Honey Bee Diseases

Rick Fell
Department of Entomology
Virginia Tech

American Foulbrood

European Foulbrood

Adult viral diseases

Chalkbrood

Nosema

Sacbrood

Major Diseases Affecting Honey Bees

1. American foulbrood - bacterial
2. European foulbrood - bacterial
3. Sacbrood - viral
4. Chalkbrood - fungal
5. Nosema - fungal
6. Adult Viral Diseases (DWV, ABP, etc)

American Foulbrood

Bacterial disease of honey bee larvae

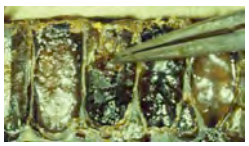
Causative organism: *Paenibacillus larvae*

American Foulbrood

- Infective stage is the spore, enters body by ingestion of contaminated food
- Attacks young larva (<2 days of age), kills in late larval to pupal stage
- Spores germinate about one day after ingestion, multiply in midgut, penetrate into body cavity, larva dies from a septicemic condition

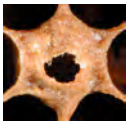
American Foulbrood

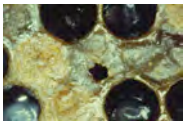
- Larvae/pupae decay in cells, change color (tan to dark brown) and become 'ropey'; pupae show tongue
- Form scales in cells that are difficult to remove



American Foulbrood - Recognition in the Bee Yard

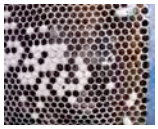
1. Critical to recognize at an early stage of infection
2. Must be able to distinguish from other diseases
3. Scan frames for perforated cappings when inspecting
4. Open cells and examine larvae





American Foulbrood - Recognition in the Bee Yard

- Larval characteristics
  - Color - tan to dark brown
  - Position - bottom wall of cell, flattened
  - Consistency - ropey
- Pupal characteristics
  - Tongue visible, color and position same as larva
- Scale
  - Adheres tightly to lower wall



American Foulbrood - Prevention and Treatment

1. Kill colony and destroy equipment by burning
2. Treat colony with an antibiotic
3. Shake bees and re-establish in a new colony with frames of foundation. Treat with an antibiotic.
4. Keep AFB resistant bees

Antibiotics for AFB Control

Standard treatment used as a preventative: terramycin

Problem of AFB resistance to terramycin.

How widespread in VA?

New antibiotics:

Tylosin tartrate

Registration Approved November 16, 2005 Recommended for use in control of AFB.

Using Antibiotics for AFB Control

Tylosin (marketed as Tylan)
Manufactured by Elanco Animal Health

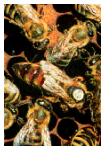
Dosage: 200 mg in 20 g confectioners sugar

Treatment: 3X at one week intervals

Effectiveness: Good results on low level infections. Found AFB in colonies with high infection rates after several weeks.

Hygienic Bees: Resistance to AFB

- Hygienic Bees
  - ✓New World Carniolan (Sue Cobey, Ohio State Univ)
    - Selected for rapid buildup, overwintering, tracheal mite resistance, gentleness, productivity, hygienic behavior
  - ✓Minnesota Hygienic Bees - M. Spivak
    - Selected for disease and mite resistance. Good AFB resistance.



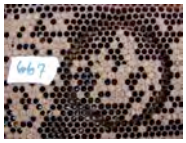
Hygienic Behavior

- Natural defense mechanism against diseases and parasites
- Hygienic bees detect, uncap, and remove diseased brood from combs before the disease becomes infectious
- The hygienic trait can be found in approximately 10% of managed colonies

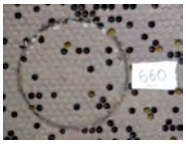
Testing for Hygienic Behavior in Bees

Technique uses liquid nitrogen to kill brood
Frames are placed in a hive and checked after 48 hours.
Amount of dead brood removed indicates hygienic behavior.

Testing for Hygienic Behavior in Bees



Non-hygienic bees



Hygienic bees

Stress Diseases of Honey Bees

European foulbrood

Sacbrood

(Chalkbrood)

Nosema

Stress conditions which aggravate problems with these diseases include, cool temperatures, moisture, food shortages

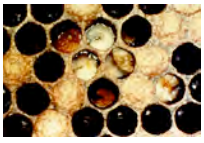
European Foulbrood

Bacterial disease of honey bee larvae

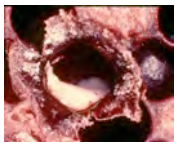
Causative organism: *Melissococcus pluton*

European Foulbrood

- Non spore forming bacteria
- Infects only young larvae after ingestion; kills larvae in the coiled stage
- Larvae turn yellowish, then brown, with white cross-pattern (from trachea)



European Foulbrood



- Older larvae typically twist in cell and do not settle in cell bottom like AFB killed larvae.
- Larvae do not become ropey; more watery or pasty.
- Scale is rubbery and easily detached

European Foulbrood - Treatment

Light infestation
- eliminate stress

Moderate
- eliminate stress, may want to requeen

Heavy infestation
- treat with terramycin
- requeen

Sacbrood

Viral disease of honey bee larvae

Sacbrood

- common virus, isolated from both healthy larvae and adults
- older larvae may be more susceptible, die after the cells are sealed
- larvae killed by the sacbrood virus turn yellow-gray then blackish, head changes to black color first

Larva recently killed by sacbrood virus

Sacbrood

- larval "skin" remains intact, larva can be removed from cell as a fluid-filled sac. Forms a scale, but easily removed.

