

#### Foulbrood Bee Diseases

# EUROPEAN FOULBROOD AMERICAN FOULBROOD

### Healthy Brood-Plump, pearly white



# Healthy Brood



- Brood diseases prevent the development of normal healthy replacement adult bees.
- Both European and American Foulbrood diseases are caused by bacteria.
- Both can show discolored larvae.

- Both can create spotty brood patterns.
- Other brood diseases- Varroa mites, sac brood, chalk brood.

- Larvae change color from pearly white to brownish grey
- Larvae die in coiled or twisted positions, usually uncapped
- Dead larvae are watery, not sticky or ropy.
- Dried larval scales are easily removed from the cell
- Some larvae die in capped cells, but are normally not ropy
- Drone and queen larvae are also affected

Transferred by-

Beekeeper- transfer from an infected hive to a healthy hive.

Robbing of weakened, infected colonies & swarms also spread the disease.

- Caused by bacterium, Melissococcus plutius
- EFB is common in colonies suffering from other stress.
- Does not produce spores.
- Treatment with Terramycin is effective.
- Breaking brood cycle can allow house bees to clean cells.
- Not as deadly as American Foulbrood; hive may recover. Both bacterial foulbrood diseases are widespread, are named
- based on where they were first studied, not location of origin.

Larvae discolored, oddly twisted, may be transparent.

# Larvae may lack segmentation

### Varroa Mites- spotty brood pattern



### Chalkbrood- Fungus; increase ventilation



#### Sac Brood- virus

The pupae do not develop or shed the last skin which locks in the pupae as it rots, contains fungal spores.





# Foulbrood Bee Diseases AMERICAN FOULBROOD

### AFB- Bacterial Disease of Bee Larvae



### CHARACTERISTICS OF AMERICAN FOULBROOD

- Most Fatal Brood Disease
- Spotty brood.
- Cappings moist, discolored, sunken.
- Perforations in cappings, from house bee inspection.
- Decayed larvae soft, sticky, ropy when drawn out with a twig.
- Dead larvae brown or black, in upright position in capped cell.
- Dead pupae has tongue (mouthparts) projecting into the center of the cell.
- Scale adheres to floor of cell.
- Stench. Genetically, some people do not smell this.



Infected larva (left) and a healthy dark-eyed pupa (right) of the same age (artificially infected, carefully uncapped)

At right, moist, sunken, perforated cappings of infected frame.



### CHARACTERISTICS OF AMERICAN FOULBROOD

- AFB caused by a spore-forming bacterium *Paenibacillus larvae*
- Rod shaped vegetative stage and Spore stage
- Spores are the contagious stage, and resistant.
- Larvae up to 3 days old become infected by eating spores in their food.
- Spores germinate and grow into the vegetative form in larvae.
- Kills larva, produces 2 billion new spores per larva.
- Spores remain viable indefinitely (80+ years).
- Extremely contagious, resistant, and spreads easily.

#### **American Foulbrood Development**



### CHARACTERISTICS OF AMERICAN FOULBROOD

- As few as 10 spores per larva can cause mortality
- Larvae die after the cell is capped
- An infected colony will worsen until most brood dies, and no new adult bees are produced. Colony dies.
- An infected colony is never cured.
- Spores remain in honey, pollen, comb, wax.
- Spores spread within colony by house bees.
- Spores remain in cleaned cells; contaminate nectar & honey.
- Adult bees are not sickened by the spores, but transport them.

# Spread of Spores Between Colonies

- Robbing from infected hive
- Drifting bees (both worker bees and drones)
- Swarms from infected hive (natural and artificial)
- Honey from infected hive
- Beekeeping tools
- Contaminated equipment

"Shotgun pattern" of brood in an infected hive  $\rightarrow$ 



#### **Diagnosis: American Foul Brood (AFB)**

The goo left by AFB killed larva can be drawn to form a "rope" while the larva is still moist.

This is commonly called a ropiness test.

The dead larva dehydrates, becomes a scale, completely dried, difficult for bees to remove, contains millions of spores.



## **Diagnosing AFB**

- Inspect brood spring and fall. Shake all bees off of brood frame to assure clear view. Look for discolored larvae, discolored, greasy, sunken or perforated cappings.
- Ropiness test- insert rough wood toothpick into a moist suspect larva or pupa. Stir well, then slowly withdraw. A sticky thread 1" long is a strong indicator of AFB. (burn twig to kill spores on it)
- Inspect floor of cell for presence of scale.
- Vita AFB Diagnostic Kit- about 5 minutes, similar in design to home pregnancy tests.
- Holst Milk Test for AFB
- Send sample to Beltsville Lab! Free, accurate.

#### Submit Sample to Beltsville Lab

Samples of Brood

- The sample of comb should be at least 2 X 2 inches and contain as much of the dead or discolored brood as possible. NO HONEY SHOULD BE PRESENT IN THE SAMPLE.
- The comb can be wrapped in paper and sent in a heavy cardboard box. AVOID plastic, aluminum foil, waxed paper, tin, glass, etc. because they promote decomposition.
  If a comb cannot be sent, the probe used to examine a diseased larva in the cell can be

wrapped in paper and sent to the laboratory in an envelope.

