THE Bee-Files
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Management of Honey Bee Brood Diseases
Part I: Identification and Treatment

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Healthy larvae, glistening white almost shiny (Jaycox Photo)

Like other animals, honey bees are susceptible to infection by a variety of organisms, including viruses, bacteria, fungi and parasites. Some organisms affect the adult bee, while others affect the brood, or immature stages. You will find that the diseases infecting the brood pose the greatest challenge to beekeeping. The most serious disease of immature honey bees is American foulbrood (AFB), a bacterial infection that infects the developing larvae. The serious nature of AFB is due to the fact that it is contagious and (if left unchecked) almost always fatal for individuals and colonies. The other major brood diseases are European foulbrood (EFB), chalkbrood (CB) and sacbrood virus (SBV). Since the arrival of the *Varroa* mite, a number of other abnormal brood conditions have become increasingly common, especially during the end-stages of the mite infestation. The symptoms associated with these mite-related brood conditions are often similar to those of the better-known brood diseases, and this makes accurate disease diagnosis more difficult. Unfortunately, if you are not able to accurately identify brood diseases, you put all of your bees at risk. Additionally, ignorance can lead to the spread of disease to colonies belonging to other beekeepers. Therefore, it is essential that every beekeeper be able to identify the major brood diseases and know what steps to take if they are found.


Learn to recoginze a healthy, good brood pattern. Caps are convex, clean & complelety sealed, with only a few or no uncapped cells.

The first step in disease identification is learning to recognize healthy brood. When conducting colony inspections, make use of the sun to illuminate the contents of the brood cells whenever possible. As you inspect the brood combs, pay close attention to the color of the larvae. Healthy larvae are glistening and pearly white. Larvae that are dull, off-white, yellow, brown or black may be diseased and merit closer inspection. You should also pay attention to the brood pattern. A healthy brood pattern has very few empty cells; and the cappings are uniformly brown or tan in color, with a decidedly convex appearance. Combs with lots of scattered brood, combs with uncapped or partially capped cells, and combs with perforated, sunken cappings should always prompt a thorough inspection.

An Integrated Pest Management Program is a desirable approach to disease management because it enables you to

minimize or even eliminate the use of antibiotics in your management system. This has two highly desirable consequences. First, it reduces the likelihood that the pathogens will develop antibiotic resistance. Second, it reduces or eliminates antibiotic residues in your honey. This, in turn, allows you greater access to the natural and organic foods markets and to the higher prices they offer at both producer and retail levels. An effective IPM program for disease management has three basic requirements: you must be able to accurately identify the major diseases, you must know what to do when you encounter a disease, and you must incorporate basic disease management protocols into your overall management scheme. So, let's examine these requirements, one at a time.

Note the pure white larva, compared to the tan/yellow larva that is infected with European Foulbrood. Side by side comparsions are best for learning. (Photos by Jaycos and Flottum)

Discolored larvae and poor brood patterns may indicate the presence of a disease, or they may indicate a non-disease condition such as a failing queen, chilled brood or starvation. The diagnosis of a disease versus non-disease condition is often one of exclusion. In the end, you may not be sure what is causing the symptom; but you **absolutely** must be able to determine whether or not AFB is the cause of the symptom. In fact, one of the principal objectives of disease identification is simply to be able to accurately identify AFB. The more examples of abnormal brood conditions that you can observe, the better you will become at diagnosing their true cause.

European Foulbrood

European Foulbrood is caused by the *bacterium Melissococcus pluton*. It is most common in the spring and to a lesser extent, in the fall, but can appear at anytime. Larvae become infected within one to two days after hatching from the egg when they consume brood food bearing the infective organism. Infected larvae first turn a light yellow, then brown. They usually die in the coiled stage and may be found lying flat in the cell or twisted up against the side of the cell wall. As the level of infection increases, the brood pattern becomes characterized by an increasing number of uncapped and partially capped cells. Capped cells may also contain infected larvae. The cappings are often concave or sunken into the surface of the comb. The infected larvae have a granular to watery consistency. The diseased larvae may rope out as much as two cm, but the rope is not elastic. Black, rubbery scales may be formed as the diseased individual dries out. These scales are relatively easy to remove from the cell.

European Foulbrood eventually causes complete meltdown of the larvae, often in the coiled stage.

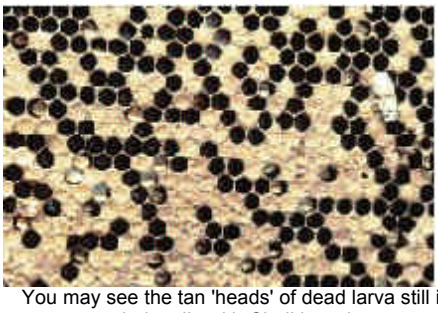
Treatment with an approved antibiotic is therapeutic, but requires that you take the infected colony out of production in order to comply with label requirements. Requeening with a different stock of bees may also end the problem. The reason for the effectiveness of this method is not entirely clear. It may be that most stocks are somewhat resistant to EFB; or, it may be that the break in the brood rearing that occurs with requeening enables the nest cleaning bees to remove the diseased larvae that would otherwise serve to perpetuate the infection. In either case, requeening is often effective.

