Animal &
Plant Health
Agency

The National Bee Unit

Foulbrood Disease of Honey Bees

and other common brood disorders

Pollination

Pollinating insects provide almost incalculable benefits to humans, flowering plants and wildlife. Pollination by bees and other insects is the first step in the fruiting process, resulting in the production of many vegetables and fruits. It is estimated 35% of the human diet is made up of plant material pollinated in this way. The production of 84% of crop species cultivated in Europe depends on pollinators to some extent; 70% of the 124 main crops used directly for human consumption in the world are dependent on pollinators[1].

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This document is also available on BeeBase (National Bee Unit) website: www.nationalbeeunit.com

About this leaflet

Foulbrood disease of honey bees and other common brood disorders

Honey bee colonies are subject to a number of diseases that affect their brood. This leaflet describes the recognition and control of the two most serious of these, American foulbrood and European foulbrood, which are subject to statutory control, along with other common but less serious brood disorders.

Acronyms

AFB	American foulbrood
APHA	Animal and Plant Health Agency
BBKA	British Beekeepers' Association
BDI	Bee Diseases Insurance Ltd
BFA	Bee Farmers' Association
CBPV	Chronic bee paralysis virus
Defra	Department for Environment, Food and Rural Affairs
DWV	Deformed wing virus
EFB	European foulbrood
IPM	Integrated pest management
ISO	International Standards Organisation
LFD	Lateral flow device
NBI	National Bee Inspector
NBU	National Bee Unit
RBI	Regional Bee Inspector
SASA	Science and Advice for Scottish Agriculture
SBI	Seasonal Bee Inspector
SS	Shook swarm
WBKA	Welsh Beekeepers' Association
WG	Welsh Government

Contents

Help and advice

The National Bee Unit

The National Bee Unit (NBU) provides a statutory and advisory service to beekeepers in England and Wales. It operates the Bee Health Programmes on behalf of the Department for Environment, Food and Rural Affairs (Defra) and Welsh Government (WG).

Most staff are trained practical beekeepers, as well as scientists, and are supported by teams of specialists across the rest of the Animal and Plant Health Agency (APHA) and Fera Science Limited.

The inspectorate comprises of a network of fully trained Bee Inspectors who operate to the ISO 17020 quality standard to deliver statutory inspections for disease; and also manage an apiary surveillance programme for exotic pests. Bee Inspectors provide free advice and assistance to beekeepers on a range of bee health issues and run training courses for beekeepers on disease recognition, disease control and good husbandry, often in conjunction with local Beekeeping Associations. Bee Inspectors also assist with field trials for a range of Bee health research projects. The NBU works in partnership with many universities and organisations, both in the UK and overseas, to achieve shared research goals.

Scientific and diagnostic support is provided by Fera Science Limited. Fera Science Limited are the UK National Reference Laboratory (NRL) for bee health; an EU-wide network of laboratories that develop standards for methods in bee health and research. The honey bee diagnostic laboratories work to a high professional standard and are fully compliant with the ISO 17025 quality standard for foulbrood diagnoses.

For further information, visit the NBU's BeeBase website key contacts pages: www.nationalbeeunit.com/contact-us/.

BeeBase

BeeBase is the NBU's website and database, which contains all the apicultural information relating to the statutory bee health programmes in England and Wales. In June 2010, the information for the Scottish inspection programme was also incorporated into BeeBase. The website allows beekeepers to register their bees, report if they have *Varroa* and it contains a wide range of beekeeping information, such as the activities of the NBU, the bee related legislation, pests and diseases information including their recognition and control, interactive maps, current research areas, publications, advisory leaflets and key contacts. To access this information, please visit the website: www.nationalbeeunit.com. Many beekeepers find this website to be a useful source of information and advice. In addition to the public pages, registered users can view their own records and details.

Why is it so important to register on BeeBase?

