



### Diseases and pests of honey bees

- Management of diseases and pests has long been recognized as an integral part of beekeeping
- Pesticides used to control plant and animal pests (including pests within a beehive) can have adverse impacts on bees
- Diagnosis of problems should begin when entering the apiary and continue into the hive and conclude when leaving

## Diseases and pests of honey bees

The beekeeper is **always** the first line of defense against diseases

Montana Department of Agriculture does provide inspection services to look for pests and diseases

 **Some pests and diseases are regulated by law and must be reported**

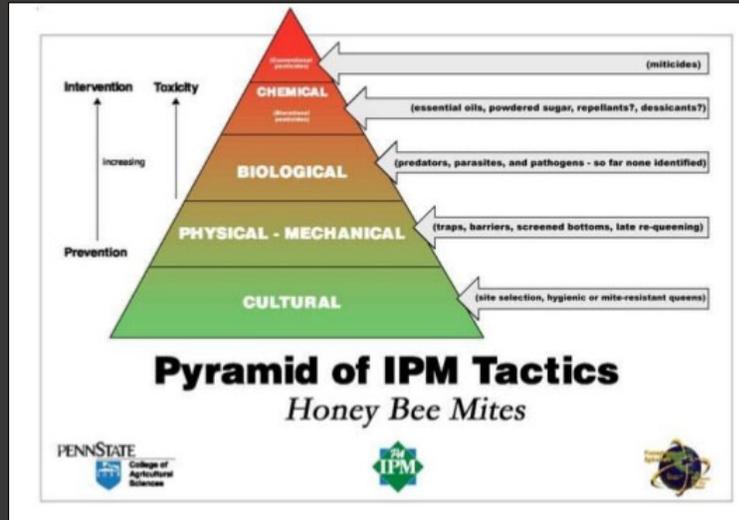
## Integrated Pest Management

**FOA Definition IPM:** The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment.

- IPM is a process that seeks to integrate more than a single (chemical) approach to pest control
- Does not seek total elimination of pest, but rather a method to keep the pest population below the economic threshold
- Focuses on long-term prevention of pests or their damage by managing the ecosystem

