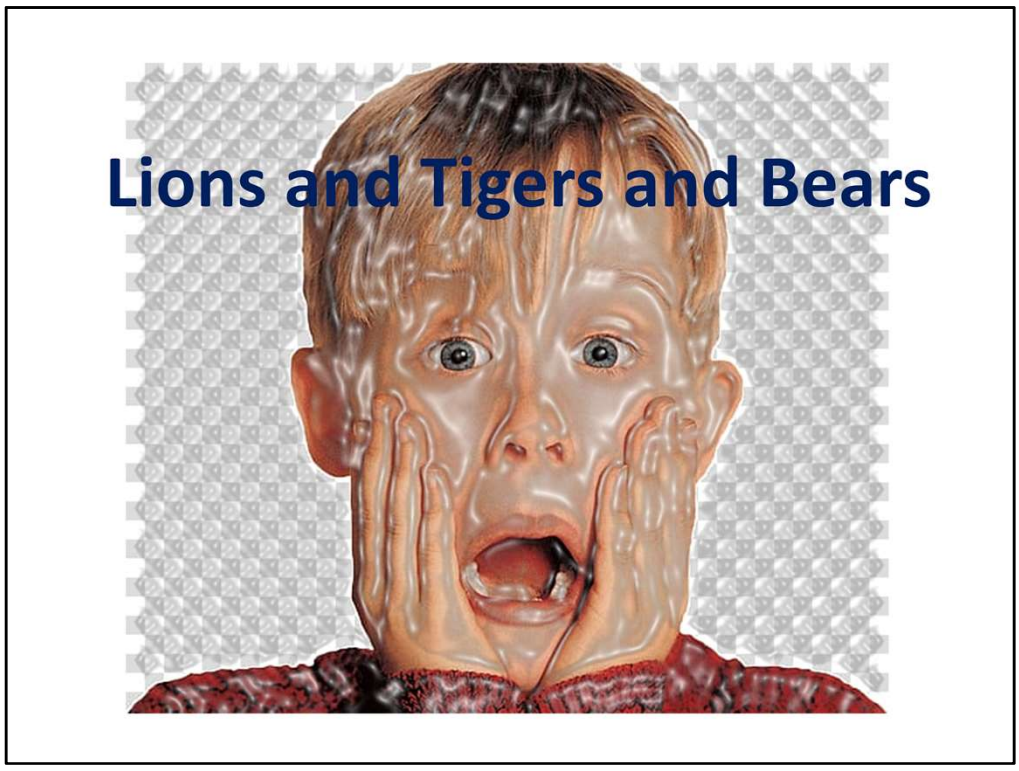


Lions and tigers and bears.... Oh, my!

Ok, skip the lions & tigers – Bears are bad enough.

Ok, skip the lions & tigers – Bears are bad enough.
This is an image of what happens if a bear gets into your apiary.
Dr. Krantz will cover hive location and protection in a later section.

Pests of the hive

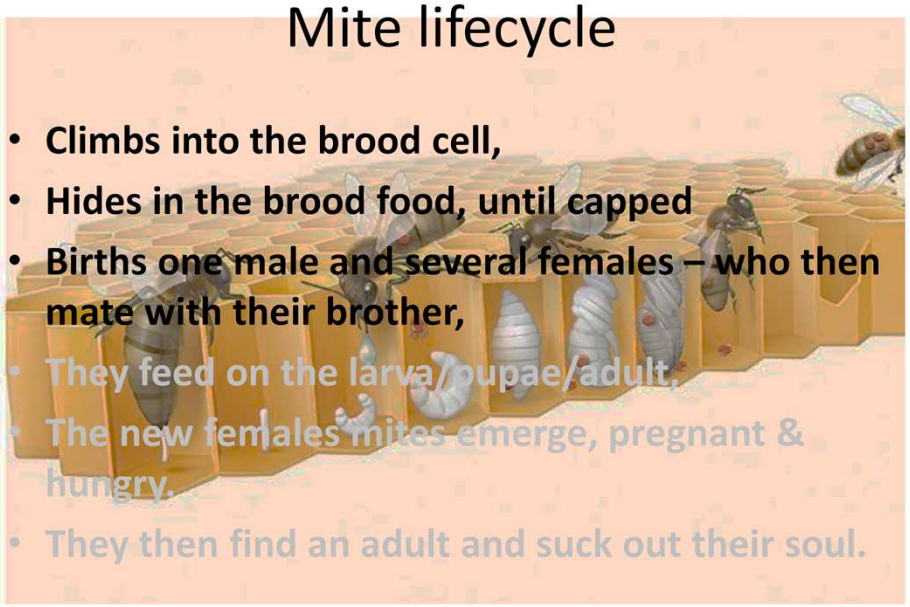
- Most likely – Mites. You have bees, you have mites.
- Most Visible – Mammals (... Including bears).
- Most feared – AFB.
- Just to round out the list – viruses, parasites, SHB, ants, and other insects.

This sections I will cover ‘Pests’.
I’m going to spend a large chunk on Mites, I know you will deal with them.
I will cover what they are, how they grew, what damage they do, and how we test for them, and treat hives with them.
A quick review of mammals, because you can see and address them pretty easily.
I will cover American Foul Brood. Not because you will ever see it (I personally have not), but if you do – what you should do.
And then, a bunch of ‘little’ annoyances; and how to address them.

Varroa destructor

This is the Varroa Distructor, commonly known as the Varroa Mite.
The forked structure in the center are the mouth parts.
Note the exterior of the mite looks much like the chitin covering a bee, this is part of how they ‘hide’ in the hive.
They are blind, and find their host by smell and touch.
The foot pads have little sticky pads. This is part of how they cling to the bee, and also a vulnerability that at least one treatment takes advantage of.

