European Foulbrood

By the Agriculture and Forestry Bee Health Assurance Team

Background

European foulbrood (Melissococcus plutonius) is a brood disease of honey bees, with near global distribution. In Alberta, European foulbrood (EFB) is listed as a bee disease under the Alberta Bee Regulation. Typically, symptoms of EFB arise early in the season, and spontaneously resolve with a strong nectar flow. In 2018 and 2019, the reported occurrence of EFB in Alberta was more widespread and prolonged than usual. The AF Bee Health Assurance Team received a number of calls regarding these outbreaks, and responded by inspecting colonies suspected to have EFB infections. In some of the colonies that were infected, we observed symptoms not commonly associated with EFB in Alberta. As a result, samples were sent to the National Bee Diagnostic Centre in Beaverlodge for EFB confirmation. In addition, we contacted beekeepers near the infected colonies to assess the regional severity and scale of the outbreak.

With the new federal anti-microbial use legislation and unpredictable spring weather across the province, it is critical that beekeepers are familiar with the distinguishing symptoms of EFB and methods for its control and treatment.

What is EFB?

Unlike American foulbrood, EFB is a disease caused by non-spore-forming bacteria that infect the digestive tract of honey bee larvae. Larvae younger than three days old are most susceptible to EFB infection, and infected larvae usually die at four or five days of age, before the cell is capped. In this case, the bees may remove the larvae from the colony and eliminate the majority of the bacteria contained within the cadaver, helping to minimise the spread of the disease. However, death of infected larvae can also occur after the cell is sealed. It is important to note that not all larvae infected with EFB will die from the disease, but the ones that do survive often emerge as underweight adults due to competition for nutrients with the bacteria. EFB is spread within a colony by nurse bees feeding larvae contaminated food, or bacteria present in the cells after an infected pre-pupa defecates in a cell. Once the adult bee emerges, the cell is cleaned, and the bacteria are passed on to other larvae or left on the cell wall.

What makes this disease unique and difficult to visually diagnose is its association with secondary bacteria that colonize the dying larvae. In addition, diagnosis can be complicated by uncharacteristic visible symptoms caused by other EFB bacterial strains. The specific mechanism through which EFB kills larvae remains inconclusive, but the leading theory is that the bacteria outcompete the young larvae for nutrients, leading to starvation. There is also some recent evidence that in some cases secondary infections or damage to vital tissues may be the cause of larval death.

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Causes and Symptoms

EFB is a complex disease, and its symptoms can be confused with other common honey bee diseases including sacbrood (a virus), AFB (a bacteria), or even early-stage chalkbrood (a fungus). In 2019, the AF Bee Health Assurance team observed unusual symptoms of EFB in many colonies. In addition to typical symptoms of EFB (below) we saw increased incidences of 'melted' or 'deflated' larvae, infected larvae of a broad age range, including post-capping, and large numbers of EFB infected cells in a colony. EFB bacteria can be present in a colony that shows no visible symptoms, particularly if antibiotics were used as a routine part of colony management. Additionally, a strong or hygienic colony may remove infected larvae before clinical signs can be detected. Diseased colonies that are starving can also lose the symptoms, because the infected larvae are ejected. As a result, frequent monitoring of brood frames is important in late spring when EFB outbreaks are most common.

The cause of EFB outbreaks is still up for debate but it is likely a number of factors interacting at once. Nutritional deficiencies caused by weather, poor forage (specifically pollen quality), or a lack or nurse bees contributes to the spread of the EFB bacteria in a hive. Visible symptoms are often observed when a period of poor forage is followed by the onset of a strong flow. Before the strong flow, the small amount of brood is well-fed and the infected bees survive, spreading the bacteria throughout the colony. When brood rearing suddenly increases at the onset of a strong flow, there can be a shortage of food and nurse bees. As a result, infected larvae do not survive to pupation; instead, they become visibly symptomatic. EFB symptoms can persist when honey and pollen flows are variable, but typically clear up when the flows are continued and strong, as long as weather is conducive to foraging. However, EFB can be present even during strong flows depending on the time of the year and strength of the colony. Other factors that may contribute to EFB outbreaks include: lack of water, transportation of bees, larval immune response, genetics and other environmental factors, and it is often considered a stress-associated disease.

Symptoms of EFB

- Visibility and appearance of symptoms depends on dis ease stage and infection level, and colonisation by secondary bacteria.
- A spotty brood pattern.
- Dead and dying larvae.
- If the cell is capped, the capping may look sunken or perforated, similar to AFB. However EFB infected larvae are watery and will only rope less than 1.5 cm when drawn out with a toothpick.
- Larvae will begin to change from pearly white to yellow in colour, then to grey and eventually a brownish-black colour. Segmentation may not be visible.
- The midgut of infected larvae may appear chalky white, compared to a healthy midgut, which is yellow-orange. The tracheae may also be visible in each segment of the bee.
- Larvae may become twisted or stretched in the cell and will move from the characteristic "c" shape at the "bottom" of the cell.
- Once an infected larva dries out, it can form a scale or plaque on the cell walls. This plaque is easy to remove, unlike AFB, and lighter in colour than typical AFB scale.
- The detection of a foul odour is not a reliable diagnostic feature of EFB. The presence of an odour would be dependent on colonisation by secondary bacteria.