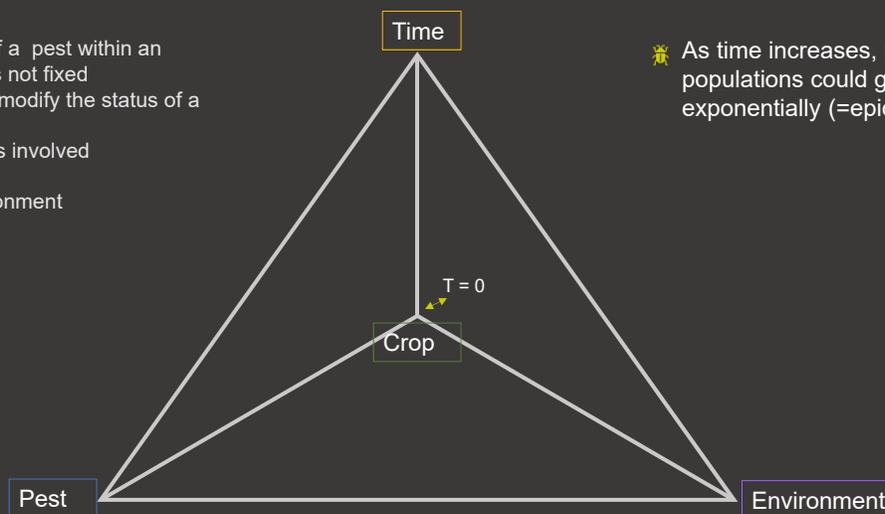
**IPM ≠ TREATMENT FREE**

## Integrated Pest Management



## IPM: Pest Tetrahedron

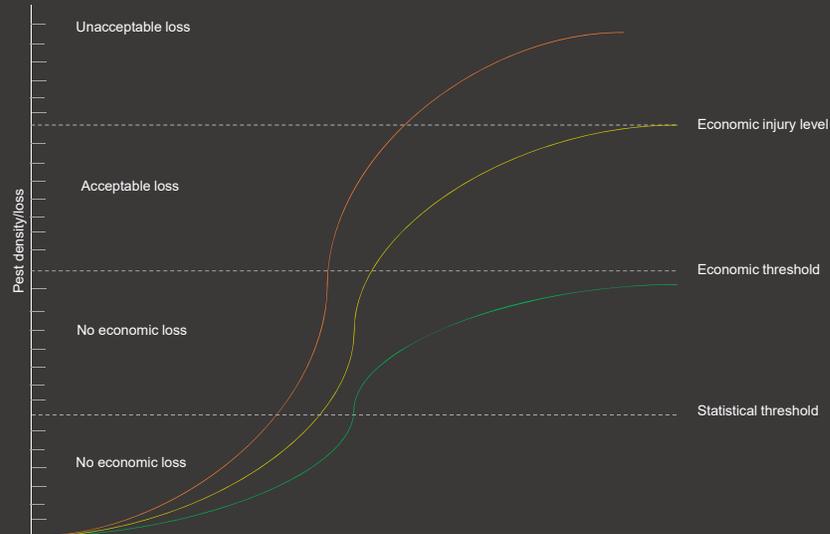
- The status of a pest within an ecosystem is not fixed
- Factors that modify the status of a pest include:
  - a. Organisms involved
  - b. The crop
  - c. The environment
  - d. Time



⚠ As time increases, pest populations could grow exponentially (=epidemic)

# Integrated Pest Management

## Economic injury level



### Regulated Pests in Montana

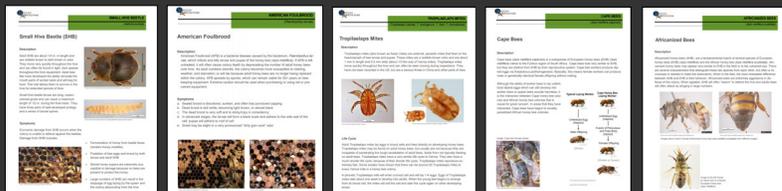
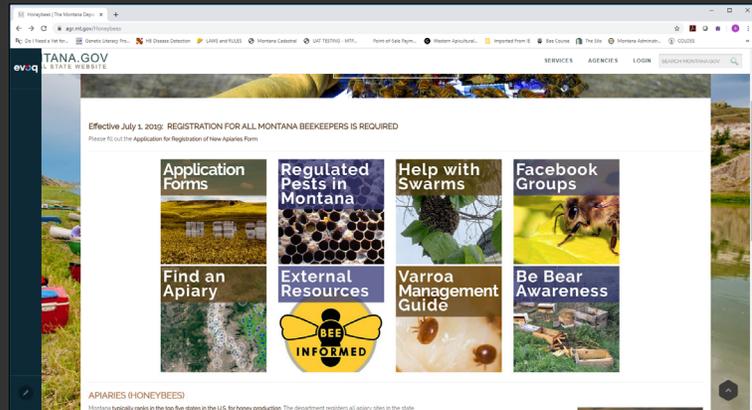
Small Hive Beetle (*Aethina tumida*)

American Foulbrood (*Paenibacillus larvae*)

Tropilaelaps Mites (*Tropilaelaps spp.*)

Cape Bees (*Apis mellifera capensis*)

Africanized Bees (*Apis mellifera scutellata*)



### Regulated Pests in Montana

#### Small Hive Beetle (*Aethina tumida*)



- SHB adults are positively phototactic
- SHB females can lay up to 1,000 eggs in her lifetime
- Larvae are attracted to protein (pollen patties)

- Larvae defecate in honey causing fermentation (issues with extraction)
- SHB is mainly an issue in southern states

#### Control Methods:

- Keep healthy colony
- Traps
- Pollen patties (must monitor frequently)
- Freezing equipment

### Regulated Pests in Montana

#### American Foulbrood (*Paenibacillus larvae*)



- Bacterium that spreads via equipment, comb, honey, in-hive tools, and out-of-hive tools
- Spores can be viable for 50+ years
- Symptoms include:
  - Ropey brood
  - Distinct sour odor
  - Scale
- Prevention\*:
  - Terramycin
  - Tylan
  - \*VFD required
- Only "treatment" is to destroy equipment