Chalkbrood

Chalkbrood is caused by a fungus, *Ascosphaera apis*. The fungus infects larvae three to four days after egg hatch and is most commonly found in worker and drone brood. Before you see the fungal growth, you may notice that an otherwise healthy-looking larvae has lost its glistening sheen. The infected larva is quickly covered by a white, fibrous mycelium, which fills the entire cell. The fungal mass quickly dries to form a hard, shrunken mass called a mummy that is easily removed from cell. The shrunken head often remains visible as a light-brown protrusion. If different strains of the fungus invade a larva, they may form spore cysts, in which case the mummy will take on black and white mottling, or it may become entirely black. Mummies are often seen in large numbers at the entrance of a heavily infected colony. They may also be found in capped cells.

There are no approved medications for control of Chalkbrood. Fortunately, it is usually self-limiting; although some areas in the northeast are known to have serious problems with this disease. If you encounter a severe and persistent case of Chalkbrood in an area where the incidence of the disease is low, try requeening the colony to eliminate the condition.

The Chalkbrood fungus first consumes the larva, completely filling the cell with mycelia

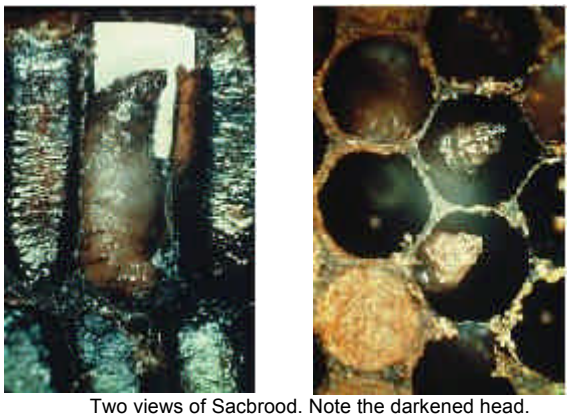


You may see the tan 'heads' of dead larva still in their cells with Chalkbrood.

Once dried down, the 'mummies' are pulled out by the bees and disposed of outside the colony.

Sacbrood

Sacbrood is caused by a virus named sacbrood virus - SBV. Typically, there are a number of uncapped or partially uncapped cells throughout the brood nest. These cells contain discolored larvae, usually gray to black, lying flat on the cell bottom with markedly darkened heads. The disease receives its name from the fact that the infected individual appears sac-like due to an accumulation of fluid between larval and pupal cuticles. If one exercises care, the SBV infected bee can be easily removed intact from the cell with forceps. If you puncture the sac, the watery contents will run out. In more severe cases, you may find dark, brittle scales on the bottoms of the cells. These scales are easily removed from the cell. Like Chalkbrood, SBV is almost always self-limiting. There are no approved medications for control of SBV. If you have a persistent case of SBV, try requeening with a different stock of bees to eliminate the condition.



Two views of Sacbrood. Note the darkened head. (Cornell photos)

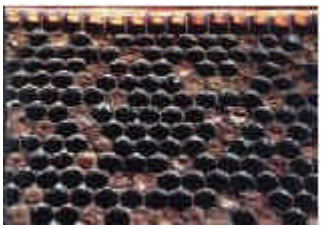
American Foulbrood

American foulbrood (AFB) remains the most damaging of the honey bee diseases. AFB is caused by the spore-forming bacterium *Paenibacillus larvae* (previously known as *Bacillus larvae*). Larvae are infected within 72 hours of hatching from the egg by ingesting brood food contaminated with spores. The pathogen kills just about the time the cell is being capped, or shortly thereafter. As the disease progresses, the cappings become discolored and sunken, and the brood pattern becomes peppered with uncapped cells and cells with perforated cappings, all mixed in with healthy cells.

The AFB Rope test. The 'rope' will be elastic, sometimes. But not all AFB will rope. (Cornell photo)

A dried down scale with the pupal tongue standing upright. Not all scales have this. (Cornell photo)

Numerous scales in a comb. This comb should be burned.



Active AFB is characterized by larvae or pupae that have melted down into a viscous pool of light to dark brown liquid lying flat on the cell bottom. During this stage, the rope test can be fairly informative. To conduct the rope test, carefully insert a flat wooden toothpick into the infected bee, gently stir three or four times, then slowly withdraw. If the diseased material can be pulled out of the cell two cm or more - the rope - before snapping back in, AFB is most likely the cause. Unlike the EFB rope, the AFB rope tends to be more elastic. Unfortunately, a negative rope test does not always guarantee that AFB is not present, so test several cells. If you do not get a positive on the rope test, take a sample for laboratory identification. The presence of a smooth, light to chocolate brown pupa in the cell with its tongue adhering to the roof of the cell is not a common symptom, but is considered to be diagnostic for AFB. Eventually, the infected individual dries down to a black scale that adheres tightly to the bottom of the cell. The tongue may or may not be visible. A single scale may contain over 2.5 billion reproductive spores.

