Official curriculum for the NCSBA Master Beekeeper Program
Certified Level course of instruction

Honey Bee Pests and Diseases

Problem Pests

Introducing the Wax Moth

Galleria mellonella

- Also known as:
  - **Bee moth**
  - **Wax miller**
  - **Bee miller**
  - **Webworm**
- Giving Side:
  - **Recycle combs of colonies that die in wild**
  - **Used as fish bait**
  - **Animal feed**
  - **Scientific research**

Wax Moth

- Larvae:
  - 3/4 of an inch long
  - Dark, hard head capsules
  - 3 pairs of small segmented legs
- Adult:
  - 3/4 of an inch long
  - Wing span ~ 1 1/4 to 1 1/2 inches
  - Males ~ smaller, scalloped front wing margins
  - Females ~ smooth margins
  - Wings fold roof-like over the body
  - Grayish-brown in color

Facts

- Sensory capability to find and exploit beeswax
- Flies at night
- Rests in dark spaces during day
- Does not digest beeswax
- Left unattended or not quickly detected, only gritty debris of comb remains with little or no comb left intact
- Webbing and tunneling done by larvae
- Prefers to infest comb that was used for brood rearing (cast skins)
- Tunnels thru comb exposing honey causing it to leak and feeding on pollen
- Numbers explode in:
  - **Weakened colonies**
  - **Stored equipment**

Life Cycle

- 4 stages in life cycle
- Egg
  - **Laid in cracks between hive parts**
  - **Females can lay 300 eggs**
  - **5-8 days in this stage**
- Larval
  - **Burrow in beeswax comb**
  - **1-5 months feed on comb**

Life Cycle (Continued)

- Cocoon: larvae spin a silk cocoon (dense and tough)
- Location: comb, debris at bottom, *attached to frame or hive body* (larvae chews in wood a boat shaped cavity)
- Pupae stage can take up to 2 months, depending on temperature

Non - Chemical Control

- Strong healthy, queen right colonies
- Reduce comb frames so bees can cover and protect
- Freezing drawn comb before storing – protecting during storage
- Sunlight and good air circulation

Chemical Controls

Read and Follow Label Directions

The use of chemical product names is for the aid of the beekeeper, and does not constitute an endorsement of any product to the exclusion of another, or one not mentioned

Chemical Control

Para-Moth:

- **Crystalline granules containing paradichlorobenzene**
- **Used to prevent infestation of stored hive equipment (drawn comb) only**
- **Don’t use in hive containing honey bees**
- **Use protective gloves when handling**
- **Fumigate is used before combs are placed in storage**

Chemical Control

Certan - Bacillus thuringiensis

- Simply dilute in water (1 part B402, 19 parts water) and spray on both sides of frames prior to storage of frames.

- Wax needs to be cleaned and dry before storage

Introducing the Tracheal Mite

Acarapis woodi

- Parasite of the adult honeybee
  - **Does not affect the immature stages**
- Can kill most or all of the adult bees
  - **Entire colony lost**
- Spends most of life in tracheal (breathing tubes) of honey bees
  - **Except for transferring to a new bee host**

Obligate Pest

- Obligate Pest ~ can't live away from host for more than a day or two
  - **Does not appear to have any other hosts**
- Microscopic mite ~ can't be readily seen with the naked eye
- Female mite ~ .004-.007 inches long
- Male mite ~ .003-.005 inches long
- Feed on the body fluids of the host bee from inside the tracheal tubes
- In some cases, mite numbers may grow to levels that result in the death of the infected bees
  - **Eventually entire colony of bees**

Tracheal System

- Enters tracheal tubes via spiracles (breathing holes)
- Tracheal tubes ~ lead to all parts of the body to bring in oxygen and take out carbon dioxide
- Female lays both male and female eggs ~ eggs can be larger than males
- Entire development cycle of mite occurs inside bee

Passing of the mite

- "Jump" from one bee to another
- Spread from bee to bee by the transfer of mated female mites to new bee hosts
- Heaviest infestations are in winter or non-productive months
- Young bees are preferred host
  - **Less than 9 days old**
  - **Bees over 30 days are acceptable hosts if no young bees are available**
- Mated female waits on hair of bee for new host

Spreading the problem

- Drifting ~workers and drones traveling between colonies
- Robbing
- Transferring bees
- Sale of bees
- Swarming