As well as containing useful information on beekeeping, BeeBase is a vital tool in the control of bee disease and pests. Where statutory pests or diseases (for example, foulbrood) are confirmed, the NBU uses BeeBase to identify apiaries at risk in the local area and, as a result, conduct surveillance and target control measures effectively. By knowing where colonies are, we can help you manage disease risks in your apiaries. Such risks include the incursion of serious exotic pest threats such as the small hive beetle, Tropilaelaps, and the yellow-legged hornet. The more beekeepers who are registered, the more rigorous our bee health surveillance is and, crucially, the better our chances of eliminating pests and diseases that pose a threat to our native species.

How to sign up to BeeBase

If you are not yet registered, please visit the public pages of BeeBase where you can sign up online: www.nationalbeeunit.com. Otherwise, you can get in touch with the NBU office team who will be happy to help. You can email us at: nbu@apha.gov.uk or contact us by telephone on: +44 (0) 300 303 0094. By telling us where you keep your bees, you will be playing an important part in helping to maintain and sustain honey bees for the future.

How do I know that my details will be secure?

All the information that you provide for the purposes of registration on BeeBase is covered by the Public Service Guarantee on Data Handling. In addition, all data will be handled according to rules stated in the UK GDPR & Data Protection Act 2018. A copy of our Data Privacy Notice can be found on BeeBase. All levels of access to BeeBase are protected in a similar way to online banking. Your personal access is password protected. When you first register, you are allocated a temporary password, which is valid for your first visit only. You will then be prompted to set your own password. You need to ensure that your own password remains confidential. You will also be allocated a personal ID number, which relates solely to you. As a personally registered beekeeper, once you have received an inspection visit, you can view and check your own record on BeeBase. NBU personnel have access to records for the purpose of delivering the bee health programmes, but no member of NBU staff will ever disclose to others that you have been inspected or any details about your bees or beekeeping without your consent. No member of the public has access to your, or other beekeepers' details.

Beekeeping Associations

In many areas, Beekeeping Associations operate disease training schemes and provide practical advice and advisory leaflets to members on bee disease recognition and management. Contact your local Beekeeping Association for details:

England
British Beekeepers' Association
www.bbka.org.uk

Scotland
Scottish Beekeepers' Association:
https://scottishbeekeepers.org.uk

Wales
Welsh Beekeepers' Association:
www.wbka.com

The Bee Farmers' Association
www.beefarmers.co.uk

Bee Diseases Insurance Ltd

An insurance scheme to compensate against colony losses incurred through destruction of foulbrood infected colonies, or colonies infested with the exotic pests, small hive beetle or Tropilaelaps, is organised by Bee Diseases Insurance Ltd (BDI). BDI is a specialist insurance company operating with the aim of reducing the incidence of the foulbrood diseases. Beekeepers can take out insurance with them, either individually or through their local Beekeeping Associations.

Honey bees and disease

Honey bees play a vital role as pollinators of agricultural crops and many wild flowers. The total economic value of pollination worldwide is in excess of €1.5 billion every year — a figure that corresponds to almost 10% of the value of world agricultural production. The economic value of insect crop pollination (including honey bees) in the UK is estimated at £500m annually; and this is in addition to the income from honey, beeswax and other hive products. The contributions of pollinating honey bees to biodiversity and the sustainability of a myriad of natural landscapes are unmeasured but are very significant. These essential and profitable activities depend upon beekeepers maintaining a healthy population of honey bees.

As with other forms of livestock, honey bees are subject to a range of harmful diseases. Some of these affect adult bees; others affect immature stages of the bees' development (larvae and pupae). The latter are referred to as brood diseases. There are several such brood diseases that affect honey bee colonies in the UK.

For more information on other diseases and pests of honey bees, please refer to our other advisory leaflets:

www.nationalbeeunit.com/resources-for-beekeepers/leaflets-guides-and-videos/advisory-leaflets2/

These include the two extremely serious and infectious foulbrood diseases, which are subject to statutory control, together with a range of common and less harmful disorders.

Foulbrood

The term 'foulbrood' covers two diseases of honey bee larvae: American foulbrood (AFB) and European foulbrood (EFB). The names bear no relation to the geographical distribution of the diseases: both occur in Great Britain and result in considerable economic damage to the beekeeping industry every year. American foulbrood is considered the most destructive brood disease in Great Britain. However, European foulbrood is more widespread, and, where it occurs, often spreads rapidly and is difficult to eradicate unless prompt measures are taken.