**Regulated Pests in Montana**

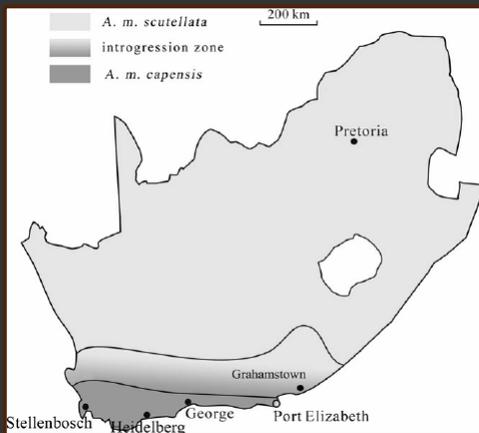
**Tropilaelaps Mites (*Tropilaelaps* spp.)**



- External parasite
- 1/3 the size of varroa
- Not documented in the US but is in parts of Asia
- Are visible during inspections
- Some studies have shown that there can be 25 TrM to every varroa mite in a colony
- Contact state inspector immediately if you suspect TrM is present in your colony(s)

**Regulated Pests in Montana**

**Cape Bees (*Apis mellifera capensis*)**



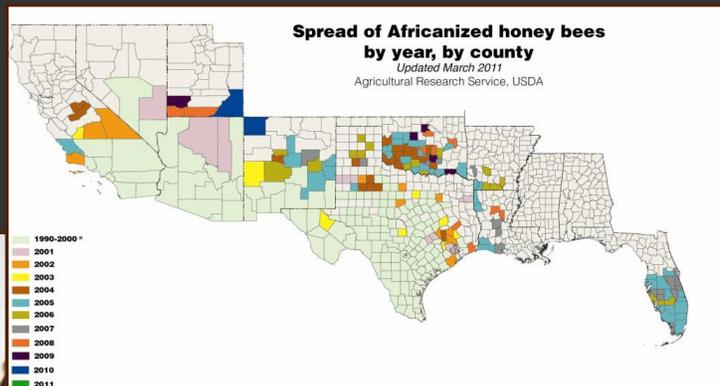
Sounds harmless, but...

\*genetic bottlenecking

\* *Am capensis* x *Am scutellata*

## Regulated Pests in Montana

Africanized Bees  
(*Apis mellifera scutellata*)



- Defend their hive more rapidly than the European honeybee
- Usually sting in greater numbers
- Are less selective about where they nest
- Swarm more often than European honeybees

## Non-Regulated Pests in Montana

Varroa Mites (*Varroa destructor*)

Tracheal Mites (*Acarapis woodi*)

European Foulbrood  
(*Melissococcus pluton*)

Nosema (*N. apis* or *N. ceranae*)

Yellow jackets (*Vespula spp.* or  
*Dolichovespula spp.*)

USDA Agricultural Research Service  
U.S. DEPARTMENT OF AGRICULTURE

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**Bee Research Laboratory: Beltsville, MD**

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Bee Disease Diagnosis Service

The diagnosis of bee diseases has been a focus of this laboratory since its inception in 1891 and we operate a "Bee Disease Diagnosis Service" for beekeepers across the U.S.

There is no charge for this service.

Samples received of adult bees and beeswax comb (with and without bee brood) are examined for bacterial, fungal and microsporidian diseases as well as for two species of parasitic mites and other pests associated with honey bees (i.e., small hive beetle, *Aethina tumida*).

When requested, American foulbrood samples are cultured and isolates are screened for their sensitivity to Terramycin (oxytetracycline) and Tylan (tylosin).

We do not analyze samples (bees, wax comb, pollen, etc.) for the presence of viruses or pesticide residue.

We do not make determinations about which species of *Nosema* (*N. apis* or *N. ceranae*) are present, when nosema disease is detected.

Diagnostic reports are transmitted to both the beekeeper, submitter of the samples and to the appropriate apiaary inspectors.

We are only able to accept samples originating from the U.S. and its territories. We do not accept samples from other countries.