Unlike the other brood diseases, AFB will almost always go on to kill the colony. If other bees rob a weakened or dying colony infected with AFB, or if combs from an AFB colony are distributed to other colonies, the disease will spread. Therefore, it is critical that you take the right action when you identify it in your colonies. The best response to a case of active AFB is to destroy the colony using an approved pesticide and to burn the equipment, especially the frames, combs, wax and honey. Be sure to kill the colony when the bees are not flying. Check with your local fire department to determine burning regulations in your area. You may save the hive bodies, bottom boards and outer covers if they are in good condition by scraping them clean with a sharp hive tool, then scorching all interior surfaces, including the narrow surfaces of the tops and bottoms of the hive bodies, to a depth of 1/16th inch with a weed burner or propane torch.


Proper placement of TM dust.

Use ***Terramycin only as a preventative***. Generally, hobbyist beekeepers in states with good inspection programs do not need to use drugs for management of AFB. However, if you keep bees in an area where AFB is known to be a problem, you should use Terramycin (TM) as a prophylactic. That means treating healthy colonies with no evidence of disease. I recommend that you use TM as a dust or as a syrup additive in the spring. Follow the label directions. This means that you must treat your colonies so that the bees consume the entire dose of antibiotic at least 45 days prior to adding supers to your hives for marketable honey. Treat again in the fall after you remove your honey supers. This will protect your bees during the time when robbing is most likely to occur.

Many beekeepers use TM patties because they require less work. Unfortunately, the patties are often intentionally or unintentionally left on the colonies throughout the summer. This is a violation of the label and increases the chance that your honey will have antibiotic residues. If you use patties, you must comply with the 45-day rule *in the spring*.

Do not use antibiotic therapy on any colony with AFB scales or symptoms of active AFB. Antibiotics may alleviate AFB symptoms, but the disease persists in a latent phase in the form of highly resistant spores that remain viable for many decades. When antibiotic treatment is withdrawn, symptoms eventually reappear. In addition, if a colony with latent AFB becomes weakened as a result of some other condition, such as parasitic mites, bees from other colonies will likely rob it. The robber bees will likely carry the infection back to their colony. The lack of symptoms will also lull you into a false sense of security. Inevitably, you will move combs from the infected colony to healthy colonies, thereby spreading the problem.


Burning is sometimes the best, and only way to deal with an AFBinfection. (Killion photo)

Parasitic Mite Syndrome

Parasitic mite syndrome is comprised of a number of symptoms, including, most notably, a pronounced pathology of the brood. Brood symptoms usually occur near the end of the mite infestation and herald the approaching death of the colony. The brood symptoms associated with varroa infestation are believed to be a consequence of viral, and possibly bacterial pathogens, although brood may also die as a result of inadequate care stemming from the negative effects of mites on nurse bees. Brood symptoms are highly variable, and are often difficult to distinguish from EFB and AFB; however, treatment with terramycin (TM) does not eliminate this condition. A working diagnosis of parasitic mite syndrome can be made by eliminating other pathogens as the source of the symptoms and confirming the presence of varroa mites in the colony. If you find this brood condition early, treat with Apistan or Coumaphos. If you want to save the honey on the hive for human consumption, you must remove it before treating. If that is not an issue, you may leave it on the hive and use it as winter feed for the bees.


BPMS symptoms are difficult to interpret. Treating for mites usually helps, antibiotics don't. (USDA photo)

If you wait until parasitic mite syndrome is advanced, you will not be able to successfully treat your colony. You may kill the mites and eliminate the brood symptoms, but the remaining bees are likely to be damaged and unable to recover, especially in the fall, when healthy bees are needed for winter.

Workshops

If you are a member of a beekeeping organization, get together with some of the more experienced members and organize a disease identification workshop. Encourage all of your members to attend, and publicize your workshops to

non-member beekeepers in your area. If you are not a member of a bee organization, seek one out and take advantage of the opportunities they provide for you to become a better beekeeper. Remember! Disease control efforts work best when everyone cooperates.

Identification and treatment are two-thirds of the solution to controlling brood diseases. Next time, we will look at a number of practices you can incorporate into your disease management program that will help reduce the chance of contracting or spreading brood diseases.

Recommended readings

Shimanuki, H., D. A. Knox, B. Furgala, D. M. Caron, and J. L. Williams. 1992. *Diseases and Pests of Honey Bees*. In: The Hive and the Honey Bee (J. M. Graham editor). Dadant & Sons. Hamilton, Il.

Links **RECOMMENDED BOOKS**

Shimanuki H and DA Knox (1997) Summary of control methods. In Honey bee pests, predators, and diseases. 3rd edition. (ed. Morse and Flottum), Cornell University Press, Ithaca, NY

Shimanuki H, Knox DA, Furgala B, Caron DM and Williams JL (1992) Diseases and pests of honey bees. In: The Hi and the Honey Bee (ed. J. Graham). Dadant and Sons, Hamilton, IL

Honey Bee Diseases & Pests. 2nd edition. Canadian Association of Professional Apiculturists, University of Guelph, Guelph, Ontario, Canada

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