- Robbing largest problem
  - **Colonies heavily infested become weak**
  - **Subject to robbing**
  - **Colonies doing the robbing will become heavily infested**

Tracheal mite facts

- Only affect adult bees
  - **Not brood**
  - **Workers, drones, and the QUEEN!!!!!!!**
- Shortens bee life and weakens it so it is unable to fly
- Good management practices help keep adult bee population strong
  - **Could "outgrow" problem**
- Can live in hive for years causing little damage, can become major problem if other issues arise
- Mated females lay 5-10 eggs
- Breed and migrate all year
- Usually die within 24 hours if removed from the bee host

Tracheal mite life cycle

Detection

- No reliable field indicators
  - **Microscopic size**
  - **Life cycle**
- May go undetected for 1-5 years
  - **Result in loss of entire colony**
- Occurs in late winter early spring
  - **When mite numbers are highest and bee numbers are lowest**
- Severely infected colony
  - **Presence of crawling bees on warm winter or early spring days**
  - **Walking bees with unhooked or “K” wings (extended out)**
  - **Terminal indicator is soon followed by the death of the entire colony**

Detection (Continued)

- Laboratory procedure can detect mites
  - **Requires dissection and microscopic examination of adult bees**
- Contact:
  - **Local Bee Inspector**
  - **Extension Apiculturist at NCSU**

Non-chemical controls

- Use of resistant stock of bees
  - **Buckfast bees ~ shown to reduce the impact of tracheal mites**
- Bees only tolerant not really resistant

- Vegetable shortening patties or sugar patties
- Interfere with the transfer or spread of mated tracheal mites from one bee host to another
- Most effective when used in fall or early spring

Chemical Controls

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Chemical Control

- Mite-A-Thol:
  - **Generates vapors**
  - **Applied to inner cover/top super**
  - **Use when temps above 70°**

Mite-A-Thol

- Crystal form of menthol
- Misuse can result in bee death and honey flavor and sell ability
- Controls tracheal mites but not varroa mites
- Ineffective at temperatures less than 60 °
- Most effective if used in late summer or early fall
  - **Prior to winter conditions**

Introducing the Small Hive Beetle

Aethina tumida

- Adult Identification:
  - **5-7 millimeters long**
  - **Brown to black in color**
  - **Club-shaped antennae**
  - **Shield-shaped thorax**
  - **Broad, flattened legs**

SHB adult behaviors

- Adults tend to hide
  - **Bottom of hive**
  - **Under the inner cover**

- Scatter quickly when hive is opened
  - **Makes them hard to spot**
  - **Low levels of infestation go unnoticed**

SHB larva

- Larva
- Small, white and worm-like
  - **10-12 millimeters long**
  - **Dorsal spines**
  - **6 legs on thorax**

Larvae of both wax moth and SHB

- Beekeepers can confuse the two different larvae of pest found in the hive

Small Hive Beetle facts:

- Adults can survive up to 5 days without food or water
- High temperatures and high humidity = increased percentage of egg hatch and emergence
  - **Cooler ~ top**
  - **Hot ~ bottom**
- Adults run from light, larvae are attracted to it

Life Cycle

Female beetles deposit masses of eggs in crevices around the hive, or directly on pollen or brood combs. Beetles may puncture the wall or capping of a sealed cell and deposit eggs inside.
Eggs hatch in 2-4 days, and larvae immediatly begin to search for food. The larvae may feed on pollen, honey or bee brood and eggs.
Beetles typically complete their larval development within 7-10 days. The mature "wandering" larvae exit the hive and burrow into the soil.
Beetle larvae pupate in the top 4" of soil, on average. Pupation takes 3-6 weeks to complete, depending on temperature and soil moisture.
Newly emerged adult beetles locate host bee colonies by their odor. They are stong fliers, and can disperse to other hives easily.
Adult beetles avoid the light, and tend to congregate in spaces inaccessible to honey bees. They may be observed running inside lids, on walls or across frames during hive inspections.