Minor brood diseases

There are several other brood diseases and disorders that, although much less serious than foulbrood, are widespread. It is essential to be able to recognise these and distinguish them from foulbrood, so the most common UK brood diseases and disorders will also be explored in this leaflet.

Varroa and exotic pests

As well as diseases and disorders of brood, there are various parasites and pathogens that affect adult bees. Adult bee diseases, infestation of honey bee colonies by the parasitic mite *Varroa destructor*, the exotic mite *Tropilaelaps* spp. and the exotic small hive beetle, *Aethina tumida*, are subjects of separate leaflets. Click on the link below the QR code to view these leaflets.

You will also find identification sheets and further information on monitoring for the yellow-legged hornet, *Vespa velutina.*

UK bee disease legislation

Both AFB and EFB are subject to statutory controls in the UK. The Bee Diseases and Pests Control (England) Order 2006 (SI 2006 No 342), empowers the Department for Environment, Food and Rural Affairs (Defra) to take measures to control both diseases in England. There are separate orders in Wales, Scotland and Northern Ireland. Beekeepers should be familiar with the provisions of the order. This order was amended in 2021 to require the reporting of the presence of *Varroa* in colonies. Copies of the order are available online from the Office of Public Sector Information (OPSI) (www.opsi.gov.uk).

The NBU operates a statutory apiary inspection and surveillance programme in England and Wales. Inspectors examine bee colonies for foulbrood, free of charge. When foulbrood disease is suspected, a sample (a symptomatic larva) is tested using a rapid diagnostic field test kit known as a Lateral Flow Device (LFD). Samples are submitted for laboratory analysis. If disease is suspected and subsequently confirmed, a 'standstill notice' is issued, prohibiting the removal of bees and equipment from the apiary. The inspector will then carry out the necessary disease control measures.

Any beekeeper in England or Wales who suspects the presence of either AFB or EFB in a colony for which they are responsible is **legally required** to contact The Animal and Plant Health Agency's NBU in order to have the colony officially examined by an APHA Bee Inspector. Beekeepers in Scotland who suspect the presence of AFB or EFB should Bees_Mailbox@gov.scot.

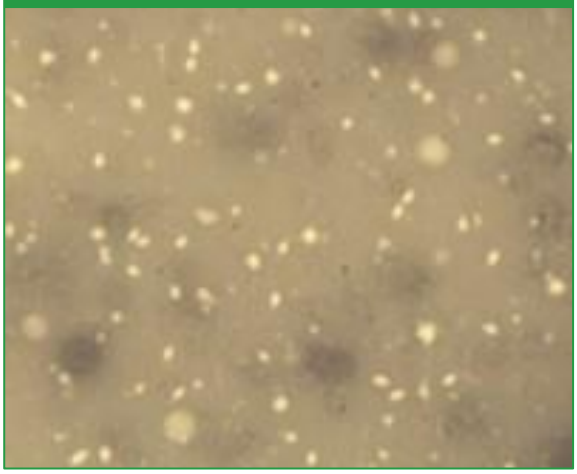
Beekeepers should also place the apiary in which foulbrood is suspected under a 'self-imposed' standstill.

Foulbrood and your responsibilities under the law

- ! It is a legal requirement to contact the NBU when either AFB or EFB is suspected in a colony of honey bees (contact Bees_Mailbox@gov.scot in Scotland)
- ! It is illegal to remove bees or equipment from an apiary that is under a standstill notice
- ! Application of antibiotics to honey bee colonies by unauthorised individuals is illegal in the UK

Figure 1: A frame is carefully inspected for signs of foulbrood

Figure 2: EFB bacteria under the microscope (x 1000) in the laboratory



What is European foulbrood?