Mite lifecycle

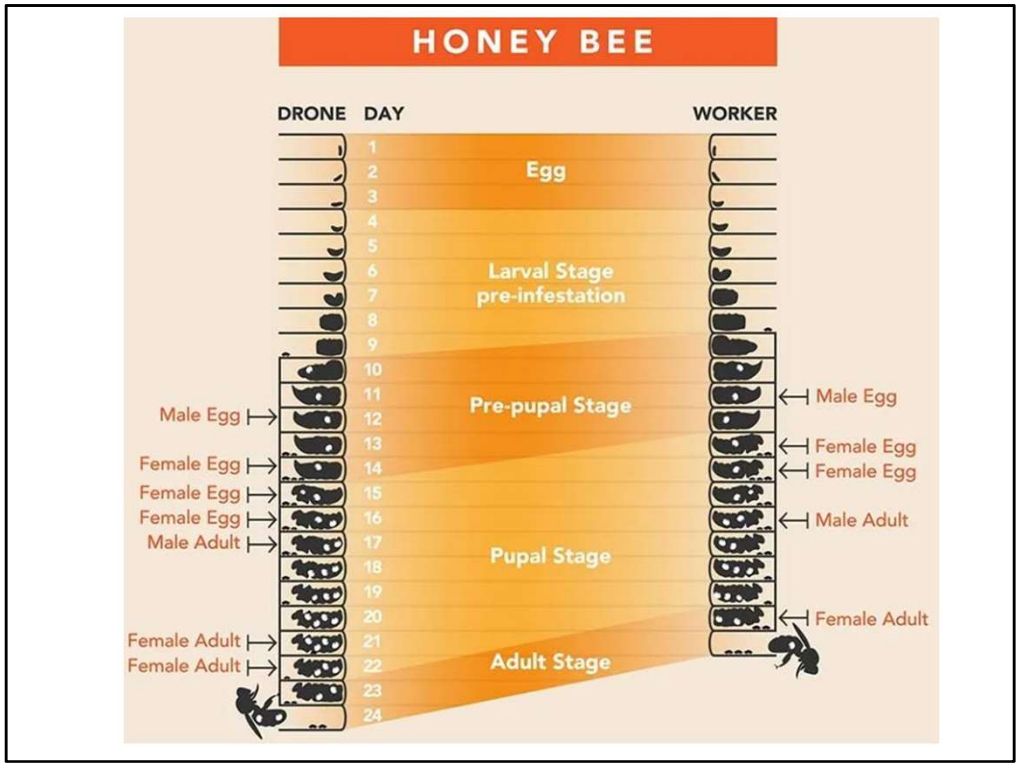


- **Climbs into the brood cell,**
- **Hides in the brood food, until capped**
- **Births one male and several females – who then mate with their brother,**
- **They feed on the larva/pupae/adult,**
- **The new females mites emerge, pregnant & hungry.**
- **They then find an adult and suck out their soul.**

When the adult mite is ready to reproduce it climbs into the cell of a bee.
It prefers the cell of a Drone, because the drone pupates longer.
That additional time allows the mite to generate one, sometimes two additional offspring.

Once inside the cell of brood, it waits for it to be capped, while floating, upside down, in the brood-food.
Hidden from view & detection.

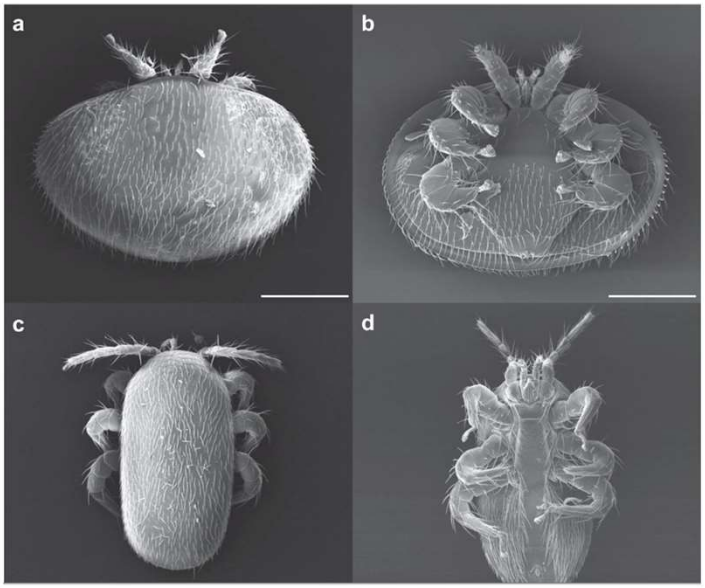
Once capped the mite gives birth the a male mite.



Life cycle compared to bees.

Note: this and other slides are on the webpage.

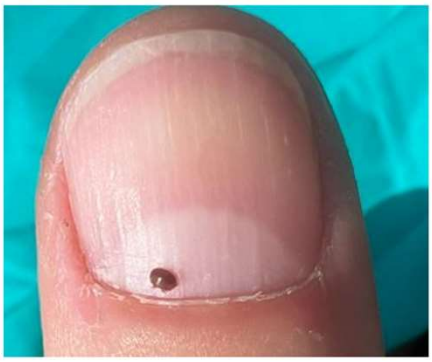
Mite, male & female



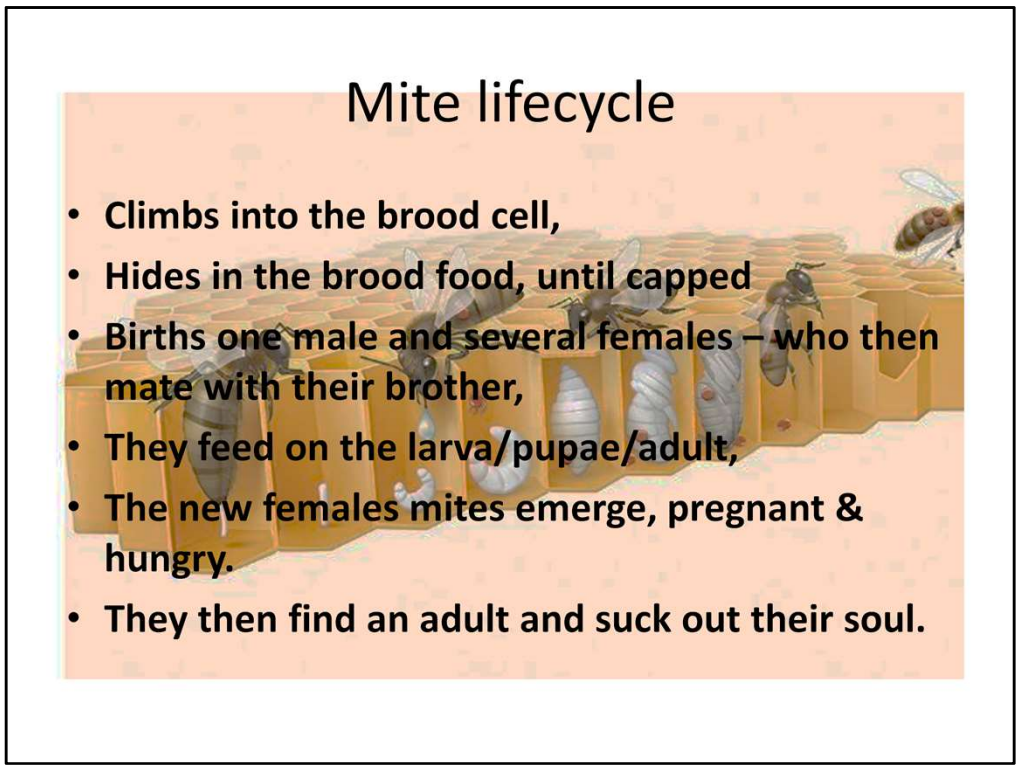
Here you can see the shape and size of the genders of the mite.
The male is actually smaller than indicated in this image.
The male will mate with each of the sisters that are subsequently laid.
Approximately one per day.
These eggs hatch into male and female protonymphs that are both transparent white.

Immature mites can only feed on capped brood, so the life cycle cannot be completed during broodless periods.

This is a vulnerability we can exploit for control.
Development time from egg to adult is 6–7 days.



