



HONEY BEE
HEALTH
COALITION

IDENTIFYING AND MITIGATING FOULBROOD IN HONEY BEE COLONIES AND REDUCING THE USE OF ANTIBIOTICS INFORMATION FOR BEEKEEPERS AND VETERINARIANS



On January 1st, 2017, the Food and Drug Administration (FDA) enacted a new Veterinary Feed Directive (VFD) rule regarding the use of antibiotic treatments on livestock. This new ruling classified honey bees (*Apis mellifera*) as livestock, thus requiring their beekeepers to consult with a veterinarian prior to purchasing and applying antibiotics to their honey bee colonies. The underlying concern is that overuse and/or prophylactic use of antibiotics can cause resistance to this important medicine.

This document articulates what are American Foulbrood (AFB) and European Foulbrood (EFB), how to test for AFB/EFB, and what to do if there is a positive diagnosis. It's important to note that antibiotics do not treat AFB, but only mask the symptoms, and that antibiotics should only be used as a last resort for EFB.

About American Foulbrood and European Foulbrood

American Foulbrood (AFB) is a disease caused by the spore-forming bacterium *Paenibacillus larvae*. This disease primarily affects the developing prepupae and pupae (referred to collectively as brood) in a honey bee colony. Adult honey bees can be carriers of AFB but are not affected by it. This disease is highly contagious, and the spores can remain viable in wax and honey for decades. The spread of AFB occurs when bees "drift" from infected colonies to healthy ones, bees rob an infected colony that has collapsed, or beekeepers exchange infected equipment or honey. Many of the symptoms of AFB are exhibited in the brood cell cappings and in the prepupal/pupal stages of a developing honey bee.

European Foulbrood (EFB) is a disease caused by the non-spore-forming bacterium, *Melissococcus plutonius*, which affects young larvae, killing this brood stage before brood cell capping is initiated. While this disease is not as detrimental as AFB, it still has the potential to substantially weaken a honey bee colony and make it more vulnerable to other stressors that can lead to colony loss. EFB can be spread along the same pathways as AFB. Unlike AFB, a colony can clear up an EFB infection during a steady nectar flow, but a beekeeper may assist through regular feeding of sugar water or requeening the colony with a queen of hygienic stock.

To prevent or limit the spread of AFB and EFB, beekeepers should consider implementing Integrated Pest Management (IPM) techniques in their honey bee colonies. IPM is a method of mitigating pests and diseases through techniques that are developed from understanding the pest, the host, and the pest-host interaction. More information on IPM is provided in the Honey Bee Health Coalition's guide for Best Management Practices for Hive Health (<https://honeybeehealthcoalition.org/hivehealthbmps/>).

How to test for AFB/EFB and what to do if there is a positive diagnosis

American Foulbrood (AFB)

HOW TO CONFIRM AFB

1. Look for signs of AFB:
 - Capped cells are perforated, sunken, and greasy-looking; late stage larvae or early stage pupae look sickly, discolored.
 - Presence of scale – desiccated remains of pupa that sticks tightly to lower cell wall and is not removable without damaging the cell wall.
 - Extended pupal proboscis (false tongue) stretching from one cell wall to opposite cell wall (only see if death occurred in early pupal stage) – very positive sign of AFB but not always present.
 - Distinctive foul odor – not the typical sour smell of dead brood.
2. Conduct the “ropiness” test. This test relies on the unique characteristic of AFB-infected honey bee brood.
 - Select a brood cell that looks infected but not dehydrated (the prepupa/pupa structure is still evident and gooey). Take a stick or toothpick to swirl the contents of the cell and slowly withdraw it. If the contents draw out up to an inch in length (2.5 centimeters) then snaps back, the cell is most likely infected with AFB.
3. Use an AFB diagnosis kit.
 - Kits are available from several bee supply companies. Be cautious to interpret the results correctly because there are times when the test may yield false results. Ideally, the test results should be considered with other lines of evidence (steps 1 and 2).

Please note that false results may occur using any of the 3 methods above. Use multiple methods to corroborate results.

4. Have colony examined by an individual trained in disease identification, such as a state apiary inspector.
5. Send a sample to a diagnostic lab.
 - Collect a sample of the suspected brood by either cutting out a piece of the comb (2 by 2 inches - 5 cm by 5 cm) or coating a stick or toothpick with contents of one or more suspected cells. Wrap the sample in paper (not plastic or aluminum) and send it to a lab. Make sure to include return contact information.

