



BEE DISEASES & THEIR CONTROL

MAAREC Publication 4.9
February 2000

This leaflet describes important symptoms, the transmission and control of the three major brood diseases and the one important adult disease of honey bees. The figures and portions of the text are taken from material prepared by the United States Department of Agriculture.

DISEASES OF THE BROOD –

Foulbrood, European Foulbrood and Sacbrood.

American Foulbrood

Cause: *Bacillus larvae*, a microscopic spore-forming bacteria.

Effect: American foulbrood (AFB) is the **most widespread** and the most **destructive** of the **brood diseases**. At first, the strength of an infected colony is not noticeably decreased and only a few dead larvae or pupae may be present. The disease may not develop to the critical stage when it seriously weakens and **finally kills** the colony until the following year, or it may advance rapidly and seriously weaken or kill the colony the first season.

Symptoms: Death of an infected larva usually takes place **after the cell** has been sealed and the cocoon has been spun. First the **capping of the diseased cell becomes moist and darkens in color**. Then as the larva shrinks, the capping is drawn into the mouth of the cell so the **convex capping becomes concave**. Worker bees may puncture this sunken capping and may eventually remove it altogether. At death, the diseased larva changes from a normal pearly white color to a creamy brown, then gradually darkens. These larval remains can be drawn out into a **brown thread or rope**. As the larva dries up, it becomes dark brown. **The final state is a very dark brown, rather rough scale that lies uniformly on the lower side of the cell** and extends from just below the mouth of the cell down to the base. **These scales stick very tightly to the cell and can be removed only with great difficulty**. If death occurs at the pupal stage, the tongue of the pupa (false tongue) protrudes from the scale across the cell. The odor of dead brood is very characteristic and has been described as resembling a glue pot or glue color.

The overall appearance of a comb infected with American foulbrood is patchy (pattern referred to as “shotgun”) because of the intermixed diseased and healthy cells and also because the remains vary from the rosy moist larvae in cells

with dark sunken or perforated capping to the dry scales lying in open cells whose cappings have been chewed away completely by the bees.

Transmission: The spores are fed to young larvae by the nurse bees. They then germinate in the gut of the larva and multiply rapidly, causing the larva to die soon after it has been sealed in its cell. By the time of death of the larva, the new spores have formed. When the house bees clean out the cell containing the dead larva, these spores are distributed throughout the hive and more and more larvae become infected. The honey in an infected colony becomes contaminated with spores and can be a source of infection for any bee that gains access to it. For example, as a colony becomes weak, it cannot defend itself from attacks by robber bees from strong nearby colonies; **these robbers take back the contaminated honey to their own colony** and start again the cycle of infection and robbing. The beekeeper also may inadvertently spread the disease by exposing contaminated honey to other bees or by interchange of infected equipment. Using stored equipment contaminated by spores will lead to a new infection even after years of storage. Moreover, drifting bees or swarms issuing from an infected colony may spread the disease.

Control: Sanitation and elimination of disease reservoirs is a necessity for adequate control of American foulbrood. The traditional control measure is to kill all bees in an affected colony and then destroy bees and their comb by burning. The hive bodies, bottom board and covers can be salvaged by scraping thoroughly and then charring the inside portions and/or boiling in a lye solution.

Ethylene oxide (ETO) combined with a drug treatment has been found to effectively control AFB. ETO gas must be administered under heat and pressure and only a few states have facilities available for treatment with ETO. Contact the Apiary Inspection Service to determine what facilities are available in your state. Maryland and Delaware have used an ETO chambers.

Drug treatment suppresses development of the AFB pathogen. However, treatment does not destroy spores. Larger beekeepers regularly feed drugs as a prophylactic. The drug oxytetracycline (Terramycin) applied as a dust or in sugar syrup or as a grease patty is permitted in most states. No drug should be fed when there is danger of contaminating the honey crop. Follow the directions carefully and do not overdose. Remember that spores may and often do survive

feeding of these drugs and colonies may break down with disease when treatment is terminated.