Size comparison



So as each of these mites hatch, they feed on the larva/pupae/and finally adult. Each of these bites is a wound that can cause later deformities.

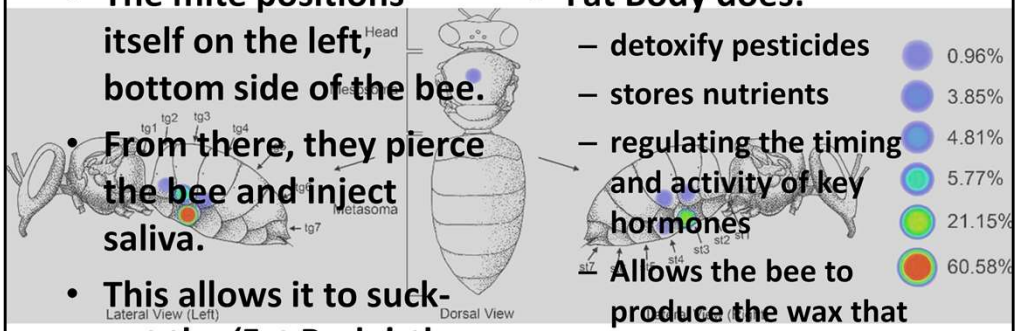
When the adult bee emerges, so do 1-3 new mites, and the foundress. The male dies. These mites are mated and hungry, they start right off to find a new host.

When they find a new host they start their damage.

Ok, maybe not the ‘soul’...

- **The mite positions itself on the left, bottom side of the bee.**
- **From there, they pierce the bee and inject saliva.**
- **This allows it to suck-out the ‘Fat Body’, the ‘liver’ of the bee.**

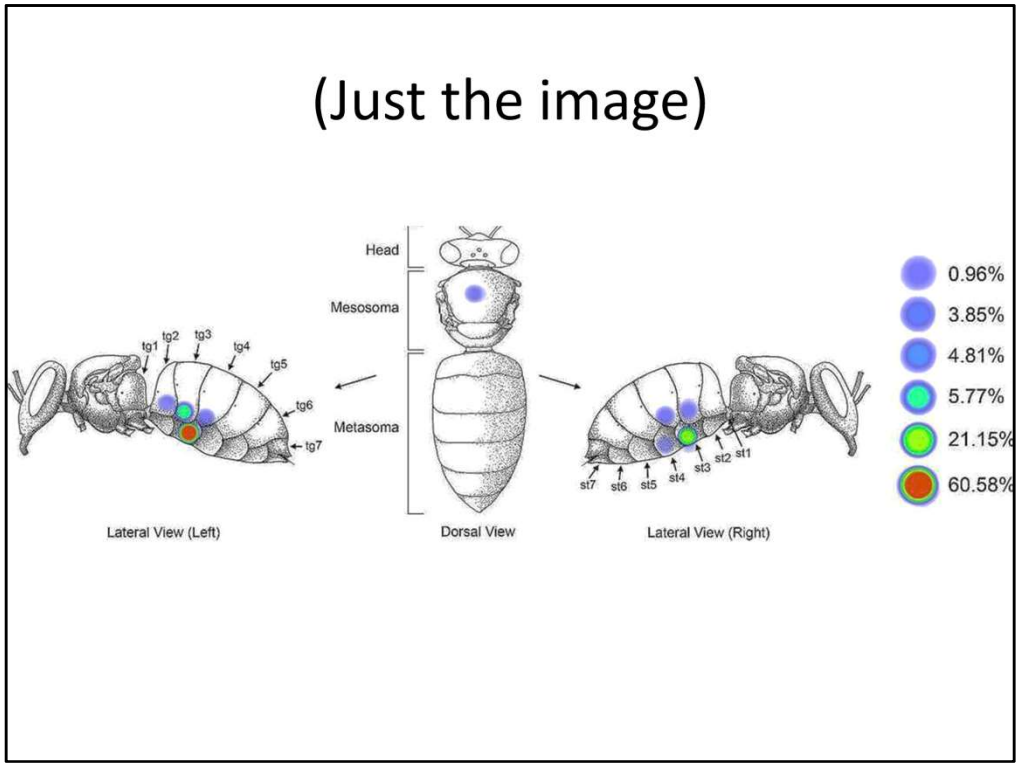
- **Fat Body does:**
  - **detoxify pesticides**
  - **stores nutrients**
  - **regulating the timing and activity of key hormones**
  - **Allows the bee to produce the wax that covers parts of exoskeletons**



Initially, we thought that the mite was like a mosquito, it poked a hole, drank some blood, (and as long as there was no virus or pathogen injecteted), and moved on.
But think if the mosquito landed right here on your body and sucked out your liver...
(Let me remind you, that without your liver you couldn’t process any alcohol.)
So, this might become a concern.

The mite positions itself on the left, bottom side of the bee.
From the image behind the text you can see that the mites show a preference for the bottom left of the bee.
There they slide between the plates of the exoskeleton and attach themselves.
They then inject saliva or stomach juices.
The mites have no ‘stomach’ – digestion happens inside the body of the bee.
The mite is then able to suck the ‘fat body’ out.

I’ll cover ‘Fat Body’ functions in a moment.



Location of where mites live on a bee

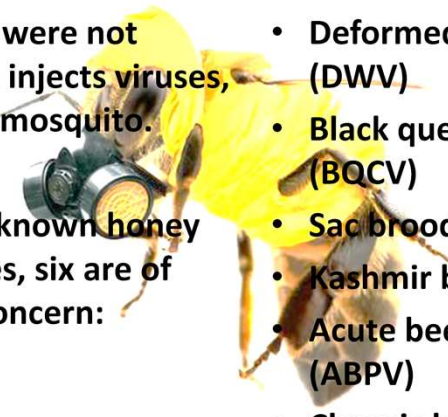
For those who download:
(Research by Sam Ramsey –
Short 2017 doctorial review - https://www.youtube.com/watch?v=Fyfyj-2O47Q&t=6s
Presentation in Ireland - https://www.youtube.com/watch?v=z2plL5NIRcw

The activities of the fat-body

- Growth and Development
- Metamorphosis
- Nutrient Storage & Mobilization (Metabolic Activity)
- Temperature Regulation (Water Loss & Osmoregulation)
- Pesticide Detoxification
- Vitellogenesis
-

The fat body serves several (9 stated in video, I only count 7) purposes for the bee:
Growth and **Development – when you see a larva, it's skin is clear- you are looking at the white 'mass'** that is the fatbody.
The fat-body is the engine of **Metamorphosis**.
The enzymes in the fat-body dissolve the tissue and then releases it in the proper time to generate an exoskeleton.
Nutrient Storage & Mobilization (Metabolic Activity) – Flight requires a large amount of energy.
The tissue that does that is... The fat body.
Bees that lack the fat body frequently have the energy to forage, to fly out to a flower.
But they lack the energy to be able to return.
Temperature Regulation (Water Loss & Osmoregulation) – The wax coating on the bee prevents the bee from dying out when they generate the heat from driving the flight muscle.
That wax was deposited during the metamorphisis from larva, to pupae, to adult.
This is what makes the bee shiny (under it's hairs).
The fat-body makes this wax.
Pesticide Detoxification – pesticides (sub-lethal dose) becomes lethal
Immune Function (Protein Synthesis) – The fat body creates anti-microbial peptides, the 'white blood cell' of the bees' immune system.
Vitellogenesis – the generation of egg yoke proteins.
Reduces oxidative stress – the ageing factor. Removed, and winter bees simply don't last.
This leads to the 'Spring Crash' of many hives.