IPM Strategy for EFB

Prevention

- Frequently monitor colonies for diseases and practice good sanitary management practices.
- Select bees from stocks that exhibit hygienic behaviour.
- Supplement colonies with protein when the weather is un predictable, during a dearth, and especially when moving from apiaries or time periods of high food availability to low food availability. Ensure there are adequate food reserves and nurse bees to care for the amount of open brood in the colony.
- Cycle out old brood frames every 3-4 years. Although EFB is not spore-forming, it can remain viable in the comb for a number of years. Getting rid of old frames can reduce the bacterial load in the colony, even when visible symptoms are not apparent. Ensure the equipment and frames are properly disposed of to reduce disease transmission.
- Be cautious when transferring equipment and combs between hives, specifically if colonies were historically treated with antibiotics. Colonies might not show clinical signs of EFB, but you might be unknowingly spreading the disease.
- Remove symptomatic colonies and dead-outs from apiaries to reduce robbing and transmission of EFB and other diseases.

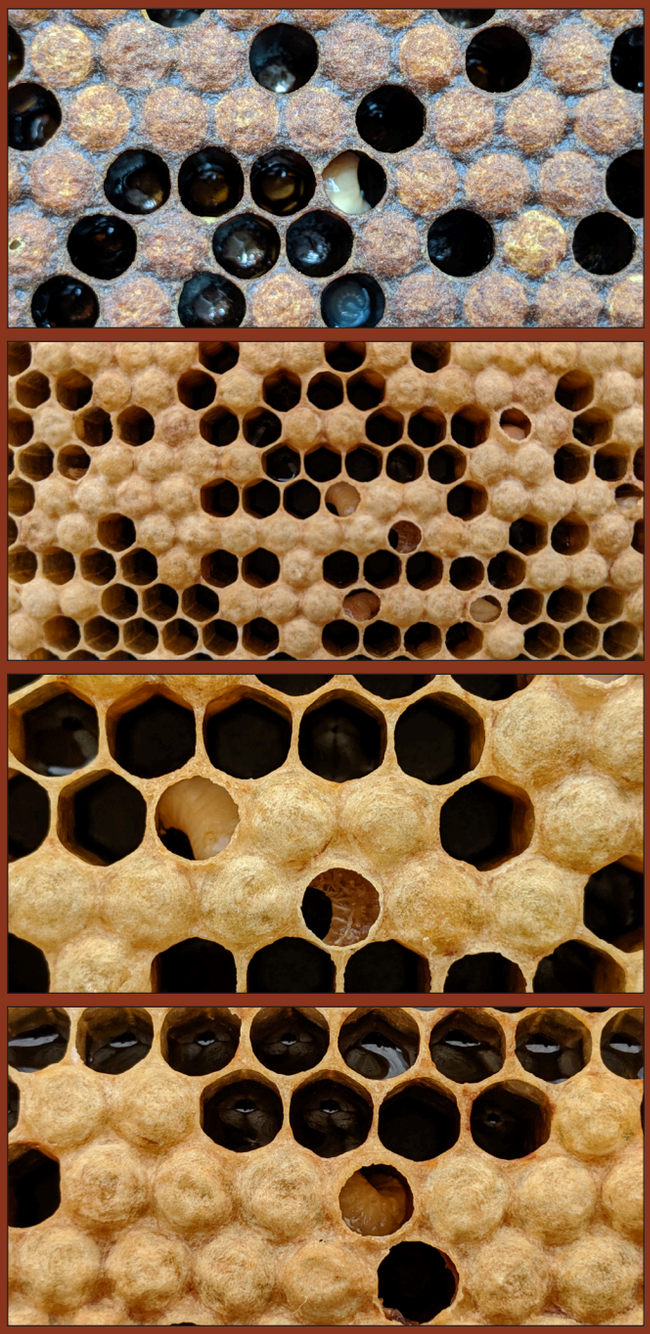

Photo Credit Andony Melathopoulos

Control

- Remove frames with clinical signs of EFB and dispose of them appropriately to reduce transfer of diseases.
- If EFB infection is severe, burn your infected colonies.
- Irradiate your comb (min. 15 kGy of radiation, compared to 10 kGy for AFB).
- Use the 'Shook Swarm' method for light infections. Keep in mind this method is only available as a control method until July.
- The use of registered antibiotics should be restricted and only used on strong colonies and under the direction of your veterinarian
- Quarantine swarms to ensure they are disease-free before placing them in an apiary.

Do you think your bees have EFB?

- Check out the Government of Alberta **Bee Health App** (found on Google Play or the App store). Here you can review diseases or send pictures to our office if you need help identifying EFB or other diseases

- Call or Email the Bee Heath Assurance team, and request an inspection
  - Email: Bee@gov.ab.ca, Call: 780-644-8746
  - Check out our website for more information: www.alberta.ca/bees-and-apiculture.aspx

- Contact your Veterinarian