



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 Veterinary Feed Directive (VFD) rule regarding the use of medically important antibiotic treatments on food-producing livestock, including honey bees. This ruling requires beekeepers to obtain an order from a veterinarian prior to purchasing antibiotics for their honey bee colonies.

The treatment of two bacterial diseases is affected by this ruling: American foulbrood (AFB) and European foulbrood (EFB). This document outlines how to test for AFB/EFB and what to do if there is a positive diagnosis.

About American Foulbrood and European Foulbrood

American Foulbrood (AFB) and European foulbrood (EFB) are bacterial diseases that affect developing honey bees (brood). Adult bees can be carriers for both diseases, but do not appear to be affected by either. The spread of both AFB and EFB between colonies occurs when bees drift from infected colonies to healthy ones, when bees rob an infected colony that has weakened, or when beekeepers move infected equipment or honey.

AFB is caused by the spore-forming bacterium *Paenibacillus larvae*. American foulbrood is generally deadly to the colony, and the spores can remain in equipment and honey for decades. EFB is a disease caused by the non-spore-forming bacterium, *Melissococcus plutonius*. While this disease may lead to colony death, colonies with EFB may also spontaneously recover.

To prevent or limit the spread of AFB and EFB, beekeepers should consider implementing biosecurity principles.

- Yards should be kept separate as much as possible and mixing of equipment should be minimized. In large operations, where yard separation is not feasible, beekeepers should employ a barrier system, splitting their operation into smaller, separate parts.
- Hive tools should be cleaned between yards or after use on a hive with visible signs of disease. Items that are frequently touched such as gloves, smokers, steering wheels etc. should be frequently cleaned and disinfected.
- Honey from other operations should never be used as feeding, and incoming equipment (frames or splits) should be kept separate as long as feasible. It is important to note that the pathogens for both EFB and AFB are common in hives that do not exhibit any signs of disease.
- Beekeepers should minimize drifting and robbing through entrance reduction and hive placement.

Testing and Management of Foulbrood Disease

American Foulbrood (AFB)

HOW TO CONFIRM AFB

Use multiple methods to corroborate results. If you are not confident in your examination, have the colony examined by an individual trained in disease identification, such as a state apiary inspector or extension specialist where available.

1. Visual inspection:

- Capped cells are perforated, sunken, and greasy- looking, often with a caramel-colored liquid; late-stage larvae or early stage pupae look sickly, discolored (coffee brown to dark brown).
- A dark scale (desiccated larval remains) is present on the lower cell wall. It is stuck tightly and is not removable without comb damage.
- Extended pupal proboscis (false tongue) stretching from the lower cell wall to the upper cell wall – unique to AFB but rarely present.
- Distinctive foul odor – not always present, and not easily identifiable to those not familiar.

2. Conduct the “ropiness”/ matchstick test.

Select a brood cell that looks infected but not dehydrated (the prepupa/pupa structure is still evident and gooey). Take a matchstick or similar wooden implement to swirl the contents of the cell and slowly withdraw them. If the contents rope out an inch in length (>2 centimeters), the cell is most likely infected with AFB.

3. Use a Holst Milk Test

Put the contents of a few diseased cells into a tube with highly diluted skim milk (kits can be made by keeping a small amount of non-fat dry milk in a small tube with a toothpick). Shake well and incubate for 15 minutes. Positive samples will bind to milk proteins removing the cloudiness from the liquid.

4. Use a commercial lateral flow device

Kits are available from several bee supply companies.

5. Send a sample to a diagnostic lab.

The USDA ARS lab in Beltsville accepts samples from within the United States and other labs are also available to accept shipped samples. Ensure that you follow the sampling and contact instructions carefully.

WHAT TO DO IF AFB IS CONFIRMED

1. AFB is a reportable disease in some states. Contact the state/provincial apiary inspector to report and follow their instructions.
2. If state regulations allow, and it is early in the season, adult bees can be shaken on to new equipment (foundation), fed syrup, and provisioned with antibiotics (shook swarm).
3. If a shook swarm is not allowed in your state as treatment for AFB, or it is late in the season, the adult bees must be euthanized. Euthanasia should be as quick as possible. Either use an insecticide, or close up the bottom of the hive and pour 70% isopropyl alcohol onto the bees, and seal the top.
4. **All Frames (brood and honey) from hives with confirmed AFB must be destroyed.**
 - Burn and bury – If local ordinances allow, it is ideal to burn and bury wooden equipment. Dig a large pit and burn the equipment in the pit, covering the ashes.
 - Send to landfill – For plastic/ polystyrene equipment, or if burning is not available, double bag all bees and frames in heavy-duty trash bags and send to a landfill.
5. Hive bodies, covers, and bottom boards can be destroyed with the frames or they may be sterilized if facilities are available.
 - Scorching with flame followed by dipping in hot wax (10 minutes at 160°C).
 - Irradiation – Some gamma irradiation sanitation facilities accept bee equipment.
6. Antibiotics can be used to control the spread of disease from adult bees (in remaining hives in the yard or bees on new equipment).
 - Request antibiotic sensitivity testing at the USDA diagnostic lab.
 - Obtain an order from a veterinarian.
 - Follow instructions closely, being careful to apply on schedule and adhere to safe withdrawal times for honey.
 - Only use antibiotics in conjunction with frame destruction, as antibiotics do not kill spores, and will not save already infected larvae. Antibiotics only control spread of disease to new larvae by adults carrying spores.
7. Prevent further spread.
 - Frequently inspect for signs of disease.
 - Do not use equipment from that yard in other parts of your operation for one year.