Viruses transferred by mite-bites



- If the bite were not enough, it injects viruses, much like mosquito.
- Of the 18 known honey bee viruses, six are of primary concern:
  - Deformed Wing Virus (DWV)
  - Black queen cell virus (BQCV)
  - Sac brood virus (SBV)
  - Kashmir bee virus (KBV)
  - Acute bee paralysis virus (ABPV)
  - Chronic bee paralysis virus (CBPV).

Much like a mosquito bite, the 'bite' part is not that bad. It is the ingection of virus or other pathogens that is the issue.
I this case, there are 18 known viruses that are transmitted by the bite.
I will cover the first (DWV), but in all of these cases – they are a product of a mite bite.
Reduce mite counts and you reduce the likelyhood of encountering any of these viruses.

So how do you kill a spider on an insect?

Mini- GI-Joes?
(sorry, couldn't find a picture of Star-Trek nano-bots.)

A bit of history..

- **What has been tried – 'hard', synthetic miticides:**
  - **Amitraz (Apivar)(Taktic)**
  - **Fumagillin**
  - **Fluvalinate (pyrethroid) (Apistan)**
  - **Coumaphos (organophosphate) (CheckMite+)**

- **The result?**
- **The mites developed resistance, sometimes in as little as one year.**
- **Contamination of wax.**
- **Use revocation.**
- **There was no 'silver bullet'.**

A bit of history.
Initial attempts to kill the mites followed other mite treatments used in Agriculture.
Taktic was used as a sheep-dip. Its over-use and off-label use was part of the reason that they are no longer used.
Most of the 'hard-chemicals' became ineffective, sometimes within a single year; as resistance was breed into the mites. The mate-with-brother tended to 'lock-in' most treatment resistance.
In one regard this was a good thing; the chemicals also contaminated the wax supply that outlasted use by several years.

There was no silver bullet.

What works today

- Organic acids
- Oxalic Acid
  - Varoxan (solid)
  - Dribble (liquid)
  - OAV (vapor)
- Formic Acid
  - FormicPro
- Hop Acids
  - HopGuard 3
- Thymol
  - Apiguard (gel)
  - ApiLife Var (wafers)

- Source? – talk to Jonas (yes, this is a plug for Hillside Beek Supply. He has provided samples for you to see.)

Organic Acid
Relatively safe. Used in 'Bartenders Friend', is wood bleach at Lowes, and a dose for the hive is about as much as contained in a can of spinach.
Excellent at keeping mite levels low, not as effective in getting high mite levels under control.
No temperature restrictions, non-disruptive of the hive.
(Solid) Varoxan – ABJ (R.O.) is reviewing this month and next.
(Liquid) 'Dribble' – (I only like to apply when temps are above 'chilling' temp.)
(Vapor) OAV – requires an expensive applicator. But after that is fast and easy.

Formic Acid
Treats under the cap(!). I prefer to use this when counts are high in part because of that. Over half of the mites are under-cap and sheltered from most other treatments. Must be applied when temps are <85*. Previous version (called MAQS) had issues with killing marginal queens.

Hop Acids – I have to admit to limited exposure/experiance with Hop Acids.

Thymol
A derivative of thyme oil.
Has similar temperature restrictions of Formic products.
Research shows 1gm in a quart (about saturation) will improve efficacy of Oxalic dribble.

What works today

- Mechanical control
  - Screened bottom boards
  - Drone foundation (green colored)
  - Thermal Control
  - Powdered sugar
- Genetic methods
  - VSH
  - Pol-line
  - Purdue Leg Chewer
  - Saskatraz
  - Russian Bees
  - BeeWeaver

Varroa mites can also be controlled through nonchemical means.
Most of these controls are intended to reduce the mite population to a manageable level, not to eliminate the mites completely.

Screened bottom boards are used both for monitoring and, can modestly reduce mite populations by 11–14%. Mites which fall from the comb or bees can land on a solid bottom board. Oil or another 'sticky' hold them for count and control.

Varroa infest drone cells at a higher rate than worker brood cells, so drone cells can be used as a trap for mite removal.
Beekeepers can also introduce a frame with drone foundation cells that encourage bees to construct more drone cells.
When the drone cells are capped, the frame can be removed to freeze out mites.
This labor-intensive process can reduce mite levels by about 50–93%, **but if trap cells are not removed early enough before mites emerge, mite populations can spike.**
This method is only viable in spring and early summer when drones are produced.
And (if you have chickens) hens just love the drone brood with mite sprinkles!

Heat is also sometimes used as a control method.
The mites cannot survive temperatures near 40 °C (104 °F), but brief exposure to these temperatures do not harm honey bees. Devices are marketed as heat brooding to these temperatures, and one of our senior members is a strong advocate.
She reports excellent results, but there is little research or comparisons with other

methods.
This method adds nothing to the hive, so results in no contamination.

When I was out west, we regularly had temperatures that reached this level, but the bees worked hard to thermoregulate the hive.
Mainly by bringing in water and evaporating it.
Many buildings out there used ‘Swamp coolers’ that used the same principle.

Powdered sugar used for estimating mite counts in hives has also been considered for mite management as it or other inert dusts were believed to initiate grooming responses. Long-term studies do not show any efficacy for reducing mite populations.

Genetic methods

VSH (Varroa Sensitive Hygiene): Developed by the USDA-ARS, these bees have a highly specialized hygienic behavior that detects and removes pupae infested with mites, disrupting the mite reproduction cycle.
Pol-line: A newer, robust line developed by the USDA that shows high mite resistance and superior winter survival (roughly 60% compared to 26% for standard bees).
Purdue Leg Chewer (Mite-Mauler): Selected for their grooming behavior, these bees actively chew the legs of Varroa mites, often resulting in lower mite loads.
Saskatraz: Bred in Canada for hygienic behavior, honey production, and cold hardiness.
Russian Bees: Known to have natural resistance to both tracheal and Varroa mites due to their coexistence in Russia.
BeeWeaver: A breed developed from over 20 years of treatment-free selection, focused on overall colony hardiness.
[list source A.I./Google]

Note that none of these lines are robustly transferred down the matriarchal line. This means that daughters resistance is limited by the drone genetic contribution.

When to treat?