Life cycle

- Adults lay eggs
  - **Eggs hatch within 24 hours**
  - **Small larvae**
- Larvae
  - **Feed immediately**
  - **Eat honey, pollen stores and developing brood**
  - **Tunnel through combs**
  - **Adult bees abandon hive**
- Larvae:
  - **Feed for 7-10 days**
  - **Leave hive; crawl to ground**
  - **Dig in soil to pupate**
- Pupation:
  - **3-5 weeks; longer in colder temperatures**
  - **Adults emerge from soil**
- Adults:
  - **Survive winter within cluster of bees**
  - **Females can lay eggs one week after emerging from the soil**

Prevention:

- Keep colonies of honeybees strong
  - **Attack stressed or weakened hives**
- When colonies die:
  - **Remove equipment and store it properly**
- After removing supers, extract the honey
- Keep honey house clean
- Collect all excess wax in a bucket and remove from bee yard
- Minimize the amount of inspecting time
  - **Beetles detect bee's alarm pheromone**
- Remove excess supers from colony
  - **Good hiding places on frames with few or no adult bees**
- Kill larvae on bottom board
  - **Freezing them 24 hours**
  - **Put in closed container of soapy water**

Mechanical beetle traps

Inside of the hive

- Bees will chase beetles
  - **Beetles looking for place to hide**
  - **Go thru holes and fall into vegetable oil and drown**

Beetle Jail

Beetle Blaster

Mechanical beetle traps

Bottom board replacements

- Two-piece plastic trap
  - **Sits on existing bottom board**
  - **Top piece: Small holes**
  - **Bottom Piece: Filled with vegetable oil**

West Trap

Miller entrance beetle trap

Freeman beetle trap

Greenbeehives.com

Chemical Controls

Read and Follow Label Directions

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Ground treatment

Outside of hive

- GardStar:
  - **Larva and pupae (soil inhabiting phase of life cycle)**
  - **Ground treatment around hives only**
  - **Mix and apply to soil**
  - **Highly TOXIC to bees**

GardStar

- Control outside of the hive when larva are seen crawling out of hive entrance

- Liquid treatment
  - **Mixed with water**
  - **Applied to the ground around the hive**
  - **Kills beetle pupating in the soil**

- Active ingredient ~ permethrin
  - **Synthetic pesticide *Highly Toxic* to honey bees**

- Should be applied with great caution

Introducing the *Varroa* Mite

Varroa Destructor

Total U.S. managed honey bee colonies loss estimates

Varroa Mite

- Reddish-brown mites
- flattened oval shape
- About the size of a pin head (.06 inches)
- Easily visible against a light background

Size Comparison

Varroa mite behavior

- Adult Mites:
  - **Mated females invade brood cells with older bee larva**
  - **Prefer drone brood but will settle for workers**
- Feed on:
  - **Larval food**
  - **Bee's fat bodies; puncturing the larval body**

The numbers game

Varroa mite facts

- External parasite
  - **Attack adult bees and larvae**
- Effect on larva based on number of mites
  - **Kill it**
  - **Cause it to be deformed**
  - **No visible effects**
- Male mites die in cell
- Females feed on fat bodies of the bee

- Serve as transmitter of several viruses that can kill bees
- Compromise the bees immune system
- Parasitic Mite Syndrome (PMS) ~ can kill colonies within months of infection

Varroa mite facts

- Female mite ~ 1.1-1.2 mm in length and 1.5-1.6 mm in width
- Male mites ~ 0.7 mm by 0.7 mm
  - **Adult males don't feed and are only found in the brood cells**
- Location on bee:
  - **Less likely to be removed by bee's grooming**

- Can be found:
  - **On top of thorax where wings attach**
  - **Between head and thorax**
  - **Between thorax and abdomen**
  - **Between overlapping segments of the abdomen**
- Reason:
  - **Easily penetrate exoskeleton of bee with piercing mouthparts**

Life cycle

1
Adult bee, with Verroa feeding on hemolymph

2
Mite enters cell with larva of 5 - 5.5 days

3
Mite in bee food

4
Mite feeds on prepupa

5
Female lays first egg 60 hours after cell capping. Female lays subsequent eggs at 30 hour intervals

6
1 - 6 eggs developing from egg to larva to protonymph to deutonymph

5 - 6 days
adult male

7

7 - 8 days
adult female

10
Mites transfer through close contact between bees

9
Adult females leave cell with emerging bee.
Male and immature stages stay in cell

8
Mating within cell

Illustrated by B. Alexander

Varroa mite life cycle

- Mated female mites can lay an egg every 30 hours
  - **First egg usually a male and stays within the cell**
  - **Other hatched eggs will be females which feed and grow inside the cell**
- Mated females can lay 6 eggs per cell
- Females mate with the males and emerge from the cell attached to the bee
- Original mated female mite will seek out another cell
- Daughters hitch a ride on adult bee and continue feeding before finding a new larval host

Detection

- First step toward control is detection

Methods of detection

- **Sugar shake**
- **Alcohol wash**
- **Sticky board**
- **Extract drone brood**
  (Visually examine larvae)

Integrated Pest Management

Integrated Pest Management (IPM) incorporates multiple tactics to reduce pest populations while being sensitive to both economics and environmental impacts. The approach integrates multiple tools to find the most effective, least intrusive solution to problems.