WHAT TO DO IF CONFIRMATION OF AFB IS POSITIVE:

1. Contact state/provincial apiary Inspection office (if your state/province has an active inspection program) to report the confirmation. The staff will advise you on the approved treatment protocol.
2. Burn and bury – Work with state apiary officials and local fire marshals before burning the equipment. After dark, when bees have returned to the colony, kill the adult bees, dig a pit large enough to completely burn and bury infected colony frames (brood and honey) and adult bees. A burn barrel will also work. Larger hive bodies, cover, and/or tops can be scorched with fire or portable torch after scraping off any wax deposits.

If there is no state apiarist:

1. Send to landfill – If open burning is prohibited, double bag all bees and frames in heavy-duty trash bags and bury in a landfill. Kill bees first by pouring soapy water from the top into the hive.
2. Irradiation – Use an approved gamma irradiation sanitation facility (there are few facilities willing to accept bee equipment). This will not be cost effective and honey is not effectively treated with irradiation.
3. DO NOT use antibiotic – It will only mask the vegetative growth signs. Burning and burying the infected hive is the recommended treatment option, but discuss alternative options with your state apiary inspection service.



AFB Diagnosis Kit
Photo Credit: Vita Bee Health

European Foulbrood (EFB)

HOW TO CONFIRM EFB

1. Use some of the signs of dead/dying larvae:
 - Larva twisted in cell
 - Larva with yellowish color or yellow color streaks
 - Rubbery scale is easily removed from cell without damaging cell walls
 - Only larvae appear sickly – capped cell appearances are normal
 - Dead larvae does not rope out, nor show false tongue
 - Odor mildly sour, not distinctive AFB foul odor
2. Use an EFB diagnosis kit (available from several beekeeping suppliers).
3. Send a sample to a diagnostic lab (as described above for AFB).
4. Have the colony examined by an individual trained in disease identification, such as a state apiary inspector.

WHAT TO DO IF CONFIRMATION OF EFB IS POSITIVE

1. Strengthen the colony by feeding sugar syrup and/or protein patties and adding adults or capped brood from a healthy colony to the diseased colony.
2. Move the colony to an apiary site with better forage and less competition.
3. Cull older darker brood frames once the colony is healthier (before subsequent season).
4. If EFB conditions persist or if the infestation is heavy, requeen with a different queen stock before the fall season.
5. Consider obtaining a VFD to use oxytetracycline antibiotic. This should only be used as a last resort.

Reminder

If you suspect your hive is carrying AFB or EFB, many states require that the beekeeper report to his or her state's apiary inspection service. A list of each inspection service is provided on the Apiary Inspectors of America website: <https://apiaryinspectors.org/>