Cause

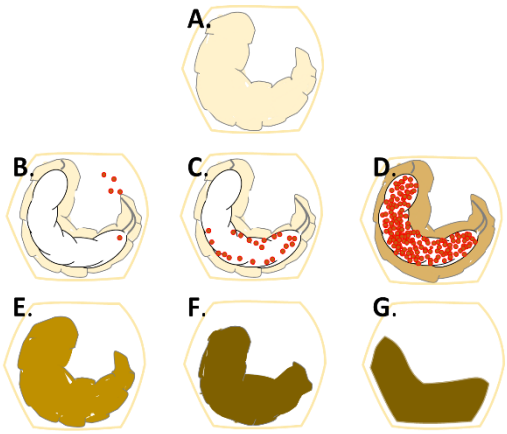
European foulbrood (EFB) is caused by the gram-positive bacterium, *Melissococcus plutonius*. The bacteria are a gut pathogen and cause the death of some proportion of the larvae they infect. EFB does not kill 100% of infected larvae but may kill more or less depending on the strain of the bacteria that is infecting the colony. Some strains are very virulent, but many strains, like most of those found in the UK, are less virulent. However, lower virulence infections aren't necessarily less bad, as they can lead to low-level or recurring infections.

Secondary invaders may multiply on the remains of the larvae but are harmless to healthy bees[2]. These may include bacteria such as *Paenibacillus alvei, Enterococcus faecalis* and *Achromobacter eurydice.*

Disease progression

At the individual level: A healthy larva (Figure 3a) becomes infected when bacteria enter the digestive tract through contaminated brood food. Figure 3b to 3d show a cross section of the gut; the bacteria, shown as red dots in the figure, multiply inside the gut (Figure 3c) until the gut is filled with a mass of bacteria (Figure 3d). This bacterial mass prevents the larva from acquiring sufficient nutrition from its diet, often leading to its eventual death by starvation. Death usually occurs at four to five days of age, before cells are sealed. Once a larva dies, it begins to turn yellow and lose its healthy segmentation pattern (Figure 3e). The larval remains will then begin to decompose and dry up which will lead to dark brown remains (Figure 3f) and, at later stages, the appearance of dark semi-circular shaped larval remains called 'scales' (Figure 3g).

Figure 3: Disease process of EFB in an individual infected larva (bacteria in red)



At the colony level: The development of the disease within a colony is complex and not fully understood. It appears that infection can develop over a period of months or years, often debilitating, but not killing the colony. During this time, signs of the disease may become more or less severe or seem to disappear altogether. Frequently there is a seasonal pattern, with signs becoming more obvious in late spring. This is thought to be caused by a large number of larvae relative to the number of nurse bees in the colony, resulting in larvae tending to receive less brood food overall; those infected with EFB are more likely to suffer from starvation. At other times, larvae that are infected, but receive an abundance of brood food, may survive the infection and develop into healthy adult bees. However, when such larvae pupate, they void their gut contents into the cell, contaminating the comb with millions of infectious bacteria. Eventually, the disease is likely to reach the stage where a high proportion of the brood is affected, and the colony will be weakened and ultimately die.

Recognising signs of EFB

- EFB mainly affects unsealed brood, killing larvae before they are sealed in their cells. A good way to remember this is **E**FB = '**E**' as in 'Early'; before the cell is capped.

The early stages of disease:

- In the early stages of disease, larvae will lose their pearly white appearance and turn yellow (Figure 4).
- The larval gut will fill with bacteria. The black arrow in Figure 5 shows a small creamy mass in the larval gut; this is the bacterial mass.
- As the bacteria multiply, this mass expands and may take up most of the gut, as seen in Figure 6. Figure 6 shows a large creamy mass (black arrow); the bacterial infection is more extensive is this larva (Figure 7 shows a zoomed in version).

Figure 4: A healthy larva (top left) compared to yellowing EFB larvae

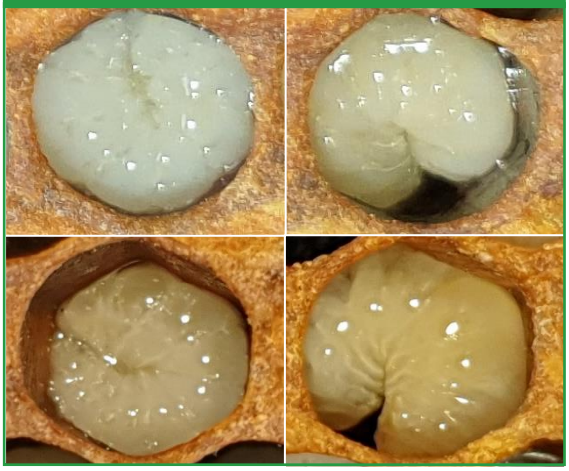


Figure 5: Creamy-coloured mass from the gut of an EFB infected larvae

Figure 6: This EFB infected larva has a bacterial mass in its gut

Figure 7: A close up shows the creamy bacterial mass filling the larval gut

The later stages of disease:

- Healthy larvae are pearly white and sit in a healthy ‘C’ shape (Figure 8), but EFB infected larvae turn yellow and may look twisted in their cells (Figure 9).
- As the disease progresses, larvae that have died from EFB lose their normal segmentation pattern and begin to look ‘melted’ (Figures 9 and 10).
- After dying, the larval remains will turn yellow, then brown (Figure 10).
- As dead larvae decompose further, they dry out and turn into a brown scale, which has a rubbery consistency, and can be easily removed from the cell (Figure 11).
- Sometimes infected larvae die after they are sealed. When this happens, there may be perforated cell cappings, where the nurse bees have detected the disease and investigate.
- When there is a heavy infection with EFB, the brood pattern will become patchy and erratic as dead brood is removed by the nurse bees.
- In cases where larvae die after the cells are sealed, there may be sunken perforated cappings resembling AFB infection. However, although brown and sticky, the cells’ contents cannot be drawn into a ‘rope’ as with AFB (Fig 20).

Figure 8: Healthy larvae are pearly white and sit in a ‘C’ shape in their cells

Figure 9: These EFB infected larvae look twisted in their cells

Figure 10: EFB infected larvae melt down and turn from yellow to brown

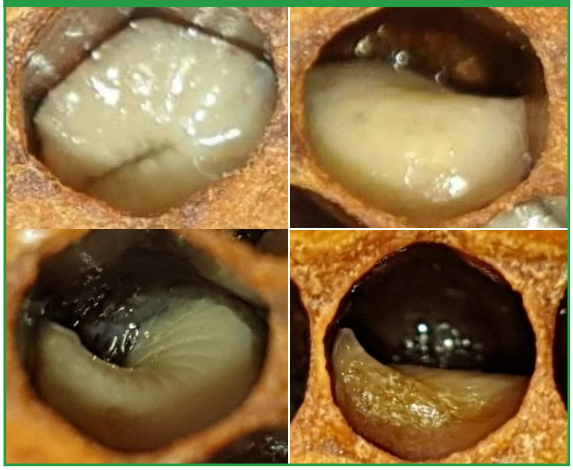


Figure 11: This dark brown scale is the remains of a larva that died from EFB

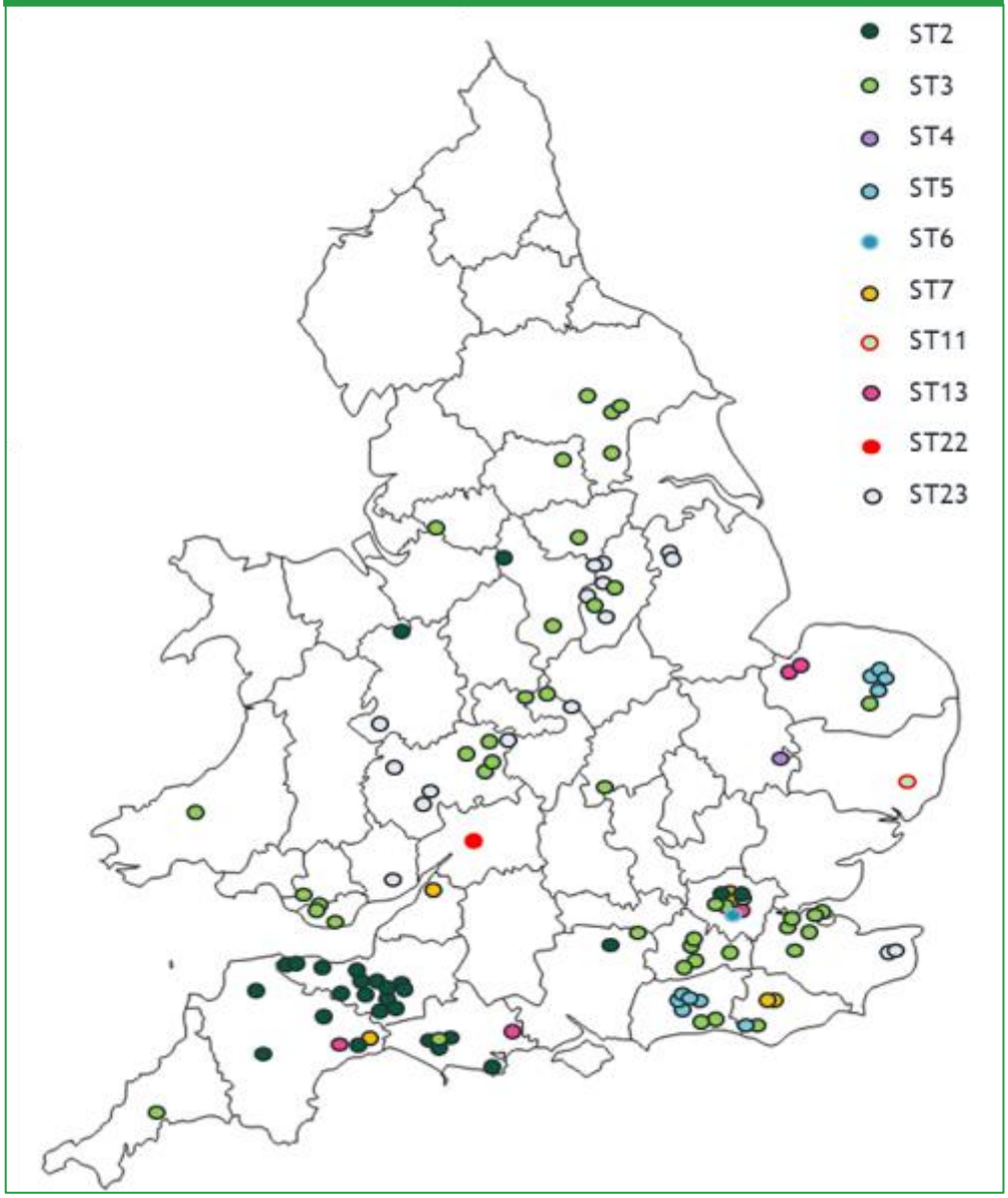
Distribution