The IPM pyramid emphasizes the prevention of pest problems rather than intervention after problems arise.

Mechanical Control

Drone-Brood Trapping

Screened Bottom Board

Inert Dust

Break the Brood Cycle

Mite-Tolerant Stocks

Honey bee genetics

- Behavioral and physiological traits help with varroa resistance
- Hygienic Behavior ~ cleanliness of queen
  - **Remove diseased or parasitized brood**
  - **Minnesota Hygienic stock**
- Varroa-Sensitive Hygiene (VSH) and Suppressing Mite Reproduction (SMR)
- Ankle-Biters

Chemical Controls

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Chemical Controls

Hard/Synthetic

- Apistan
- Apivar
- AmiFlex
- CheckMite+

Soft/Natural

- ApiLife VAR
- ApiGuard
- Mite-Away Quick Strips
- Oxalic Acid
- HopGuard II

Apistan

- Tau-fluvalinate main ingredient
- Plastic strip with pesticide inside
- Contact poison
  - **Insect must come in contact with the chemical (plastic)**
  - **Queen and drones may be damaged** (HBHC)

- Use protective gloves when handling strips
- Hang strips in brood-chamber
- Best time to treat is in fall when amount of brood is lowest
  - **If moderately infested in spring then treat; many don't make to fall**

Apivar

- Amitraz is the active ingredient
- Plastic strip with pesticide inside
- Contact poison
  - **Insect must come in contact with the chemical (plastic)**
  - **Queen and drones may be damaged** (HBHC)

- Hang strips in brood-chamber
- Use maximum of 2 times per year – bees should be out of cluster and able to move freely in hive

Ami*Flex*

- Amitraz is the active ingredient
- Flash treatment
- Must have pesticide applicators license to purchase or use

CheckMite+

- Coumaphos is the main ingredient
- Plastic strip with pesticide inside
- Contact poison
  - **Insect must come in contact with the chemical (plastic)**

  Queen and drones may be damaged (HBHC)

- Use protective gloves when handling strips
- Hang strips in brood chamber
- Best time to treat is in fall when amount of brood is lowest

If moderately infested in spring then treat; many colonies don't make it to fall

ApiLife VAR

- Thymol main active ingredient
- Essential oils (camphor, eucalyptol, menthol)

ApiGuard

- Thymol is active ingredient
- Place 1 tray on top of frames with a shim
- Leave 2 weeks and replace
- Most effective late summer or early fall

Mite-Away Quick Strips

- Formic Acid is active ingredient
- Knockdown treatment – 1 strip gives 70% control
- Knockout treatment – 2 strips gives 95% control
- Hive must be well ventilated and bees need to be able to move into empty hive body

Oxalic Acid

- Can be dripped between frames (dribble method)

Oxalic Acid

- Can be used to fumigate
- Close up the hive
- Protective equipment is a must
- Must be used when LEAST amount of brood present

HopGuard II

- Potassium Salt is active ingredient
- Treatment is 1 strip per 5 frames of brood
- Labeled to be used 3 times per year
- Should not be used as a stand alone product

Skunk

Skunk

- Elevating your hive bodies off the ground will help keep a skunk from eating the bees

Raccoons and Opossum

Black Bear

Problem Diseases
and Virus's

- American Foulbrood (AFB)
- European foulbrood (EFB)
- Vairimorpha (formerly Nosema)
- Chalk Brood
- Sacbrood

- Chronic Paralysis Virus
- Acute Bee Paralysis Virus
- Israeli Acute Paralysis Virus
- Black Queen Cell Virus
- Cloudy Wing Virus
- Deformed Wing Virus