The proper mixing directions for TM-25 formula is 1 lb. TM-25 to 8 lbs. powdered sugar. Apply 8 tablespoons up to 3 times at 4-5 day intervals. If TM-10 is used mix 1 lb. TM-10 to 2 lbs. powdered sugar. Apply 28 grams up to 3 times at 4-5 day intervals. Terramycin is usually most readily available as TAFSP-terramycin animal formula soluble powder. To apply as a liquid mix 1 teaspoon TAFSP in a 5 lb. pail of 1:1 sugar syrup. Feed 2 quarts up to 3 times at 4-5 day intervals. To apply as a dust mix 1 teaspoon TAFSP to 1 oz. powdered sugar and feed 4 tablespoons up to 3 times at 4-5 day intervals.

European Foulbrood

Cause: *Streptococcus pluton*, a microscopic lancet-shaped bacteria.

Effect: European foulbrood (EFB) is **most common in the spring when brood rearing is at its height**, though usually the earliest reared brood is not affected. Sometimes the disease appears suddenly and spreads rapidly within infected colonies; at other times it spreads slowly and does little damage. European foulbrood may severely weaken a colony but usually does not kill an entire colony. **As a rule, it subsides by mid-summer**, but occasionally it continues to be active during summer and fall or may reappear in the fall. A good honey flow seems to hasten recovery.

Symptoms: Larvae diseased by European foulbrood move restlessly within their cells and, therefore, when they die, are usually twisted in the cells. However, some larvae may be stretched out lengthwise from the top to the base. **The larva collapses as though it had been melted**, turns yellowish brown, and eventually dries to form a loosely attached brown scale. The consistency of recently dead larvae varies but it is **not ropy**. The **odor** of the larval remains also **varies** but it is usually a sour odor. **The scales are loose within the cells** and can be removed readily. Combs containing larvae infected with European foulbrood usually present a rather uniform appearance because the cells are not usually sealed.

Transmission: The organism becomes mixed with the brood food fed to the young larva by the nurse bees, multiplies rapidly within the gut of the larva, and causes death within about 4 days after egg hatch. House bees cleaning out the dead larvae from the cells distribute the organism throughout the hive. Since the honey of infected colonies and the beekeepers equipment are undoubtedly contaminated, **subsequent spread of the disease is accomplished by robber bees, exposure of contaminated honey by the beekeeper, interchange of contaminated equipment** among colonies, and perhaps to some extent, by **drifting bees**. The bacteria is not a spore forming species.

Control: **Requeening** of badly infected colonies usually will help clear up the disease. Moving colonies to areas where

there is a better honey flow or mix of flowering plants also usually decreases disease symptoms. Feeding of the drug oxytetracycline (**Terramycin**) as a **dust** may be necessary in severe cases. Drug treatment must be done in **very early spring** one month or more before the honey flow season. Follow the directions for proper mixing and do not overdrug as brood can be killed with an overdose. Proper colony dosage is 4 tablespoons of TM-25 mixed at the ratio of 1 lb. TM-25 to 8 lbs. powdered sugar. Three feedings at 4-5 day intervals are usually recommended. If the TAFSP (Terramycin Animal Formula Soluble Powder) foundation is used dust 4 tablespoons of TAFSP mixed at the ratio of 1 level teaspoon to 1 ounce of powdered sugar. Repeat 3 times at 4-5 day intervals. The TAFSP formulation can be fed as a liquid but the TM-25 cannot. Feed 2 quarts of a mixture of 1 teaspoon TAFSP in a 5 lb. pail of 1:1 syrup. Repeat 3 times at 4-5 day intervals.

Sacbrood

Cause: A virus.

Effect: Sacbrood is a widely distributed disease, **but it usually does not cause serious loss**. However, the beekeeper should learn to recognize sacbrood so it will not be mistaken for the serious foulbrood diseases.

Sacbrood may appear at any time during the brood-rearing season, but it is most common during the first half of the season. Usually it subsides after the main honey flow starts.

However, the beekeeper should learn to recognize sacbrood so it will not be mistaken for the serious foulbrood diseases.

Sacbrood may appear at any time during the brood-rearing season, but it is most common during the first half of the season. Usually it subsides after the main honey flow starts.

Symptoms: Scattered among the healthy brood are cells containing dead brood. Their **cappings are dark** and may be **punctured or partly removed by the adult bees**.