[How to submit samples](#)

### Non-Regulated Pests in Montana

#### Varroa Mites (*Varroa destructor*)



- Reddish-brown, Large-bodied mite (1.0 mm long x 1.4 mm wide)
- Are active on adult bees, but fluctuates with population
- Mites can differentiate and prefer drone brood to worker brood, probably using brood pheromones to find the preferred male brood host
- Sampling Varroa may be done by looking at brood, adult bee bodies, or by estimating the number of mites in the whole colony (there are several ways to do this)

#### Symptoms:

- Visible on adult bees
- Deformed Wing Virus (DWV) and other pathogens present

### Non-Regulated Pests in Montana

#### Varroa Mites (*Varroa destructor*)



## Non-Regulated Pests in Montana

Varroa Mites (*Varroa destructor*)

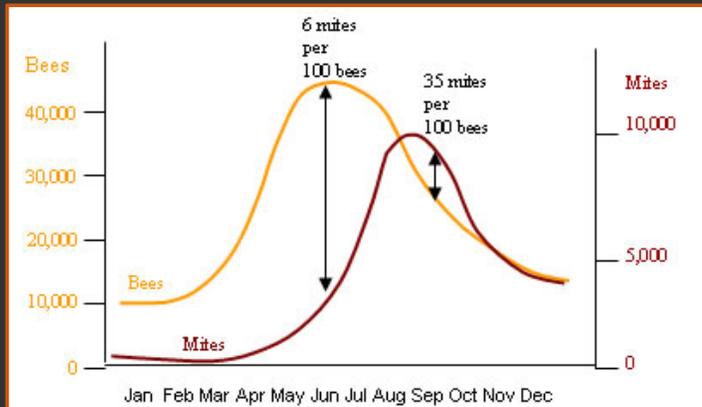


Figure 1. Simplified bee and mite population growth curves for a temperate climate. The mite growth curve lags behind the bee curve. Note how the number of mites per hundred bees greatly increases in fall. A colony is unlikely to survive a fall infestation rate this high.

Randy Oliver: [www.scientificbeekeeping.com](http://www.scientificbeekeeping.com)

## Non-Regulated Pests in Montana

Varroa Mites (*Varroa destructor*)

Sampling methods

Sample BEFORE and AFTER treatment!

**For the soapy water/alcohol and sugar shake sampling method, a little bit of math is needed**

Divide the number of mites by the number of bees in the sample  
ex) If you find 9 mites in a 300-adult-bee sample

$$9/300 = 0.03 * 100 = 3\%$$

**Results anywhere from 2-5% requires treatment for mites**

## Non-Regulated Pests in Montana

Varroa Mites (*Varroa destructor*)

Treatment methods

- Miticides:** synthetic and natural chemical compounds
  - One of the earliest control strategies
  - Specifically targets mites without causing apparent harm to the bees or hive
 Ex) Apistan®, Mavrik®, Checkmite+, Apivar®
- Organic acid chemicals:** Have been shown to provide varroa control but are not as convenient to use because they are temperature dependent and maybe have negative side effects.
  - Ex) Formic Acid (Mite Away Quick Strips (MAQS®))
    - Impregnated sugar pad with formic acid
    - Eliminates need to reenter colony to remove strips
    - MAQS targets mites within brood cells and is permitted when honey is still on the colony being treated
    - MAQS caused moderate queen death during initial season of use



## Non-Regulated Pests in Montana

Varroa Mites (*Varroa destructor*)

Treatment methods

- Organic acid chemicals:**
  - Ex) Oxalic Acid (wood bleach)
    - Is **not** permitted when honey is still on colony
    - Applied in fall/early spring when little brood is present
    - Outside temperature must be at least 37° F
    - Can be applied in 3 ways:
      1. In sugar solution as a spray to packages
      2. In sugar solution trickled between frames
      3. Vapor treatment

Resource:

<https://www.dadant.com/>

Oxalic Acid Vaporization: Questions and Answers



**Non-Regulated Pests in Montana**

Varroa Mites (*Varroa destructor*)

Treatment methods

**3. Essential Oils:** Many essential oil extracts have been tested as miticides and several have confirmed activity

Ex) Thymol (Apiguard®, Api-Life VAR®)

