chamber in such a way that the bees can walk on both sides of the strips. Leave strips inside the hive for 42 days, and then remove. In case of movement inside the beehive far from the strips, it is very important to reposition the strips into the bee cluster, and leave the strips in place for 14 more days before removal. Strips must be removed after a maximum of 56 days. **DO NOT** re-use the strips.

**Timing:** Hang Apivar® strips in the hives in spring before the first honey flow if varroa mite infestations have reached treatment threshold. **DO NOT USE APIVAR® STRIPS WHEN HONEY SUPERS ARE PRESENT.** If mite infestation is severe, colonies are to be treated in the autumn after all surplus honey has been removed from the hive. Remove honey supers before use of Apivar® strips. Consult provincial guidelines for more information on varroa control.

Withholding period for honey collection: **Do NOT** use while honey supers are present. Wait 14 days after removing strips before placing honey supers on hive.

**Formic Acid Applications:**

There are a number of commercial formic acid pads available on the market (ex: MiteGone™, and Mite-Wipes). Note to CAPCO (C94-05): Proposed Scheduling of 65 Percent Formic Acid for the Detection and Control of Honey Bee Mites is currently being phased out unless the methods described in the C94-05 document are registered.

For more information on applying formic acid using Mite-Wipes, please visit the following website: [http://www.hc-sc.gc.ca/cps-spc/pubs/pest/\\_decisions/c94-05/index-eng.php](http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_decisions/c94-05/index-eng.php)

For more information about MiteGone™, and Mite-Wipes please visit the manufacture's website: MiteGone™ - <http://www.mitegone.com/>

## **THYMOVAR Application: Brand name Thymovar**

*Active ingredient: Thymol (15 g per wafer)*

FOR CONTROL OF VARROA MITES

**CAUTION:** Wear protective goggles or a face shield and chemically resistant gloves, long-sleeve shirt, pants, shoes, and socks whenever handling Thymovar and when performing clean-up and maintenance activities. **CORROSIVE** to the eyes. **CORROSIVE** to skin. Potential skin sensitizer. Harmful or fatal if swallowed. Avoid inhaling the vapour. May cause respiratory irritation. Handle Thymovar in a well-ventilated area.

**Refer to product labels for instructions on specific product use.** Prior to Thymovar treatment, remove all honey supers and close or replace open or screened hive floors with solid floors, and reduce the hive entrance to normal size. It is recommended that if bees are fed, that part of the feeding be carried out before treatment with Thymovar, if varroa infestation levels and temperatures allow.

For control of varroa mite in honey bee hives, apply 2 consecutive applications of Thymovar. Thymovar is applied at a rate of ½ wafer for nucleus hives, 1 wafer for single brood chamber hives, or 2 wafers for double brood chamber hives. Thymovar wafers are left in the hive for a 3-4 week treatment period. Immediately following the first application, remove the used wafer(s) and apply a second application of Thymovar. The second application of wafer(s) is also left in the hive for 3-4 weeks. All wafers should be used immediately after opening the sealed sachet. Remove all wafer(s) from the hive after each application period.

For 1 wafer applications in single brood chamber hives, cut the wafer in half. For 2 wafer applications in double brood chamber hives, use uncut wafers. The cut or uncut wafer(s) are placed on top of the combs of the top brood chamber on either side of the edge of the brood, close to but not directly over open or sealed brood. Wafers are preferably placed a minimum of 4 cm from brood. Close the hive, leaving a space (about 5 mm) between the wafers and the hive covers, to improve the evaporation of thymol.

**Timing:** Thymovar must only be used when honey supers are not present on the hive. Applications may be made in the spring, before honey flow or in the late summer to early autumn, after all surplus honey has been removed. Apply when maximum daily temperatures are above 12°C and below 30°C. Temperatures below 12°C will reduce the effectiveness of the treatment, while temperatures above 30° will cause increased stress and mortality of adult bees and brood.

### **Application Notes:**

- Thymovar does not control varroa mites in capped cells, therefore the lethal thymol vapour concentration must be maintained in the hive for several weeks.
- DO NOT use more Thymovar wafers than recommended. To minimize residues, carefully follow all label instructions. At higher concentrations, thymol residue may impart off-flavour to honey.
- Bees may remove food from directly under the Thymovar wafer(s).
- The application of Thymovar during feeding may reduce acceptance of the feed. Do not place Thymovar wafer(s) near a sugar feeder as this may reduce feeding. Efficacy of Thymovar may be reduced if applied during the feeding period, due to increased ventilation by the bees.
- To reduce risk of robbery, all colonies in an apiary should be treated with Thymovar at the same time.
- Following treatment, monitor mite levels and apply a non-thymol based control if needed.
- DO NOT apply to any body of water.

