

The History of Treatments for European Foulbrood

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European foulbrood (EFB) is a statutory notifiable brood disease of honey bees caused by the gram-positive bacterium *Melissococcus plutonius* (Figure 1). National Bee Unit (NBU) inspectors actively search for EFB in a priority-based inspection programme, based on the risk of disease. The Bee Diseases and Pests Control Order 2006, as amended, empowers the NBU inspectors to take appropriate measures to control EFB, and once disease is confirmed, the inspectors follow strict operating procedures for the safe treatment or destruction of colonies.

Further information on EFB and the legislation governing the statutory notifiable bee pest and diseases, can be found on the NBU website, BeeBase, at <https://www.nationalbeeunit.com>. For more information on the number of cases of foulbrood, BeeBase also holds historical data on disease incidence and the number of colonies inspected since 1952. These data can be found on the 'Disease Incidence' pages of BeeBase and show that the number of detected cases of American foulbrood (AFB) have decreased, while the number of cases of EFB have increased since the late 1980s.

Approaches to control EFB infections

Various control strategies have been used against EFB infections over the years, which are described briefly below.

Oxytetracycline

Light infections of EFB have traditionally been controlled with the use of the bacteriostatic antibiotic, oxytetracycline (OTC). OTC was applied, by NBU inspectors, to colonies as a single dose of 1g of OTC suspended in a sugar solution of 1kg sugar/568ml water. The antibiotic suspension was trickled from a honey jar with a modified lid onto brood frames on the edge of the brood nest, before being spread around the colony by the adult bees.

Shook swarm

Shook swarm involves the removal of infected brood and comb material from the colony, thereby removing a large reservoir of infective disease and forcing a brood break. Although shook swarm has now essentially replaced OTC as a non-destructive control measure in England and Wales, the 'shaking' technique was used widely for AFB infections before the advent of antibiotics.¹

During the shook swarm procedure, the adult bees from infected colonies are shaken onto clean hive equipment that is either new or sterilised by scorching with a blowtorch. All parts of the hive; the floor, the boxes, the crown board, the feeder and queen excluder, must be clean and scorched or new. New frames, containing wax foundation, are placed into the new brood box, leaving a central gap for the bees to be shaken into (Figure 2). Infected frames are then shaken above the new hive so that the adults fall into the new box containing foundation frames (Figure 3). Ideally, the queen is first isolated before being introduced to the new colony separately, to avoid damage during shaking. The new colony is then fed with a sugar solution, about nine litres, in order to allow the bees to draw out the new comb. In order to avoid the bees absconding from the new hive, a queen excluder can be placed between the bottom of the brood box and the floor. The excluder can then be placed on top of the brood box once brood is seen in the colony. All of the frames from an infected colony are destroyed

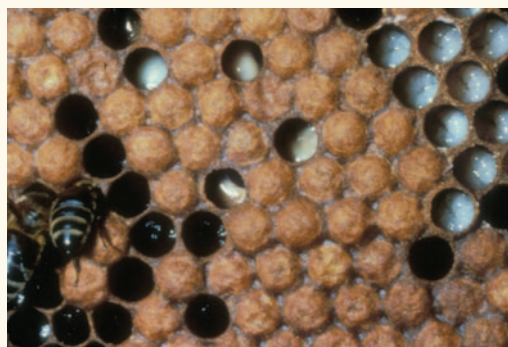


Figure 1. Open larvae displaying symptoms of European foulbrood. Courtesy The Animal and Plant Health Agency (APHA), Crown Copyright.



Figure 2. Bees are shaken into a clean box containing new frames of wax foundation during a shook swarm. Courtesy The Animal and Plant Health Agency (APHA), Crown Copyright.



Figure 3. Infected frames are shaken into the new hive during a shook swarm. Courtesy The Animal and Plant Health Agency (APHA), Crown Copyright.

by burning and all other hive equipment scraped clean and scorched. In the case of polystyrene hives, the equipment is sterilised by twenty minutes immersion in a 0.5% sodium hypochlorite solution (bleach). The NBU can issue movement licences for beekeepers to extract honey from the supers on the basis that all frames and cappings are returned and destroyed.