Sacbrood - Treatment

No effective treatment, other than improving colony conditions. Reduce stress on the colony.

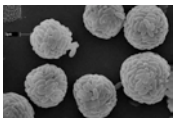
Chalkbrood

Fungal disease of honey bee larvae

Causative organism: *Ascosphaera apis*

Chalkbrood

Spore balls



- 3-4 day old larvae are infected after ingestion of spores
- Spores germinate in the gut of the larva
- Fungal mycelia grow throughout the larva, killing the larva after the cell has been sealed
- The larva is transformed into a white chalk-like mummy

Chalkbrood Symptoms

- Chalkbrood mummies are white to grayish-blue or black in color (darker mummies have fruiting bodies)
- Bees uncap cells with chalkbrood but typically leave the mummies in the cells
- Mummies are also typically found on the bottom board

Chalkbrood - Treatment

- Disease may be encouraged by stress, especially chilling of the larvae
- Elimination of stress can help reduce incidence
- No effective treatments are available, requeening may help

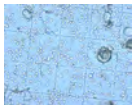
Nosema

Microsporidian (fungus) disease of adult honey bees.

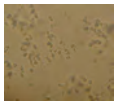
Causative organism: *Nosema apis*
Second species now in US: *Nosema ceranae*

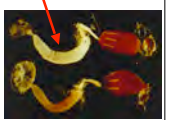
Nosema Disease (*N. apis*)

- Very common disease condition, 50 - 90% of the colonies have bees with Nosema
- Most prevalent in late winter and early spring, aggravated by stress
- Ingested spores germinate in the midgut and invade the epithelial cells
- The protozoan damages the cells, affects digestion, causes malnutrition and premature death



Nosema spores

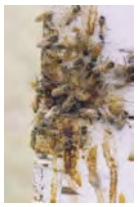




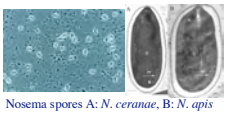
Non-infected midgut

Nosema: Symptoms and Treatment

- No good symptoms of infection, identification by analysis of bee abdomens
- May see defecation in the hive, weak, crawling bees, retarded build-up in spring
- Heavy infections may lead to dysentery
- Control
  - ✓elimination of stress
  - ✓use of antibiotic fumagillin (Fumigilin B) which is fed in the fall as a preventative



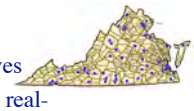
New Pathogen: *Nosema ceranae*



Nosema spores A: *N. ceranae*, B: *N. apis*

- Discovered in 1996 in *Apis cerana* and assumed to be specific to Eastern honey bee
- In 2005 Chineses researchers reported *N. ceranae* in *A. mellifera*. In same year it was discovered in Spain (following increases in Nosema infections from 2000 (10%) - 2004 (88%)
- *N. caranae* appears to be highly pathogenic to *mellifera* bees, killing 100% of test bees in lab studies in Spain
- Now identified in US, possible factor in CCD. Not as seasonally limited

Nosema ceranae in Virginia



- Collected samples from >300 hives
- Analyzed using spore counts and real-time PCR
- Results indicate approximately 72% of the hives in Virginia are infected with N. ceranae
  - ✓ 11% showed heavy infection, 16% moderate, and 73% a low infection level.

Colony Collapse Disorder (CCD)

- Sudden loss of a colony's population of adult bees leading to colony death
- Disorder is characterized by:
  - ✓ An absence of adult bees in colonies with few dead bees, if any, in the hive or in front of the hive
  - ✓ Frequent presence of capped brood in colonies
  - ✓ Presence of food reserves (honey, pollen) that had not been robbed out, and hives not attacked by pests such as wax moths
  - ✓ In colonies that still have bees, characterized by small clusters with a laying queen, not responsive to stimulative feeding

Colony Collapse Disorder

Photographs from a collapsing colony in Georgia. Large amounts of brood but few adults. (photos from Jeff Pettis, USDA)

CCD - A New or Old Problem?

- Symptoms similar to disorder first reported in 1915 - Disappearing Disease
  - ✓ Large losses of adult bees with no accumulation of dead bees in the hive or at the entrance
  - ✓ Queens were generally the last to be affected
  - ✓ Pollen and honey stores were normal and often abundant in dead hives
  - ✓ No single pathogen was ever identified or associated with the disorder

Where Do We Stand On CCD?

- What has been eliminated as possible causes
  - ✓ Feeding, Use of bees (honey production, pollination), Queen sources, Chemical use (?)
- What possible causes are being examined
  - ✓ Pathogens of bees or brood (IAPV - Israel Acute Paralysis Virus)
  - ✓ Chemical residues/contamination
  - ✓ Parasite loads in bees and brood
  - ✓ Nutritional fitness of adult bees
  - ✓ Levels of stress (indicated by stress induced proteins)
  - ✓ Lack of genetic diversity