Although referred to as ‘European’ foulbrood, EFB is widespread throughout Europe, North and South America, Russia and some Asian countries. It is found throughout the UK, with variation in regional distribution. For example, there are often more cases in south and central England than the north of England (Figure 12).

The risk of contracting EFB is significantly increased if the disease is present nearby, especially if it is within 1 km. The risk is higher the closer to the outbreak that an apiary or colony is sited[3]. In the UK, the data from outbreaks is publicly available and can be viewed on BeeBase on our live EFB report page.

Beekeepers who are signed up to BeeBase will receive email alerts if EFB is in their region, so they can take preventative action by increasing colony checks (see page 29) and hygiene measures (see pages 27 and 28).

Figure 12: An example of EFB distribution in England and Wales in a year. Different coloured circles represent different strain types of EFB



Diagnosis

EFB cannot be definitively diagnosed from a visual inspection, as the signs of disease may be caused by other brood disorders. Suspect infections must be reported to NBU inspectors, who will make a primary confirmation in the field, using a lateral flow device (LFD).

The samples taken will then be send back to the laboratories at Fera Science Ltd (Fera) for official confirmation of EFB. Occasionally, multiple samples, or a brood comb, may be sent to the laboratory for examination.

Samples sent to the laboratories at Fera are then analysed to determine which strain of EFB is infecting the colony. This data forms part of ongoing research into the distribution of different EFB strains around the UK.