About the time the cell is sealed, the larva dies. When it does, **the head end turns up like the end of a canoe and remains in that position**; also the pearly white color begins to darken, and the skin then becomes tough and the contents watery. At that stage, the larva, which **resembles a liquid-filled sac**, can be removed from the cell intact; hence, the name sacbrood. The dead larva then continues to dry and harden until the **dried-down scale is almost black**. The head end is usually the darkest. **Scales of larvae dead of sacbrood can be removed from the cell easily.**

Transmission: The virus is probably **fed to the young larva by the nurse bees** in the brood food. It multiplies rapidly within the larva until it causes death. Then the house bees cleaning out the cells probably distribute the virus to other larvae within the hive. The disease is usually limited to one or a few colonies in an apiary.

Control: No known control exists. In severe cases moving the colony or requeening may help. Colonies usually recover from sacbrood without beekeeper aid.

DISEASES OF THE ADULT –

Nosema.

Nosema

Cause: *Nosema apis*, a small, single-celled protozoan.

Effect: Nosema disease is widespread and can cause extensive losses of adult bees. Workers with Nosema disease have a life span shortened by 10 to 40%. There is reduced brood production in a colony affected with the disease. It is also responsible for **supersedure of queens** especially in colonies established from infected package bees. Colonies infected with Nosema have heavier winter losses and there is a decrease in foraging and colonies store less honey. The decrease in honey production may approach 50% of production of healthy Nosema-free colonies. Surveys of Delmarva apiaries have shown that better than 50% of all colonies can be expected to contain detectable levels of Nosema.

Symptoms: **No symptoms are specifically indicative of Nosema.** Inability of bees to fly when they leave the hive, excreta on combs or entrance boards, and a pile of dead bees on the ground in front of the hive may be manifestations of Nosema infection, but they may also be caused by other abnormal conditions. Also, the disease may be present without any obvious signs. However, if crawlers or unusual numbers of dead bees are seen in the apiary or if a colony fails to build up properly in the spring Nosema disease should be suspected. To definitely ascertain whether Nosema disease is present requires microscopic examination of the abdomens of older adult bees.

Transmission: The spores of *Nosema apis* enter the body of the adult bee through the mouth and germinate in the gut. After germination, the active phase of the organism enters the digestive cells that line the midgut of the adult bee where they multiply rapidly. The contents of these cells are used as a food supply until reproduction ceases and new spores are formed. The cell then ruptures and sheds the new spores into the midgut where they pass down through the small intestine to the rectum. Here these accumulate and are voided in the excreta of the bee. The cycle begins over again when the spores contaminate the water or food of other bees. **Spores will remain viable for many months in dried spots of excreta on brood combs.** They lose their viability within a few days in water exposed to direct sunlight, and they are also easily killed by heat and by some fumigants.

Near the end of winter combs are often soiled with excreta dropped by infected workers. Other bees lap up the newly voided liquid excreta or become infected later when they pick

up the spores in the dried excreta as they clean the soiled combs **during the spring expansion of the brood nest.** Thus, at this season, the **disease within the colony increases rapidly** for a time, and a colony may dwindle in the spring because of the premature death of overwintered bees. Usually the colony survives and the proportion of infected bees begins to decline rapidly. This decline occurs because the excreta are normally voided away from the hive when regular flights become possible in later spring. The infected bees no longer transmit the disease by excreta to the other occupants of the hive. Since the old bees now die off and are replaced by healthy bees emerging from the brood combs **the disease is not detectable in the colony by the end of the season.** However, enough spores remain on the combs from the previous winter to infect a few bees in the cluster that forms when winter sets in again. These infected bees then form the nucleus for a repetition of the cycle.

The disappearance of the infection during the summer seems to indicate that outside agencies such as drinking water, flowers, or vegetation are not important in the spread of the disease. Also, the honey is probably not contaminated to any significant degree, since excreta are not deposited on the combs while the cells are being filled and sealed. The spread of Nosema disease occurs chiefly because of the use of contaminated equipment, infected package bees, infected queens and her attendant workers, and the robbing of infected hives.

Control: The drug fumagillin (Fumidil-B) is approved for Nosema control. It should be fed only in a sugar syrup with feeding and mixing directions followed carefully. The recommended feedings is 100 mg. fumagillin (about 1 teaspoon) to 1 gallon of sugar syrup (mix 2 parts sugar to 1 part water). Feed two or three gallons in the fall and a minimum of one gallon to newly installed spring packages. Spring syrup feeding would be 1 part sugar to 1 part water. The drug will not completely eliminate Nosema since the disease spores can survive drug treatment. Proper use of drug chemotherapy has been shown to increase honey yields by as much as 30 to 50 percent.