Learn to recognize healthy brood and healthy bees

American Foulbrood

- THE WORST OF THE WORST. THE MAIN AGENT IS A BACTERIUM. THE DISEASE CENTERS AROUND THE LARVA, BUT ADULT BEES PLAY AN IMPORTANT ROLL IN SPREADING THE LONG-LIVED SPORES.
- The disease begins when the larva ingest spores that are in contaminated food.
- Dead brood have chocolate-brown color, and an odor reminiscent of a bad chicken house.
- The most decisive field test is the ropy test. Take a small stick and insert it into the cell, twist and pull, the brood is stringy and ropes out an inch or more.
- If you find AFB, use a zero tolerance approach. Burn affected comb and hive components in an open pit.
- The state owns a large chamber where hive components can be pressure treated so equipment can be reused.
- Caution on buying used equipment. Heat-sterilize hive tools after hive visits. State inspectors can help if AFB is suspected.
- No Chemical Cure

American Foulbrood

Distinctive Symptoms

- Foul odor – decomposition
- Shotgun appearance of brood
- Sunken and/or perforated caps
- Grey to dark larvae
- Ropey test

Treatment for AFB

Should be completed after dark

European Foulbrood (EFB)

- Also a bacterium disease, and similar to AFB. Important to distinguish between the two.
- Different from AFB as it infects the larva and kills the larva before it is capped.
- Color is off-white to yellow. No ropy effect. Odor sour to none at all. Rubbery and easily removed.

European Foulbrood

European Foulbrood treatments

- Avoid bad behavior
- Discourage robbing and drifting
- Don’t share equipment
- Clean / Sterilize tools used in the hives

- Treatments can include treating the hive with **Terramycin**
- Requeening is believed to speed the recovery period

Vairimorpha (formerly Nosema)

- Arises mostly in the spring after periods of bad weather.
- Worker bees are mostly afflicted, less so the drones.
- Visible symptom, dysentery. Appears on outside of the hive.

Vairimorpha

- Standard treatment is to mix FUMIDIL-B in heavy syrup and feed to colonies in the fall.

Chalkbrood

- Caused by a fungus
- Affects both sealed and unsealed brood
- Brood becomes a hard white – chalk-like mummy

Chalkbrood

- There is no registered chemicals for the control of Chalkbrood. The only real means of controlling it is through management practices and Disease Resistant Queens.

- Remove mummies from bottom board
- Destroy combs containing large numbers
- Add young Adult bees to the colony
- Maintain strong hives by requeening regularly
- Prevent interchange of hive materials
- Good hygiene with your tools and smoker

Sacbrood

- Caused by a virus
- Brood dies soon after being capped but before changing to pupae.
- No chemical control
- Re-Queening is highly recommended

Chronic Paralysis Virus

- Caused by a virus
- Greasy and hairless
- Transmission thru body contact
- Bad weather, confined for long periods of time
- Control Varroa mites

Black Queen Cell Virus

- Caused by a virus
- Associated with K-wing
- Queen pupa similar to Sacbrood

Deformed Wing Virus

- Caused by a virus
- Deformed wings
- Shortened abdomen
- Cuticle discoloration
- Die within 3 days of emerging

Stop your bees from Drifting

Bees spread diseases by drifting, or by robbing weak colonies

Stop your bees from Drifting

Bees spread diseases by drifting, or by robbing weak colonies

Use different colors, place colonies at varying heights

Practice Biological Security

- Clean Hive tools – torch

- Never allow another beekeeper's tools into your apiary and don't use your hive tools elsewhere

- Purchase bees from sellers who have a "permit to sell bees" issued by the NCDA&CS

NORTH CAROLINA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES

Permit to Sell Bees in North Carolina

Permit # 20 – 020

Eric Talley
315 Tassel Court
Hubert, NC 28539

has been approved to sell bees in North Carolina. The said person is permitted to sell or ship bees of this apiary until December 31, 2020.

This permit is not transferable, and may be revoked at the discretion of the Commissioner in order to prevent the introduction or spread of colonies with contagious or infectious diseases, disorders, or conditions deemed harmful to the North Carolina beekeeping industry.

Issued in Raleigh, NC.
March 4, 2020

Steve Troxler
Commissioner

Donald Hopkins, State Apiarist
Plant Industry Division, 1060 Mail Service Center, Raleigh, North Carolina 27699-1060

BS-12 (Rev. 01/05)

Colony Collapse Disorder (CCD)

- Shared symptoms
- Contributing factors
- Still no known single cause
- Research continues
- More prevalent in commercial operations

Honey Bee Pests and Diseases ??????????????