Although some infective bacteria will remain on the adult bees that are shaken into the new colony, the operating principle of shook swarm is that the infective agent is reduced below the threshold for disease^{2,3} by the time brood is present in the new colony.

Destruction

Colonies displaying very heavy EFB infections are destroyed via burning. Colonies are first killed by pouring a small amount of petrol into the colony; it is the fumes that kill the colony. After a short time, the bees will be observed dead under the crown board. All of the frames and dead bees are then placed in a deep fire pit for destruction (Figure 4). As with shook swarm, supers can be moved for honey extraction under a movement licence issued by the NBU. The boxes and other hive equipment can be scraped clean and scorched with a blowtorch or sterilised with 0.5% sodium hypochlorite solution in the case of polystyrene hives.

Changes in control policy

OTC has been used for the treatment of colonies with light EFB infections since 1967. However, the use of OTC has now drastically reduced, with the vast majority of EFB infections in England in Wales now being controlled by shook swarm or destruction.

Reoccurrence

The chances of EFB reoccurring are approximately five times higher in colonies treated with OTC compared to those with shook swarm. Reoccurrence rates of 21–22% have been demonstrated in the subsequent year after treatment with OTC.^{4,1} Reoccurrence rates in colonies treated with the shook swarm procedure are relatively low at 4%,¹ and similar to the 5% reoccurrence rates of colonies treated with both shook swarm and OTC.⁴ This is perhaps unsurprising as OTC is bacteriostatic (which prevents bacteria multiplying but does not kill them) rather than bactericidal (which does kill bacteria) and therefore it does not clear the infection. Shook swarm on the other hand, removes a large reservoir of the infective bacteria from the colony.

Residues in honey

Antibiotic residues pose an obvious risk to consumers if honey is extracted from colonies treated with OTC and enters the food chain. Previous work investigating the residues remaining in honey after the application of OTC in powder or suspension, found that residues can persist for up to 32 weeks.⁵ A withdrawal period of six months was therefore recommended before beekeepers could sell honey from colonies that have been treated with OTC.

Toxicity to brood

A further consideration when treating with OTC is the antibiotic's toxicity to open brood. Significant brood mortality, of up to 48%, can be seen in developing brood after OTC has been applied to colonies.⁶

Whole apiary shook swarm

In recent years, some beekeepers have opted to perform the shook swarm procedure on all colonies within an apiary once EFB has been found. The rationale behind this approach is that asymptomatic colonies in infected apiaries, or 'contact colonies', can carry *M. plutonius*.¹ Contact colonies could therefore develop the disease or act as infective reservoirs for other colonies in the apiary.



Figure 4. Destruction of infected material in a deep fire pit, courtesy The Animal and Plant Health Agency, Crown Copyright.

The NBU is collaborating with Bee Diseases Insurance Ltd in a two-year trial to assess the effectiveness of the 'whole apiary shook swarm' approach for controlling EFB. Participating beekeepers can opt to shook swarm all colonies in infected apiaries. These field data will provide valuable information on reoccurrence rates in apiaries that have undergone the whole apiary shook swarm procedure. Further information can be found on the Bee Diseases Insurance Ltd website at <https://www.beediseasesinsurance.co.uk/research/efb-whole-apiary-shook-swarm-trial>.

References

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Key Points:

1. European foulbrood (EFB) is a statutory notifiable brood disease of honey bees.
2. The main approaches to treatment of a light EFB infection are oxytetracycline (OTC), administered by NBU inspectors, and shook swarm, carried out by beekeepers. Colonies with heavy EFB infections are destroyed.
3. Reoccurrence rates after OTC treatment are 21–22% and after shook swarm, 4%.
4. Disadvantages of OTC treatment include:
 - toxicity to brood, resulting in mortality of up to 48%
 - OTC presence in honey for up to 32 weeks, impacting on honey sales
5. A two-year trial is underway to assess the value of whole apiary shook swarm when an EFB infection is detected.