## **OXALIC ACID Application:**

*Active ingredient: Oxalic Acid Dihydrate*

FOR CONTROL OF VARROA MITES

CAUTION: WEAR GOGGLES, CHEMICAL-RESISTANT GLOVES, PROTECTIVE CLOTHING, AND BOOTS WHEN HANDLING OXALIC ACID

\* \* Wear a respirator when applying oxalic acid with a fumigator \* \*

There are two oxalic acid application methods for varroa control: Syrup Solution and Fumigation Method (see below). **Apply either oxalic acid method during broodless periods in spring or fall. The oxalic acid treatment will NOT control varroa mites in capped brood.**

### **1. Syrup Solution Method:**

Preparation:

- Prepare 50% sugar syrup (ex: 1 kg of sugar in 1L of water).
- Add 35 g of oxalic acid dihydrate crystals to every 1L of sugar syrup.
- Stir the solution very well. The crystals dissolve best if the sugar solution is warm. All of the crystals must be dissolved.
- Make the solution within days of treating the colonies and keep refrigerated until use.

**NOTE: 1L oxalic acid solution will treat 20 colonies (calculate: 1000mL / 50mL per colony)**

Do not store leftover oxalic acid treatment solution. The oxalic acid changes in composition and becomes toxic to the bees. The crystalline powder should be stored at room temperature in an airtight container. This will prevent absorption of moisture, which causes the powder to solidify. Oxalic acid is odourless in all forms.

### **Application:**

This is a single application treatment. With a syringe (ex: 60 CC) or an applicator (ex: drench gun), trickle 5 ml of this solution directly onto the bees in each occupied bee space (i.e. between frames) in each brood box. **The maximum dose is 50 ml (i.e. 50 CC) solution per colony whether bees are in nucs, single, or multiple brood chambers.** When treating doubles, split the boxes and treat the bees in both boxes (25 ml in the bottom box and 25 ml in the top box).

Note: after fall application, the colony may be wrapped for the winter the same day. *Caution:* It has been reported that under unfavourable conditions, (ex: weak colonies), this application method may cause some bee mortality or over winter bee loss.

### **2. Fumigator 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. When possible, treat while hives are wrapped to ensure they are properly sealed. Smoke the hive entrance to drive the bees away from the entrance and up onto frames. Place 2.0 g oxalic acid dehydrate powder into the fumigator. **Follow the fumigation manufacturer's directions for use.**

Insert the fumigator into the hive through the bottom entrance. Apply heat until all oxalic acid dehydrate has been sublimated. There are reports that the fumigation method of treating hives with oxalic acid may also help to control honey bee tracheal mite, whereas the syrup solution method has little to no-effect on honey bee tracheal mites, but this needs further investigation.

## **TRACHEAL MITE CONTROL (Acarapis woodi)**

### **MENTHOL Application:**

*Active ingredient:* Menthol (food grade, purity greater than 98%)

FOR CONTROL OF HONEY BEE TRACHEAL MITES (HBTM)

**Refer to product labels for instructions on specific product use.** Menthol crystals should be used when outside temperature is 20-30°C, while menthol-shortening formulations should be used when outside temperature is 15-30°C, unless otherwise indicated on packaging. Store in a well-sealed container in a cool place (ex: freezer). *Caution:* Menthol vapourizes readily and should only be used in a well-ventilated area. **Menthol treatments must be removed 4 WEEKS before the main honey flow** to prevent unwanted residues from occurring in honey or wax, unless otherwise stated on the product packaging.

Apply Menthol at the following rates, according to colony type/size (see applications below):

1. Two-story colony (bees covering 15+ frames): ■ Use approx. 50 g per colony placed on the bottomboard or above the cluster until vapourization is complete.
2. One-story colony (bees covering 5-9 frames): ■ Use approx. 25 g per colony.
3. Nucleus hive (“nuc”) (bees covering 1-4 frames): ■ Use approx. 5-10 g per colony.

### **Menthol Applications for HBTM Control (spring or fall treatment):**

#### **Menthol-shortening mixture:**

1. Menthol-shortening in cardboard (i.e. “menthol boards”): Commercial formulations are available as 20 g menthol boards or pads. Equal weight of menthol and shortening (ex: Crisco®) can be combined by adding menthol crystals to liquid shortening maintained at 65°C.
2. Sheets of corrugated cardboard (30 cm x 30 cm) are then immersed into the menthol-shortening mixture until the cardboard is saturated (approx. 20 g of menthol). The cardboard is then removed and cooled (and can be frozen in plastic bags until needed).
3. One sheet of cardboard placed on the bottom board may need to be replaced once or twice a week depending on how fast it vapourizes. The recommended treatment period is approximately 2 weeks.

#### **Menthol crystals:**

1. Menthol crystals in a porous bag: Commercial formulations are available (ex: Mite-A-Thol®) in dosages of 50 g per porous bag, where one packet per hive is applied on the top bars of the upper corner of the brood box for a minimum of 28 days. The bag may also be placed on the bottom board (especially if outside temperature is hot) unless otherwise stated on the label.
2. The menthol crystals (50 g) may also be placed on a piece of aluminum foil which is folded over a piece of wire mesh (15 cm x 15 cm) to enclose the menthol and allow vaporization. The packet can be placed above the cluster or on the bottom board.

### **Formic Acid Applications:**

For Tracheal mite control using formic acid based treatments, please refer to information on page 7.