- Apiguard®: slow-release gel
- Api-Life VAR®: wafer application
- Both also control for tracheal mites and some control of chalkbrood (fungus)
- Negative side effects:
  - brood removal when applied at higher temperatures
  - queen mortality
- Work poorly under lower temperatures and can cause bee mortality at higher temperatures



**4. Others?**

Article | OPEN

Lithium chloride effectively kills the honey bee parasite *Varroa destructor* by a systemic mode of action

Bettina Zieglermann, Elisabeth Abele, Stefan Hamms, Michaela Betzinger, Stefan Berg & Peter Renwick



**Non-Regulated Pests in Montana**

Varroa Mites (*Varroa destructor*)

Treatment vs. Non-treatment

Report date: 12/1/2017  
 Date sample was collected: June 21, 2017  
 Date live sample was received: June 30, 2017  
 Date alcohol sample was received: July 27, 2017

National Honey Bee Survey - Funded by  
 USDA/APHIS  
 Honey Bee Diagnostic Report



Sample ID: MT-01-2017

The following report is from molecular and microscopic analysis of the live and alcohol-collected bees from your apiary located at Latitude **46.640737** Longitude **-112.641802**. Molecular analysis was performed on a composite sample of 50 live bees sent from your apiary. The bees were frozen, pooled, and their extracted nucleic acids were analyzed using molecular techniques to look for the presence of a select # of viruses. Visual, microscopic techniques were used to determine the levels of exotic mite, bee, and nosema species. The results for sample **MT-01-2017** follow. A plus symbol (+) indicates that the tested target was detected in your sample. A negative symbol (-) indicates that the tested target was not detected. The use of N/A indicates that no data is available for the particular test.

Counts of colonies with the following visual observations			
Colonies in Apiary	9	Sacbrood	0
Sampled colonies	8	Chalkbrood	0
Queen right	8	Parasitic Mite Syndrome	0
Colonies with queen cells	0	Deformed Wing Virus symptoms	0
Queenless	0	Colonies with Black Shiny Bees	0
Drone laying queen	0	Colonies with Small Hive Beetle	0
American Foulbrood	0	Colonies with Wax Moth	0
European Foulbrood	0		

## Non-Regulated Pests in Montana

### Varroa Mites (*Varroa destructor*)

### Treatment vs. Non-treatment

#### Microscopic and Visual Report

The microscopic and visual report summarizes the alcohol sample size, the varroa mite count, the nosema spore load, and any *Apis cerana* and *Tropilaelaps* spp. mites found.

Target	Number	Notes
Sample size (# bees)	225.0	Total number of bees in alcohol sample
Total Varroa mites counted	0	Total number of Varroa mites counted in entire sample.
Varroa mites per 100 bees	0	Varroa mites detected at more than 3-10 mites/100 bees are thought to cause damage and colonies exceeding this threshold should be treated to reduce mite loads ASAP.
Average Nosema load per bee (millions of spores/bee)	0	Nosema spore counts in excess of 1 million spores per bee are thought to cause damage, and colonies with infection levels above this threshold should consider treatment.
<i>Apis cerana</i>	-	Asian honey bee that can be an invasive pest. Not known to be in the U.S.
<i>Tropilaelaps</i> spp. mites	-	<i>Tropilaelaps</i> mites are parasitic mites native to Asia. They are not known to be in the U.S.

Note: Based on analysis of samples since Jan 01, 2016. Varroa mites were present in 88% of samples. Nosema spores were present in 46% of samples (microscopy analysis only).

Figure 1 below indicates sample results inclusive of all data collected from Jan 01, 2016 to present. It illustrates the percentage (prevalence) of the samples that tested positive for the indicated virus out of 3013 samples.

#### Microscopic and Visual Report

The microscopic and visual report summarizes the alcohol sample size, the varroa mite count, the nosema spore load, and any *Apis cerana* and *Tropilaelaps* spp. mites found.