Send all samples to:

Bee Disease Diagnosis Bee Research Laboratory Bldg. 476, BARC-East Beltsville, MD 20705 (301) 504-8821

- Include a short description of the problem along with your name and address.
- There is no charge for this service.
- Email: SmithB@ba.ars.usda.gov

## **Holst Milk Test**

- The Holst milk test (Holst 1946) is based on the fact that high levels of proteolytic enzymes are produced by sporulating Paenibacillus larvae.
- Place suspect scale or smear of diseased larva in a vial containing a few spoonfuls of powdered milk in water (about 1 part powder to 4 parts water), stir.
- Incubate at 37° C (body temperature; pocket). If AFB is present, the suspension should clear in 10 to 20 minutes. This test is not totally reliable, but is good for how simple it is.
- Preparing an identical vial with no bee tissue provides a good comparison.



### Prevention of American Foulbrood

- Check for AFB before making splits or transferring brood comb to hive.
- Do not feed honey or pollen from an unknown source
- Check for AFB in spring and fall
- Prevent robbing
- Position and/or distinguish hives in manner to reduce drifting
- Replace 3 or 4 old brood frames in each brood box each year.
- Sterilize hive tool, smoker, gloves, and hands after working a suspect hive
- Obtain bees from known sources. Bees bred for hygienic behavior demonstrate some resistance to AFB, chalkbrood and varroa mites.
- If AFB is present, when antibiotic treatments stop, AFB spores germinate. If your bee source treated with antibiotics in a state where prophylactic treatment is permitted, there may be spores in the old comb.

### **Prevention of American Foulbrood**

- Do not purchase used combs, which may harbor spores.
- Disinfect second-hand hives by thoroughly scorching inside with a blow torch, or fire built inside a stack

> or immerse in 3% sodium hypochlorite (bleach) solution

- Hive swarms of unknown origin onto Foundation and do not feed for 3 days. Contaminated honey carried by the bees will be consumed while drawing new comb. Keep isolated for 3 months before combining into regular apiary. If AFB appears, destroy these bees and frames, and treat the woodenware.
- Treatment with Terramycin or Tylan will prevent spores from germinating in larvae. Does NOT KILL Spores. Treatment must be completed 4 weeks prior to honey flow.

- If you find a suspect hive-
- Send sample for clinical testing.
- Isolate hive. Change its appearance from that of nearby hives, to reduce drifting, reduce opening to 1 bee width, or screen in and feed syrup.
- DO NOT create infirmary to maintain known AFB hives. They will produce spores and spread the disease.

- When AFB is verified, spores are destroyed by burning.
- Frames, bottom boards and foundation should be burnt.
- Hive boxes, inner covers and lids should be Burnt or thoroughly scorched
  - Build a fire inside a stack of boxes, extinguish after thorough scorching, or
  - Use a torch to thoroughly scorch all insides, especially corners, seams, cracks
    - This is not always sufficiently effective to justify the 'savings'.

- Hive, honey and pollen can be sterilized by exposure to ethlene oxide gas in a closed chamber, as used for sterilization of hospital equipment.
- Hive can be sterilized by gamma irradiation, which kills AFB and leaves no harmful residue.http://www.montcobeekeepers.org/Pages/Irradiation.aspx
- Woodenware can be sterilized by boiling in lye or boiling paraffin.
- Honey from an infected hive
  is safe for human consumption
  (If antibiotics have not been in use)
  but should not be fed to bees.
  Healthy brood →



- Antibiotics can prevent spores from germinating into the vegetative form. They Do Not Cure sick larvae.
- Spores remain present, but healthy young larvae can develop normally.
- When treatment stops, spores germinate.
- Terramycin (oxytetracycline hydrochloride, OTC) has been used effectively Careless prophylactic use has led to OTC resistant strains of OFB
- Tylan (Tylosin tartrate) was approved in 2005 for *treatment of known cases* of AFB. In NYS, known cases Must be destroyed; the apiary can be treated.
- Either antibiotic is applied early spring and late fall, usually mixed with powdered sugar and sprinkled over the frames 3 times, one week apart. Treatment must be completed 4 weeks prior to honey flow.

### Take-away messages-

- Hygiene- your task as beekeeper, and hopefully your bees also.
   Prevent contamination
- Early identification and destruction of diseased brood
- Regular replacement of brood comb to reduce build-up of spores or other toxins
- Record keeping- critically important for tracking health and history
  - On-line https://www.beetight.com or https://hivetracks.com
  - Hand written notes
  - Pictures

Appearance						
of brood	Age of dead	Color of dead	Consistency	Odor of	Scale	Infectious
comb	brood	brood	of dead brood	dead brood	characteristics	agent
Cooled	Lisually older	Dulluubite			Lies uniformly flat on lower side of cell.	
brood	coaled larvas	bocoming light			Autheres lightly to cell	
Discolored	orvoung	becoming light			tonguo of doad	
sunkon or	nunge Lying	brown to dark		S lightly to	maybe present Head	
Sunken, or	pupue. Lying				inaybe present. Head	
punctured	lengthwise in	brown, or	S oft, becoming	pronounced	lies flat. Black in	American
cappings.	cells.	almost black.	sticky to ropy.	putrid odor.	color.	Foulbrood
Unsealed	Usually					
biodu. 3 onie	young					
Sealed brood	unseuleu					
in advanced	larvae ;	Dull white,				
cases with	occasionally	becoming				
dis colored,	older sealed	yellowish white			Usually twisted in cell.	
s unken or	larvae.	to brown, dark	Watery; rarely	S lightly to	Does not adhere to	
punctured	Typically in	brown, or	s tic ky or ropy.	penetrating	cell wall. R ubbery.	European
cappings.	coiled stage.	almost black.	Granular.	s our.	Black in color.	foulbrood