- You can't control, what you can't measure.
- Alcohol mite wash – the gold standard. (Dawn)
- Sugar shake. (less accurate)
- Bottom board. (Least reliable)

Easy check can be picked up from Jonas.
Randy Oliver started with two Starbucks cups and tulle fabric.
A low cost (and not very rugged) cup can be had from 'For Bees Sake'. I will try to obtain a bunch for the yard walk.

Alcohol is the 'gold standard'. The higher % makes the mites fall faster.

Instructional on how to test & interpret:
https://scientificbeekeeping.com/scibeeimages/Mite-wash-instructions.pdf

Monitoring to Breed vs. Monitoring to Treat (hour long):
https://www.youtube.com/watch?v=GQIcbwzjRxg

How to do a Mite Wash.

- https://www.youtube.com/watch?v=oiu_dIZu7Uk

50 washes in under an hour - https://www.youtube.com/watch?v=nMimZzRSfPk
Watch it get done, fast! - https://www.dropbox.com/s/7bbjcenpuwg2cob/Video%20Aug%2016%2C%2012%2052%2002%20PM.mov?dl=0
Walk the walk - https://scientificbeekeeping.com/selective-breeding-for-mite-resistance-walking-the-walk/

Want to get off the matricide hamster wheel? Be part of the solution: https://scientificbeekeeping.com/scibeeimages/2017-KISS-Breeding.pdf

I washed, now what?

- A quarter cup holds (about) 300 bees.
- Go ahead, count ‘em. I have!
- The threshold for treatment used to be 3mites per 100bees. (or a count of 9) Now that is ONE per 100 bees. (3 mites in a wash.

Wait a couple weeks after a ‘new’ hive (swarm/nuc/package). Allow the queen to get settled, you don’t want to disturb the hive any more than necessary.

Count the mites.
Be a bit aware of the season; Early summer (laying ramping up) there are more mites under cap. Don’t get complacent on low counts. (And they can be regularly!)
Late summer – you want *very* low counts, as this is when the RATIO of mites to bees goes up (driving counts stratospheric!), AND this is when ‘winter bees’ are born.

Mammals

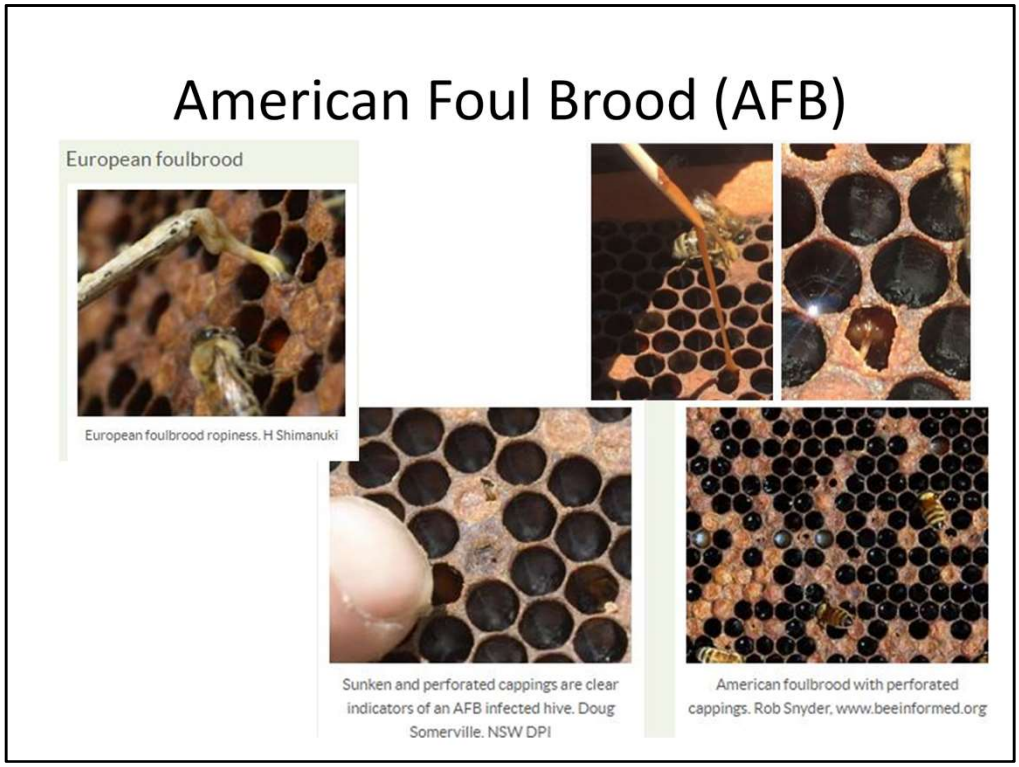
- Bears
- Skunks
- Mice

- Electric Fence (Pat will talk about this).
- Place your hives on cinder blocks.
- Mouse guards.

Bears – An electric fence is effective. And required if you are in ‘Bear Country’.

Skunks – By placing hives up 16”, the skunk has to expose it’s belly.
- marks can be seen on the landing board.
- (Randy’s use of Lye)

Mice – Mouse guards, installed BEFORE they move in for winter.



AFB infections start when spores on the nurse bee's mouthparts are spread to larvae when feeding the developing brood.
Only around 10 spores are required to cause an infection in a day old larvae.
A bee larva less than 24 hours old is the most susceptible stage to be infected by AFB.
The younger the larvae, the more susceptible and less spores required to cause infection.

EFB
Ropiness: Usually not ropey in its early stages, with some rope capable of being drawn out at around 1.5cm. In latter stage of infection, and possible secondary infection, the ropiness will increase.
Appearance of rope: Slightly ropey, but more of a light grey semi-liquid mass, with some yellow seen due to tracheal tubes infected.
Odour: Possibly sour odour.
Brood pattern and stage of infection: Patchy brood with EFB cells usually containing dead, or discoloured and twisted larvae in uncapped cells.
Scale: Rubbery, brown to black.

AFB
Ropiness: Can be quite ropey, sometimes forming a fine ropey thread around 3-5cm.
Appearance of rope: The ropey thread is generally a dark brown and can be quite elastic.
Odour: Can be quite a sulphurous odour
Brood pattern and stage of infection: Patchy, perforated brood. Infected brood usually die after cell capping.

Scale: Brittle, brown to black.

Contact your Inspector if you suspect.
This is the most EVIL thing in the pest pantheon.
But it is rare. Bonnie (southwestern PA) finds ONE case every two years or so, and frequently from bees imported to state. I have never seen it.

Round out the OTHER things

- Round out the other pests:
  - Small Hive Beetle (SHB)
  - Viruses
  - Ants
  - Yellow Jackets
  - Chalkbrood
  - Wax Moth
  - Nosema
  - Tracheal Mites

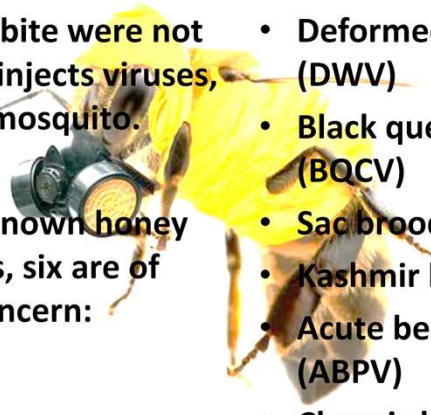
viruses, parasites, SHB, ants, and other insects.