Target	Number	Notes
Sample size (# bees)	495.0	Total number of bees in alcohol sample
Total Varroa mites counted	175	Total number of Varroa mites counted in entire sample.
Varroa mites per 100 bees	35.4	Varroa mites detected at more than 3-10 mites/100 bees are thought to cause damage and colonies exceeding this threshold should be treated to reduce mite loads ASAP.
Average Nosema load per bee (millions of spores/bee)	0	Nosema spore counts in excess of 1 million spores per bee are thought to cause damage, and colonies with infection levels above this threshold should consider treatment.
<i>Apis cerana</i>	-	Asian honey bee that can be an invasive pest. Not known to be in the U.S.
<i>Tropilaelaps</i> spp. mites	-	<i>Tropilaelaps</i> mites are parasitic mites native to Asia. They are not known to be in the U.S.

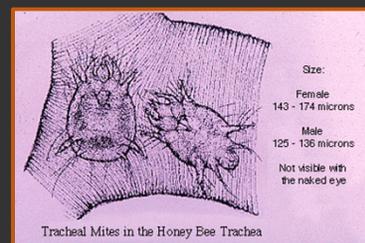
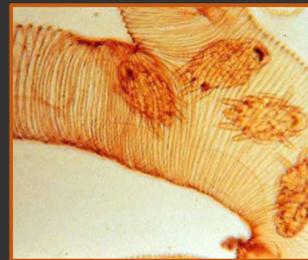
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Figure 1 below indicates sample results inclusive of all data collected from Jan 01, 2016 to present. It illustrates the percentage (prevalence) of the samples that tested positive for the indicated virus out of 3054 samples.

## Non-Regulated Pests in Montana

### Tracheal Mites (*Acarapis woodi*)

- Microscopic, internal mites of the honeybee respiratory system
  - Enters through thoracic spiracles
  - Feeds on haemolymph of honeybee
  - Infection affects the honeybees' capacity to breathe and opens the tracheal surface to pathogens and reduces air flow to muscles (flight)
- Mites infections combined with other stressors can lead to colony death
  - Strong, populous bee colonies with abundant resources tend to have lower levels of infestation
  - Causes minor annual loss and is not a major pest



## Non-Regulated Pests in Montana

### Tracheal Mites (*Acarapis woodi*)

#### Control methods:

- Re-queening colonies
- Crisco® patties
- Menthol/grease patties

#### Symptoms:

- Dwindling populations
- Weak bees crawling in front of hive
- K-wing adults

★ Non-specific

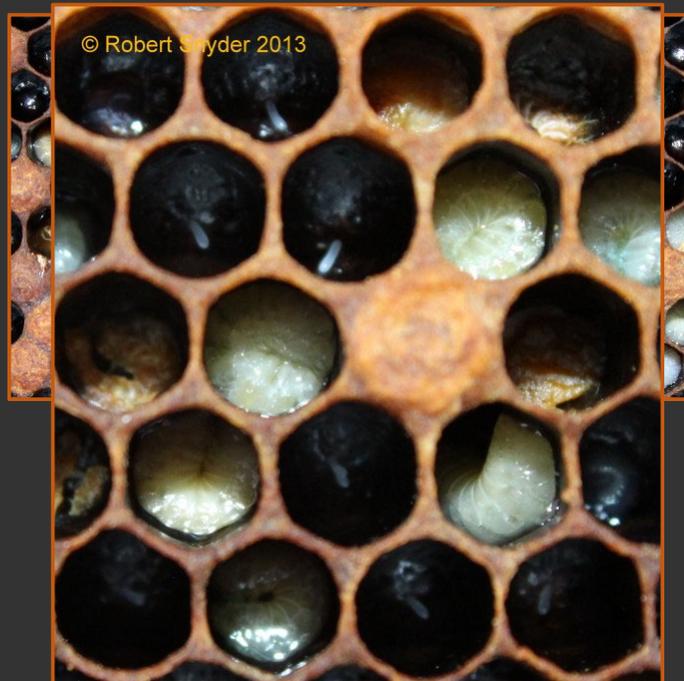
Can submit samples to the USDA lab in Beltsville, MD or call Sam Abban if you have questions regarding TM:

BEE DISEASE DIAGNOSIS  
BEE RESEARCH LAB  
10300 BALTIMORE AVE BARC – EAST  
BLDG 306 ROOM 316  
BELTSVILLE AGRICULTURAL RESEARCH CENTER – EAST  
BELTSVILLE, MD 20705

## Non-Regulated Pests in Montana

### European Foulbrood (*Melissococcus pluton*)

- Bacterial disease that effect larvae before capping
- Classic symptoms of EFB: larvae curled upward, flaccid, deflated with tracheal system prominent, and brown or yellowish
- Caused by mites and ingesting contaminated food



## Non-Regulated Pests in Montana

### European Foulbrood (*Melissococcus pluton*)

European foulbrood	American foulbrood
	
<ul style="list-style-type: none"> <li>• Can be slightly ropery with threads less than 1.5cm, but usually not ropery.</li> <li>• Odor: sour or none</li> <li>• Scale: brown to black, rubbery</li> <li>• Stage of Brood: before capped</li> <li>• Appearance: twisted, dull to yellow to dark brown, tracheal tubes often visible</li> </ul>	<ul style="list-style-type: none"> <li>• Coffee color, ropery with a fine thread about 2.5cm</li> <li>• Odor: sulfurous, "chicken house"</li> <li>• Scale: brown to black, brittle</li> <li>• Stage of Brood: after capped</li> <li>• Appearance: chocolate brown to black, perforated cappings</li> </ul>
<p><small>Fig. 3: Table from Shimanuki and Knox (2000) and Delaplane (1998), Ropy length from Shimanuki (1997), American foulbrood photo by Williams, USDA.</small></p>	

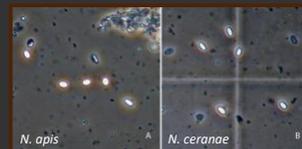
## Non-Regulated Pests in Montana

### Nosema (*N. apis* or *N. ceranae*)

- Microsporidium (can only reproduce in cell of their host), unicellular parasite
- Labs usually only testing for level of Nosema, not distinguishing between the two
  - Historically, *N. apis* was the only form found present in the US but *N. ceranae* has become the more common form

#### Symptoms:

- less productive hives
- lower populations
- increased winter loss
- Dead and wandering bees in front of hive
- K-wing
- Dysentery is not a symptom, but is often correlated

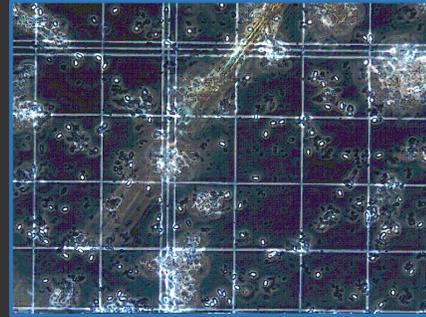


### Non-Regulated Pests in Montana

Nosema (*N. apis* or *N. ceranae*)

#### Spread and control

- Nosema is spread from colony to colony via drifting and robbing bees that come in contact with contaminated fecal matter
- Water collection sites also act as a repository
- Spore-contaminated comb is greatest source
  - Always make sure great care is taken before swapping frames from hive to hive
  - Spores can remain viable for over a year
- Fumagilin-B is currently only chemical treatment for disease
  - Threshold is 1 million spores/bee
  - Debate over whether chemical treatment is necessary
  - FB no longer available for purchase



Testing is available  
for FREE in MT!

Send samples to:  
MT Dept of Ag  
c/o State Entomologist  
302 N Roberts St  
Helena, MT 59901

### Non-Regulated Pests in Montana

Yellow jackets (*Vespula spp.*)



- Wasps collect protein in early spring/summer to feed to brood and collect sugary secretions later in the summer
- Queens can lay thousands of eggs throughout the growing season

#### Highly aggressive in the fall:

- Nests are super-sized in the fall
- Nests reach max size in fall (usually around 5,000 individuals)
- Highly defensive of nest

- Food sources are scarce in fall and yellowjackets can become desperate
- Workers are searching for sugar (energy) later in the year

- Focused on survival
- Queen dies at end of year and new queens emerge and look for mates

## Non-Regulated Pests in Montana

Yellow jackets (*Vespula* spp.)