To eliminate disease spores from bee equipment, treatment in a heated chamber (120°F for 24 hours) has been found to be completely effective. Ethylene Oxide (ETO) fumigation also eliminates Nosema spores when combined with the heat treatment as will acetic acid and heat. Treating equipment followed by treatment of bees with fumagillin is the best method to reduce Nosema losses and promote colony health.

Precautions in Use of Drugs

Treating a colony with drugs does not destroy the disease causing organisms but rather prevents them from multiplying. They also suppress outward manifestations of the disease and disease can reappear after cessation of chemical therapy. Therefore, **USE DRUGS OR ANTIBIOTICS ONLY WHEN NECESSARY.**

DRUGS SHOULD NEVER BE CONSIDERED A SUBSTITUTE FOR GOOD BEEKEEPING. The beekeeper should be able to recognize the various diseases and treat colonies accordingly. The beekeeper should inspect every colony at least two times a year (spring & fall) for disease.

Any drug used may become mixed into honey. **DO NOT ADMINISTER ANY DRUGS OR ANTIBIOTICS DURING A HONEY FLOW OR INTO HONEY SUPERS.** The only time to feed medicinal agents is in the early spring during colony buildup or in the fall after honey supers have been removed.

Use drugs only in the recommended dosage to avoid poisoning of bees and brood. **ALL DRUGS ARE TOXIC IF USED IN EXCESSIVE QUANTITIES.**

COMPARATIVE SYMPTOMS OF BROOD DISEASES

Symptoms	American foulbrood	European foulbrood	Sacbrood
Appearance of brood comb	Sealed brood, Discolored, sunken or punctured cappings.	Unsealed brood. Some sealed brood in advanced cases with discolored, sunken or punctured cappings.	Sealed brood. Scattered cells with punctured cappings, often with two holes.
Age of dead brood	Usually older sealed larvae or young pupae.	Usually young unsealed larvae; Occasionally older sealed larvae.	Usually older sealed larvae; Occasionally young unsealed larvae.
Color of dead brood	Dull white, becoming light brown, coffee brown to dark brown or almost black.	Dull white, becoming yellowish white to brown, dark brown, or almost black.	Grayish or straw colored becoming brown, grayish black, or black. Head end darker.
Consistency of dead brood	Soft, becoming sticky to ropy.	Watery to pasty; rarely sticky or ropy.	Watery & granular tough skin forms a sac.
Odor of dead brood	Slight to pronounced glue odor to glue-pot odor.	Slightly to penetratingly sour.	None to slightly sour.
Character of scale	Uniformly lies flat on lower side of cell. Adheres tightly to cell wall. Fine, threadlike tongue of dead pupa adheres to roof of cell. Head lies flat.	Usually twisted in cell. Does not adhere tightly to cell wall. Rubbery.	Head prominently curled up. Does not adhere tightly to cell wall. Lies flat on lower side of cell. Rough texture. Brittle.

MAAREC, the Mid-Atlantic Apiculture Research and Extension Consortium, is an official activity of five land grant universities and the U. S. Department of Agriculture. The following are cooperating members:

University of Delaware
Newark, Delaware

University of Maryland
College Park, Maryland

West Virginia University
Morgantown, West Virginia

Rutgers University
New Brunswick, New Jersey

The Pennsylvania State University
University Park, Pennsylvania

USDA/ARS
Bee Research Lab
Beltsville, Maryland

Requests for information or publications should be sent to: MAAREC, 501 ASI Building, University Park, PA 16802 Phone: (814) 865-1896 Fax: (814) 865-3048 Web site: <http://MAAREC.cas.psu.edu>

The mention of trade names or commercial products in this publication is for illustrative purposes only and does not constitute endorsement or recommendation by the Mid-Atlantic Apiculture Research and Extension Consortium or their employees.

The U.S. Cooperative Extension Service and the U.S. Department of Agriculture provide Equal Opportunities in employment and programs.

Participants in MAAREC also include state beekeeper associations, and State Departments of Agriculture from Delaware, Maryland, New Jersey, Pennsylvania and West Virginia.

MAAREC Publication 4.9. Original USDA Farmers Bulletin 2255. Adapted by Dewey M. Caron, Univ. of Delaware.

Visit the MAAREC Website at: <http://MAAREC.cas.psu.edu>