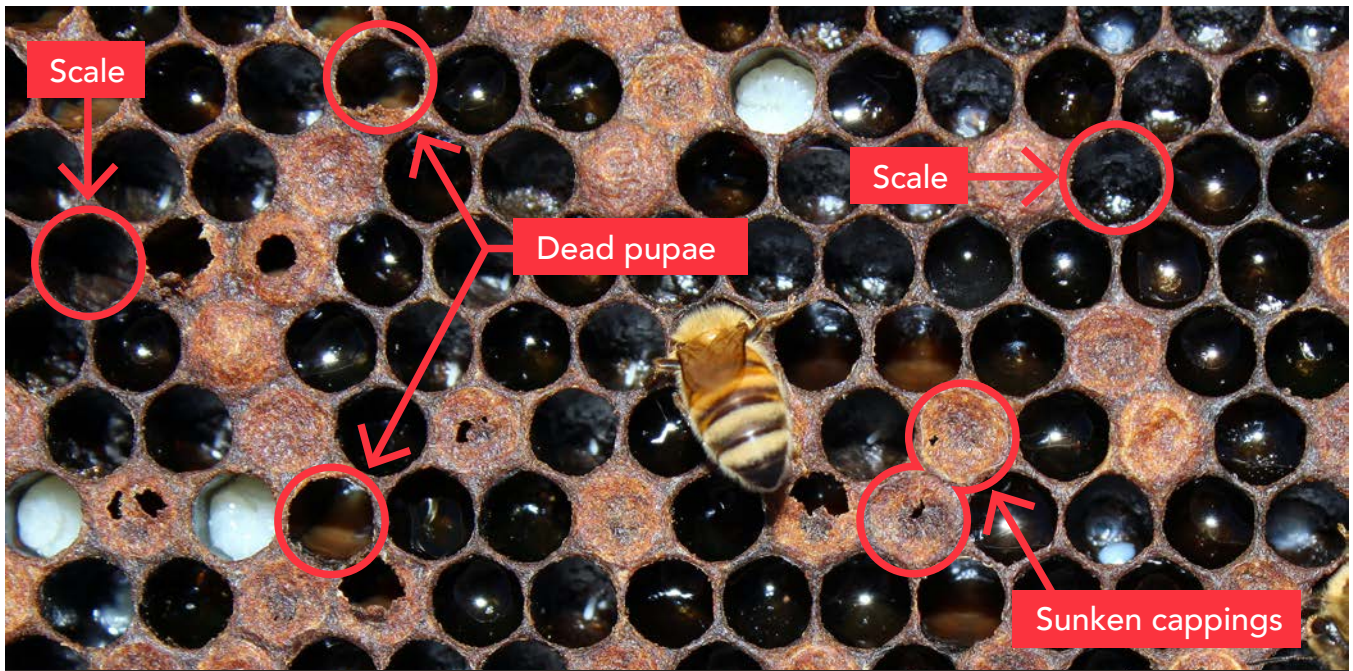


Figure 1. AFB sunken cappings, dead brood and scale
 Photo credit: Rob Snyder, Bee Informed Partnership



Figure 2. Rope test confirming AFB infection
 Photo credit: USDA



Figure 3. "False" pupal tongue (sign of AFB)
 Photo Credit: Scott Camazine, Penn State University

DO NOT DELAY
 ALWAYS get confirmation of AFB/EFB as soon as possible.



Figure 4. Yellowing larvae (sign of EFB)
 Photo Credit: Rob Snyder, Bee Informed Partnership

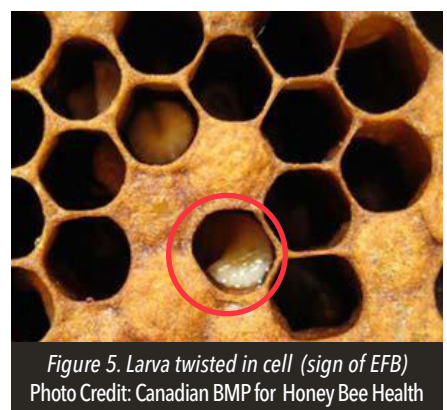


Figure 5. Larva twisted in cell (sign of EFB)
 Photo Credit: Canadian BMP for Honey Bee Health

Concern about Antibiotics

Antibiotics are drugs used to treat harmful bacterial infections. However, the misuse and overuse of these drugs can result in bacteria developing resistance to the antibiotic. Antibiotic-resistant bacteria can make treatments ineffective, prolong infections, and spread to otherwise healthy organisms. To prevent the development of antibiotic-resistant bacteria, antibiotics should only be considered as a last resort and never for prophylactic use. Beekeepers should use other methods of disease prevention to reduce the need for antibiotic drugs.

What is a VFD?

A Veterinary Feed Directive (VFD) is a written statement issued by a licensed veterinarian that allows the use of a VFD drug, or combination of VFD drugs, to be used with animal feed. The VFD must be issued within the state-defined parameters for a veterinary-client-patient relationship (VCPR). Several states have developed their own definition. Please see the FDA website for more information about each states' requirements (<https://tinyurl.com/VFDFDA16>). In states where there is not a state-defined VCPR, the FDA requires that the VFD be issued as defined in the federal regulations (<https://tinyurl.com/VFDFDA15>).

The implementation of VFD drugs has allowed the FDA to better control the use of certain antimicrobial drugs in animal feed. The VFDs are intended to reduce the prophylactic use of drugs in animal feed, thus slowing or even preventing the development of resistance to certain antimicrobial drugs that are important to animal agriculture.

What is the difference between a VFD and a prescription?

Both a VFD and a prescription (Rx) require the oversight of a licensed veterinarian. However, a VFD is a drug that is administered through animal feed; whereas, a prescription is an animal drug that is not used in animal feed. Antibiotics for honey bees would typically be administered through feed, such as sugar syrup. Although some beekeepers may feed bees honey, this method is not recommended because of the potential to spread American Foulbrood.

How does a beekeeper access a VFD?