Make sure the amount of bees is appropriate for the size of the hive. If you have too much space beetles can take over.

Swiffer (pennies)
Mineral Oil traps (<$5)(Jonas)
Metal ‘lip’ on bottom board ($60-70).
Beneficial Nematodes ($45 treats 218 sq.ft. ~ 10 hives)

Viruses transferred by mite-bites

- If the mite bite were not enough, it injects viruses, much like mosquito.
- Of the 18 known honey bee viruses, six are of primary concern:



- Deformed Wing Virus (DWV)
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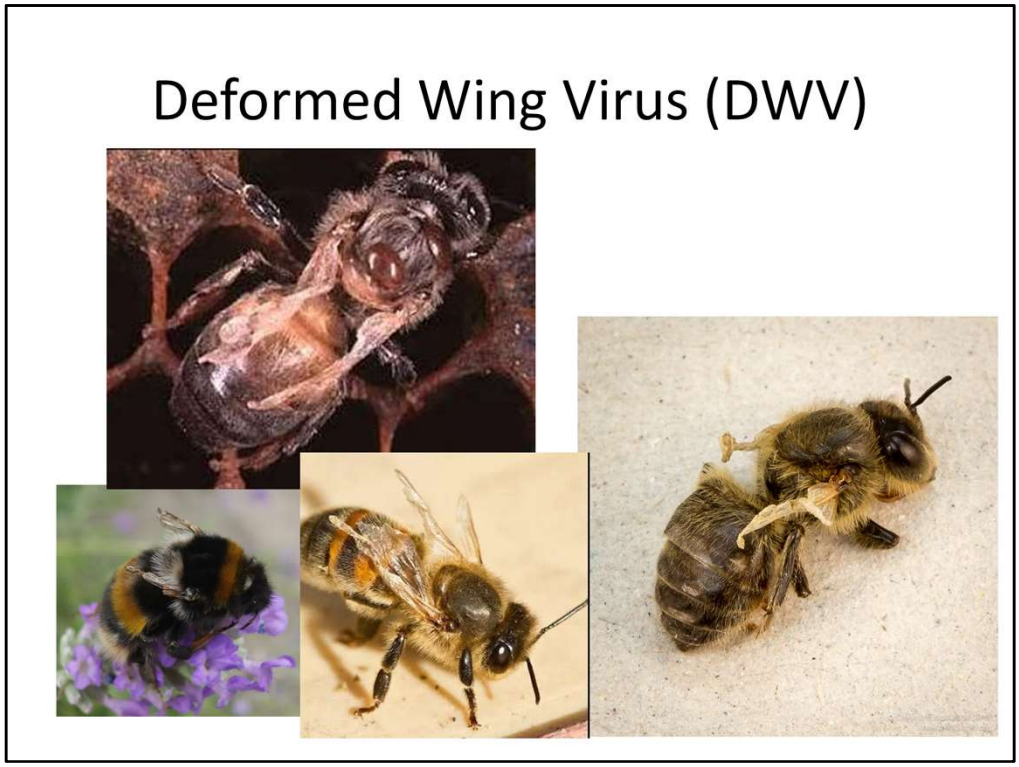


Aside from the wing deformities that characterize this virus, symptoms of DWV can also include paralysis, abdominal bloating, early death, and learning deficiencies. However, it has been observed that over 99% of bees with DWV are asymptomatic (no wing deformities), making it difficult to grasp disease prevalence in the hive until it is too late. Because DWV can also replicate in European honey bees, it can be passed to eggs through the ovaries and spermatheca of infected queens and drones, and to larval stages through contact with infected nurse bees. Visible infection with DWV is significantly more prevalent in temperate climates, and this virus is thought to be generally responsible for heavy overwintering colony losses.

Here, we report for the first time the occurrence of bumble bees *Bombus terrestris, Bombus pascuorum* exhibiting wing deformities resembling those seen in clinically DWV-infected honey bees.. Since such deformed bumble bees are not viable DWV infection may pose a serious threat to bumble bee populations'.

Ants

- Ants in a beehive are really more of a nuisance than a huge beekeeping issue.
- Ants and other insects (Earwigs, spiders) like the warmth and protection of the inner cover.
- Ants will also build a nest between the metal and wood of a telescoping cover.

s for ants it's a simple treatment, I've found cinnamon on the legs and the top of a hive works very effectively. In the future planting mint around the hive will help as well.

Botanicals are a great way to repel pests from a beehive. While mint can be used as a wax moth treatment, cinnamon can be used as an ant deterrent. Cinnamon can be used inside and outside of the hive to keep ants off the beehive. To use it outside the hive, sprinkle it liberally on the ground around the hive. To use cinnamon inside the hive, sprinkle it on the inner cover. The bees don't mind, but the ants don't like it and will stay away.

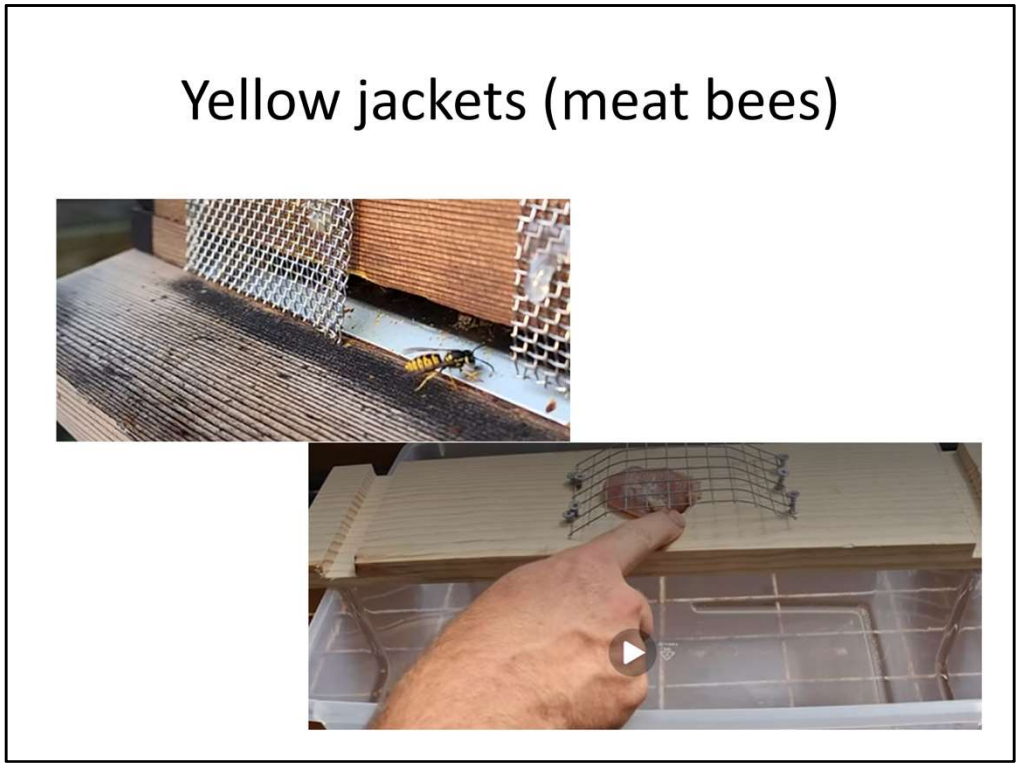
Many beekeepers use old motor oil, however, I prefer to use food-grade oils such as vegetable oil. When it rains, the oil will probably overflow the bucket and get into your soil, which is why I don't use motor oil. Motor oil is a contaminant to soil and you don't want your bees foraging flowers that are growing in contaminated soil. You will need to refill the oil periodically.