European Foulbrood (EFB)

HOW TO CONFIRM EFB

Use multiple methods to corroborate results. If you are not confident in your examination, have the colony examined by an individual trained in disease identification, such as a state apiary inspector or extension specialist where available.

1. Visual inspection:

- Larvae twisted in cell (corkscrew shape).
- Discolored larvae can be yellowish, gray or brown.
- Larvae with visible trachea – larvae look transparent with visible lines.
- Larvae with loss of internal pressure, appear 'melty'.
- May have holes in cappings, sunken cappings.
- Dark rubbery scale on bottom cell wall - is easily removed from cell without damage.
- May be odorless or mildly sour

2. Use a commercial lateral flow device

Kits are available from several bee supply companies.

3. Negative results for other tests

European foulbrood disease is often mistaken for other diseases including AFB, chalkbrood, and parasitic mite syndrome (PMS). It is often helpful to rule out other diseases:

- High varroa mite counts – likely PMS
- Rope test or Holst milk test - AFB
- Presence of chalk-like mummies – chalkbrood.

Be aware that co-infection of EFB with chalkbrood and sacbrood is common.

4. **Seasonality can aid in diagnosis.** EFB is common following a strong honey flow (late spring in northern states). Larval disease that appears in the late fall is more likely related to high levels of the varroa mite.

5. **Send a sample to a diagnostic lab.**

WHAT TO DO IF CONFIRMATION OF EFB IS CONFIRMED

1. Colonies with EFB may spontaneously recover. Watchful waiting may be employed. Carefully inspect all brood frames of all colonies in the yard, noting the level of infection (approximate number of diseased cells / hive). If disease lessens, no further action is required.
2. Worker bees can be shaken onto new equipment (shook swarm method), and brood frames destroyed. This can be done without or in conjunction with antibiotics.
3. Antibiotics can be used after a positive diagnosis of EFB for hives with signs of disease, as well as other hives in that yard, as the bacteria is generally present in adult bees in hives in yards where disease is present.

Reminder

Some states require that the beekeeper report bacterial diseases to the apiary inspection service. More information can be found on the [Apiary Inspectors of America website](https://apiaryinspectors.org/): <https://apiaryinspectors.org/>