There are currently 3 microbials used for management of foulbrood. These include oxytetracycline, tylosin, and lincomycin. Use of these antibiotics for European Foulbrood is justified as a hive treatment to control the management of the bacteria from infected larvae to healthy larvae. Before a beekeeper can apply an antibiotic, a licensed veterinarian must diagnose the condition and issue a VFD. The beekeeper or the veterinarian can then work with an appropriate distributor to receive the drug (many bee supply companies handle the animal feed formulations of both oxytetracycline and tylosin). As an alternative, once a VFD is obtained, the beekeeper can generate his/her own feed as long as it stays compliant with the state or federal regulations.

Can AFB be eradicated?

Short answer: Yes, but...

Long answer: Eradication of AFB requires that beekeepers work together to eliminate colonies with active infections of AFB. This requires destroying brood/honey frames and all adult bees by burning or burying. Here are the steps for eradication of AFB:

1. Do not use antibiotics.
2. Monitor colonies frequently, especially during the spring and early summer period when brood is abundant and the colony is in a growth phase. Know how to identify all the varied signs of an AFB infection, and be prepared to act quickly when signs are detected. *Remember, early detection saves hives!*
3. If symptoms of AFB are detected, contact your state apiary inspection service for treatment options. Burning and burying infected hives is the most effective treatment method. However shaking bees onto new foundation early in the season and burning and burying the old, dark comb may be an acceptable alternative option (<https://tinyurl.com/VDFFDA14>).

Resources

RESOURCES FOR BEEKEEPERS:

- Food and Drug Administration – Using Medically Important Antimicrobials in Bees – Questions and Answers (<https://tinyurl.com/VDFFDA1>)
- Bee Culture – Do I Need a Vet for My Bees? (<https://tinyurl.com/VDFFDA2>)
- USDA and Canadian Association of Professional Apiculturists (CAPA) bulletins
- Honey Bee Biology and Beekeeping by Dewey Caron and Lawrence Connor, 2019 Wicwas Press
- Contact state/provincial bee inspection services at: <https://apiaryinspectors.org/inspection-services/>

RESOURCES FOR VETERINARIANS:

- American Veterinary Medical Association (AVMA) Honey Bees 101 for Veterinarians (<https://tinyurl.com/VDFFDA3>)
- National Veterinary Accreditation Program, Module 30: The Role of Veterinarians in Honey Bee Health (<https://tinyurl.com/VDFFDA4>)
- University of Florida – Webinar: Veterinarian’s Guide to Honey Bee Antibiotics (<https://tinyurl.com/VDFFDA5>)
- University of Maryland Honey Bee Health Seminar for Veterinarians (<https://tinyurl.com/VDFFDA6>)
- Diagnosis of Honey Bee Diseases (<https://tinyurl.com/VDFFDA12>)
- Canadian Veterinary Medical Association: Treating Honey Bees and Pollinators (<https://tinyurl.com/VDFFDA13>)

RESOURCES FOR BOTH BEEKEEPERS AND VETERINARIANS:

- FDA Veterinary Feed Directive Overview (<https://tinyurl.com/VDFFDA10>)
- Guidance for Industry (#120) – Small Entity Compliance Guide Veterinary Feed Directive Regulation Questions and Answers (<https://tinyurl.com/VDFFDA7>)
- Guidance for Industry (#233) Veterinary Feed Directive Common Format Questions and Answers (<https://tinyurl.com/VDFFDA8>)
- Honey Bee Veterinary Consortium (<https://tinyurl.com/VDFFDA9>)
- Find a Bee Vet (<https://tinyurl.com/VDFFDA17>)
- Shaking is an Effective and Profitable Method for Managing AFB (<https://tinyurl.com/VDFFDA14>)

References

- Canadian Association of Professional Apiculturists. (editors S. F. Pernal & H Clay). 2013. Honey Bee Diseases & Pests. 3rd edition. (www.capabees.org)
- Caron, D. and L. Connor 2019. Honey Bee Biology & Beekeeping. Wicwas Press.
- Shimanuki, Hachiro, and David A. Knox. 2000. Diagnosis of Honey Bee Diseases. U.S. Department of Agriculture, Agriculture Handbook No. AH– 690, 61 pp.
- U.S. Food & Drug Administration Veterinary Feed Directive (<https://www.fda.gov/AnimalVeterinary/DevelopmentApprovalProcess/ucm071807.htm>)

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