She shoots, she Scores

Wing-slapping behavior might have evolved among Japanese honey bees as a relatively low-energy, generic defense against the threat of ant incursion.

https://esajournals.onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Fecy.4372&file=ecy4372-sup-0001-VideoS1.mov

https://esajournals.onlinelibrary.wiley.com/action/downloadSupplement?doi=10.1002%2Fecy.4372&file=ecy4372-sup-0003-VideoS2.mov

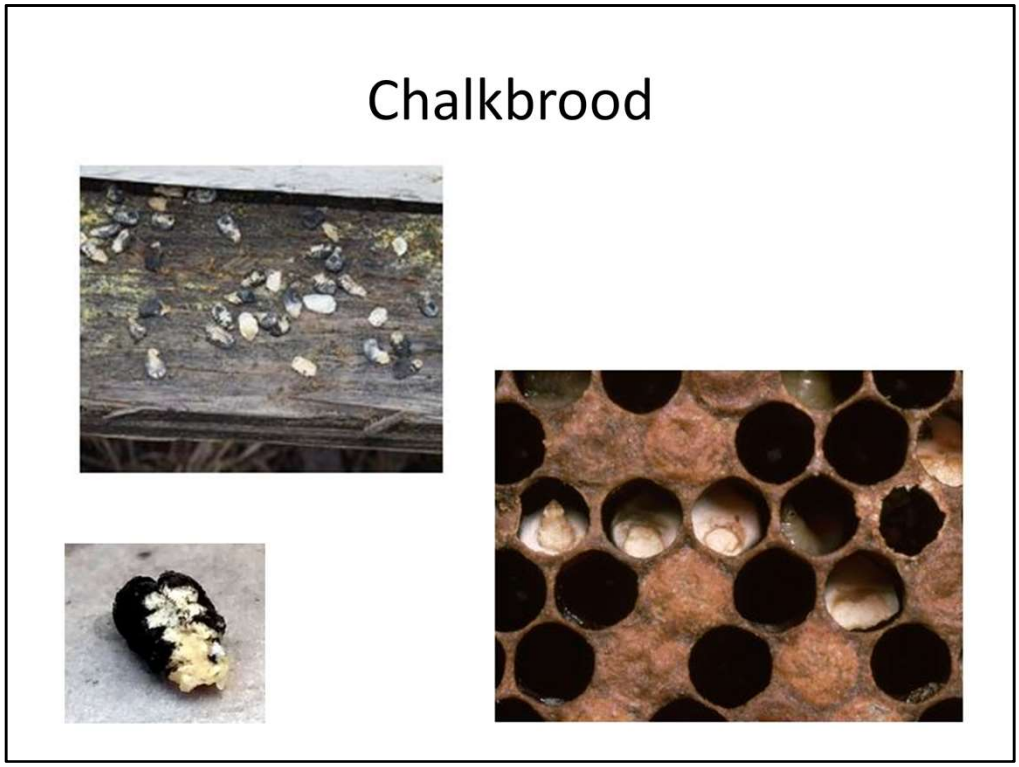


https://www.youtube.com/watch?v=-F1mv8lFNjY – Fred Dunn video of morning (<60º) meat bee attack.

https://www.youtube.com/watch?v=fPPfKKDQLvk – Meat bee trap.

Fatal Bait
Another fatal bait lure is meat mixed with one packet of Front Line-brand liquid flea treatment. It contains a chemical that kills yellow jackets very quickly. Again, be darn sure it is not accessible by anything but the yellow jackets. My brother tried this a few weeks ago, hanging a can of laced tuna from a thin tree branch in a net bag. The yellow jacket nest was no longer active by the following morning. This is a potentially dangerous undertaking if you do not think it through. You do not want your pet or some harmless wild creature killed.

Fake Out
Wasps, including yellow jackets, are very territorial, and will not choose to build nests where other wasps have built. Knowing this, you can create (or buy at any garden store) fake hornet nests that mimic the balloon-shaped paper nests of bald-faced hornets. The favorite food of the bald-faced hornet is yellow jackets! I've read that in areas with high yellow jacket populations, the paper coating of the huge hornet nests is a greenish yellow—the yellow being the coloring from the bodies of yellow jackets.



The Banana Thing. -- http://beespoke.info/2016/09/13/chalkbrood-and-the-banana-thing/

Hives should be kept well ventilated and free from damp, with plenty of food. (Location – back to Pat's presentation) Where persistent chalkbrood infections occur, re-queening is advisable. Workers showing a high level of hygienic behavior are less prone to chalkbrood infection.

How chalkbrood spreads

Spores of the chalkbrood fungus in brood food are ingested by the bee larva and germinate in their hindgut. Infection can also occur by growth of the fungus through the cuticle. After the cells are capped, mycelia develop from the fungal spores and eventually engulf the entire larva, giving it a white fluffy cotton-wool appearance.

The greater wax moth, Galleria mellonella, and lesser wax moth, Achroia grisella, are estimated to cause more than $5 million worth of damage a year in the USA alone. Its larvae feed on impurities in wax, pollen and even bee larvae and they can destroy comb very rapidly. Damage is most frequently found in stored comb, but weak colonies can also succumb.

Freeze removed brood comb, 48 hours plus.
Honey comb not affected.

Bt – B402 – Xentari - Bacillus thuringiensis subsp. aizawai

Nosema

Nosema apis is a long-established pathogen of the western honeybee and often causes dysentery reducing the lifespan of bees. A new variant, Nosema ceranae, was first identified on the western honeybee in Spain in 2004 and has been associated with Colony Collapse Disorder (CCD) in the USA and Europe.

Although there are no reliable or specific field diagnostic symptoms associated with Nosemosis, beekeepers should also become familiar with some of the general symptoms that may be caused by Nosema infection.
Because Nosema is invisible to the naked eye and the fact that it causes very general symptoms, it is commonly referred to as the 'silent killer' of bees. For this reason and as a precautionary biosecurity measure, beekeepers are encouraged to send samples of bees away every spring to monitor the Nosema levels in your loads of hives.