AFB Diagnosis Kit
Photo Credit: Vita Bee Health

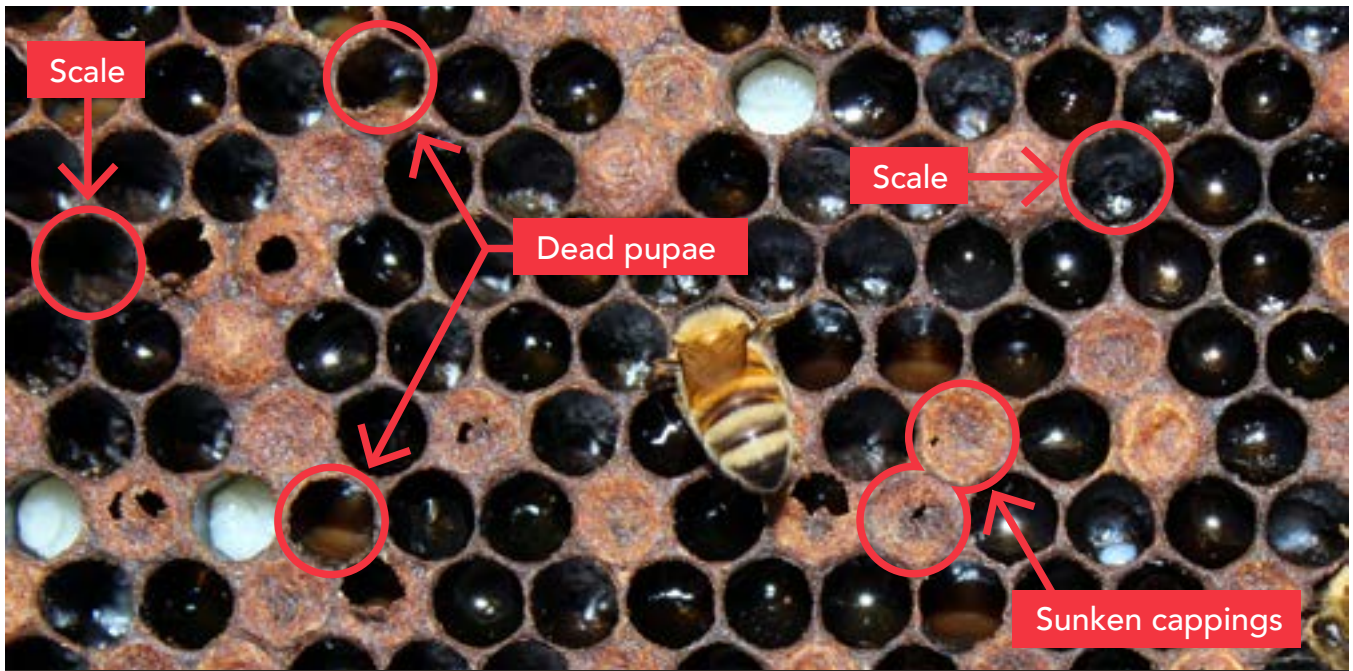


Figure 1. AFB sunken cappings, dead brood and scale
 Photo credit: Rob Snyder, Bee Informed Partnership



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

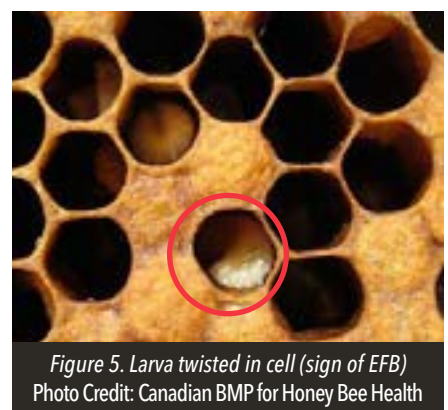


Figure 5. Larva twisted in cell (sign of EFB)
 Photo Credit: Canadian BMP for Honey Bee Health

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 be used judiciously. Beekeepers should take measures to prevent the pathogens from entering their operation and to minimize their spread within their operation. Beekeepers and all of their employees should be well trained to recognize disease and should frequently screen colonies so that diseases are caught early and can be controlled. If antibiotics are used, label instructions must be followed exactly.

How do beekeepers access antibiotics?

1. **Establish a veterinary-client relationship with a veterinarian.** Beekeepers must obtain an order from a veterinarian in order to access antibiotics. Before a veterinarian can issue an order, they must have established a veterinary-client-patient relationship (VCPR). Most states follow the federal definition, but some states have additional requirements as to what constitutes a VCPR. More information can be found at the FDA website: <https://tinyurl.com/VDFDA16>.
2. **Determine the antibiotic formulation.** As of 2022, three antibiotics are available for use in honey bees: oxytetracycline, tylosin, and lincomycin. All three have formulations for use in the control of AFB, but only oxytetracycline is labeled for control of EFB. The website Animal Drugs @ FDA: <https://animaldrugsatfda.fda.gov/> has more information - searching for "honey bees" on this site will provide you with all available formulations and sample information. This site also contains Blue Bird labels with additional directions for antibiotic application.
3. **Obtain an order.** The Animal Drugs @ FDA site will indicate what type of order the veterinarian must write: a veterinary feed directive (VFD) or a prescription. If the drug is available through a prescription, the drug can be purchased through a pharmacy. Antibiotics that are available through a VFD can be purchased at a licensed feed mill.
4. **Purchase the antibiotics.** Once the order has been submitted, the beekeeper can purchase the antibiotics from the pharmacy or licensed feed mill/ bee supply company. It may be difficult to find pharmacies that can fill small quantities of honey bee drugs, so veterinarians should work with beekeepers to make sure they can access what they need. Most major beekeeping supply companies are now licensed feed mills, so the veterinarian will send the VFD directly to the supply company. The FDA website <https://animaldrugsatfda.fda.gov/> has a listing of all federally registered feed mills under the "Medicated Feeds" Section.
5. **Apply the antibiotics.** Antibiotics should be applied exactly as specified by the label. It is important to complete all applications of the antibiotic, even if it appears that the colony is recovering.

Can AFB be eradicated?

Eradication of AFB is possible, especially as new sensitive screening tools become available, and as more veterinarians and diagnostic labs are trained to identify AFB. Eradication requires that beekeepers work together to eliminate colonies with active infections of AFB, and are frequently screening for signs of disease. This requires destroying brood/honey frames and all adult bees by burning or burying. Here are the steps for eradication of AFB:

1. 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!
2. If symptoms of AFB are detected, contact your state apiary inspection service for treatment options, and destroy all frames from infected hives immediately. Monitor all colonies in the yard closely, and take action to prevent robbing.

Resources

- 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>)
- Diagnosing and Treating American Foulbrood in Honey Bee Colonies. (<https://tinyurl.com/mrxxdc7w>)
- Honey Bee Biology and Beekeeping by Dewey Caron and Lawrence Connor, 2022 Wicwas Press
- State/provincial bee inspection services: <https://apiaryinspectors.org/inspection-services/>
- American Veterinary Medical Association (AVMA) Honey Bees 101 for Veterinarians (<https://bit.ly/VDFFDA15>)
- 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>)
- Honey Bee Medicine for the Veterinary Practitioner. Wiley Press

- 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

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- Euthanasia and welfare of managed honey bee colonies. Franco Mutinelli. Journal of Apicultural Research, 2021.
- 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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