So far, there is a lack of knowledge regarding control methods for nosemosis.

Nosema apis infection tends to cause adult bees to become bloated with water and this leads to dysentery. Digestion and production of royal jelly can be severely affected.
Nosema apis infection causes young adult bees to change their behaviour. They stop brood-rearing and attending to the queen earlier than normal and instead they start foraging and guarding the hive like older bees.

Good beekeeping will help to prevent Nosema. **Stress factors such as damp apiary sites**, lack of nutrients. Fumagillin fed to colonies can suppress the effects of *Nosema apis* and – where permitted by local regulations – can be administered as a prophylactic or as a control treatment.
No other registered treatments are known.

Veterinary Directive: Under FDA regulations, particularly the Animal Medicinal Drug Use Clarification Act (AMDUCA), legal access to, and use of, antibiotics like Fumagillin is facilitated through a veterinarian

Good management practices (such as keeping hives in a warm and sunny position over the autumn, winter and spring periods to allow regular cleansing flights) can reduce the risk of the disease building up to damaging levels over the cooler part of the year.

It is also good practice to try and avoid moving hives, or inspecting hives during winter, as inspections and movements at this time can increase the stress levels within the colony. When getting hives ready for winter, always ensure that there are not excess boxes on the hive, as well as ensure that there is enough good quality honey and pollen for the colony.

Infection by *N. apis* is also associated with the presence of honey bees crawling around the hive entrance, sometimes with wings held at odd angles. Some bees will have swollen and greasy looking abdomens and in severe cases may appear to be trembling.

A common symptom of *Nosema apis* infection is dysentery (brown diarrhoea on combs and the outside of the hive). Dysentery is not actually caused by the fungus, although *N. apis* infections make the infected bee more susceptible to other secondary infections, which subsequently cause the dysentery.

A very effective method to control *N. ceranae* in field conditions is the queen's replacement, as demonstrated by [**40**]. Indeed, this biotechnical management is a basic apicultural practice because of the crucial role of the queen in the renewal of the bee population and consequently to replace the bees lost due to the infection, keeping the colony homeostasis. Young queens have a greater egg laying potential, and they produce a higher proportion of uninfected newly hatched bees to compensate for adult bee losses.

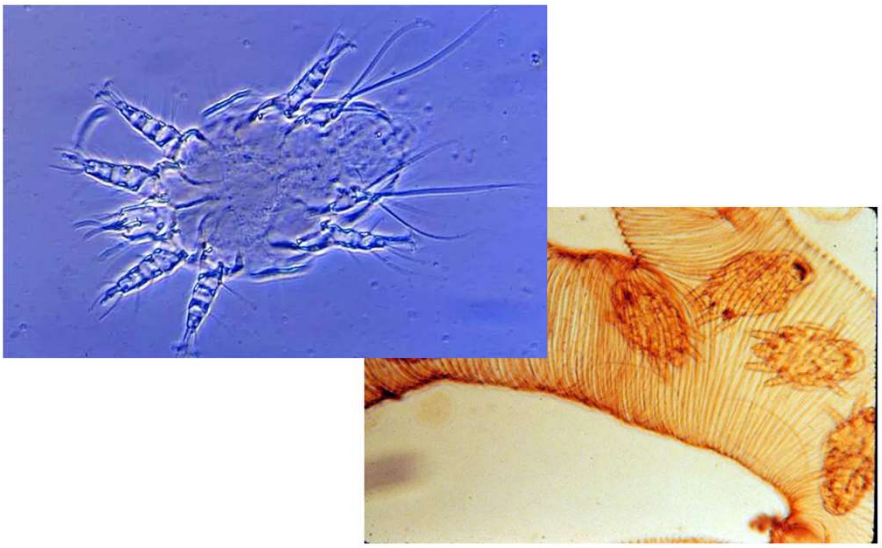
fumagillin (specifically as **Fumagilin-B**) is legally permitted in the U.S. to treat *Nosema* in

honey bees, despite being banned in the European Union. It is the only approved antibiotic for control of *Nosema apis* and *Nosema ceranae*. However, its manufacturer stopped production in 2018, making it less accessible. Concerns exist regarding residue in honey, making it necessary to follow label instructions regarding feeding times to avoid contamination.

Rx may require a prescription by a veterinarian.

Several methods can be employed to eradicate Nosema apis. Disinfecting contaminated combs is essential to prevent further spread within the hive. Fumigation with 60-80% acetic acid vapor can achieve this, effectively killing spores within a week. The recommended mixture is 1 part water to 4 parts glacial water-free acetic acid, applied at a temperature higher than 15°C for faster evaporation. Fumagilin-B treatment is another straightforward approach for treating infected hives, although it may not be efficient for heavily infested colonies. In cases where Nosema apis spores persist for years, complete eradication requires disposing of all living organisms in the hive and burning the equipment.

Tracheal mite (Acarapis woodi)



A second mite that infests honey bees is the honey bee tracheal mite. This internal parasitic mite lives within the tracheae, or breathing tubes, inside the thorax of adult honey bees. Tracheal mites may also be found in air sacs in the thorax, abdomen, and head. The mites pierce the breathing tube walls with their mouthparts and feed on the hemolymph, or blood, of the bees.

Menthol is the only material that is currently approved by the Environmental Protection Agency (EPA) for the control of these mites in the United States. Beekeepers can minimize the impact of tracheal mites by intensive management practices to maintain populous colonies and by using menthol.

Colonies can be treated with menthol when there is no heavy nectar flow and daytime temperatures are expected to reach at least 60 F. The best time being in the spring when the weather is warm, and in the late summer or fall of the year immediately after removing the surplus honey.

Directions for Using Menthol: Fifty grams (1.8 ounce) of crystalline menthol should be enclosed in a 7" x 7" plastic screen bag or equally porous material and placed inside a colony for 20-25 days. Menthol placed on the top bars is the preferred method of treatment provided the daytime temperature does not exceed 80 degrees F. During hot weather, the menthol should be placed on the bottom board of the colony. There should be no honey supers on the hive during the treatment, and the menthol should be taken out of

a colony at least one month before any anticipated flow. Before using menthol, read and follow the approved label carefully.

The population of *A. woodi* in a colony may vary seasonally. During the period of maximum bee population, the percentage of bees with mites is reduced. The likelihood of detecting tracheal mites is highest in the fall and winter. No one symptom characterizes this disease; an affected bee could have disjointed wings and be unable to fly, or have a distended abdomen, or both. Absence of these symptoms does not necessarily imply freedom from mites. Positive diagnosis can only be made by microscopic examination of the tracheae; since only *A. woodi* is found in the bee tracheae, this is an important diagnostic feature.

Formic acid has also been used against A. woodi (Hoppe et al., 1989; Amrine and Noel, 2006; Underwood and Currie, 2009; Hood and McCreadie 2001). Widely used as a treatment for varroa mites, formic acid (along with other acaricides used against varroa) may be contributing to current lower populations of HBTM in North America.

You have met the enemy, are you armed & ready?