Transmission

EFB can be transmitted in a variety of ways:

- **Bees**: EFB can be transmitted between colonies by the bees: robbing or drifting, or via swarms.
  It can be transferred into apiaries through the sale of infected package bees or nucs.
- **Frames**: EFB may be present in wax, pollen or honey, so can be transmitted between colonies or apiaries through transfer of infected hive materials.
- **Clothing, tools & boxes:** EFB may be present on the surface of clothing, tools, boxes or other equipment. In this way EFB can be inadvertently transferred between colonies or apiaries.

Figure 13: The bacteria that cause EFB may be transmitted by honey, wax and pollen, by the bees themselves, or on the surface of tools and equipment

What is American foulbrood?

Cause

American foulbrood (AFB) is caused by a spore-forming bacterium called *Paenibacillus larvae.* As with EFB, these bacteria are a gut pathogen, but unlike EFB, AFB is extremely virulent and will kill 100% of infected larvae. Some rare strains kill larvae within two to three days, but UK strains usually take around twelve days to kill larvae[4].

AFB can form spores. Spores are a dormant form of the bacteria that are very resilient in the environment and can survive extremes of temperature and humidity. This means that AFB spores can be difficult to eliminate.

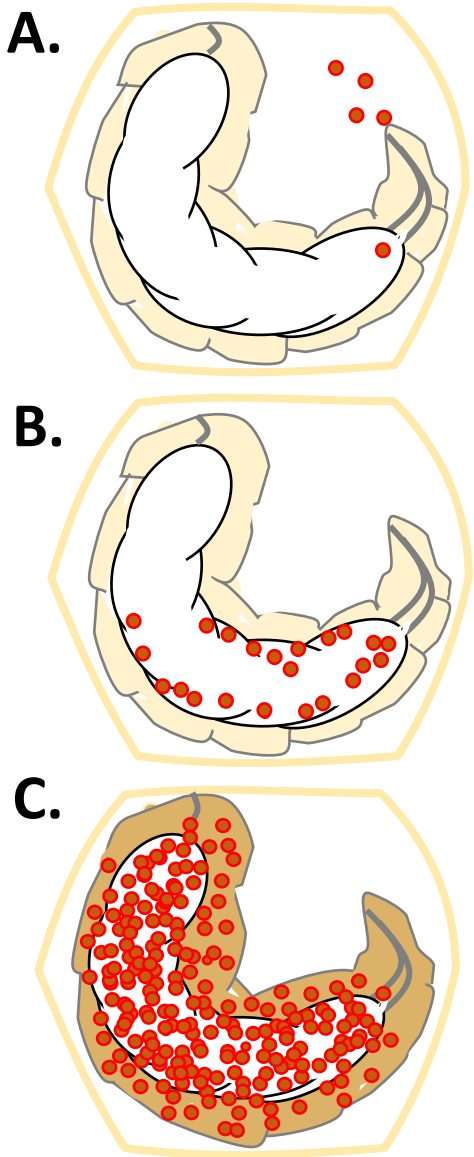
Disease progression

At the individual level: Young honey bee larvae become infected when they consume *P. larvae* spores in their food. They are most susceptible to acquiring the infection between twelve and thirty-six hours of age. The spores germinate in the gut and the bacteria infect the gut tissues, where they multiply, and eventually spread to the rest of the body (Figure 14).

Infected larvae normally die after their cells are sealed. As the bacteria multiply, millions of infectious spores (up to 2500 million) are formed in their remains. The larval remains eventually dry out to form 'scales' that adhere closely to the cell wall and cannot easily be removed by the bees.

At the colony level: Once a colony is infected, the disease will progress until most of the brood is affected. The colony then becomes unable to replace the ageing adult bee population, causing it to become weakened and, finally, to die out. The disease may develop for months before the colony succumbs. Death may occur at any time of the year.

Figure 14: Progression of infection with AFB. Unlike EFB bacteria, which remain in the gut (Figure 3), AFB bacteria (in red) invade tissues throughout the larva



Recognising signs of AFB

- AFB generally affects only sealed brood. When infected larvae die within the sealed cells, the appearance of the cell capping changes. A good way of remembering this is: **A**FB = '**A**' as in 'After' the cell is capped.

- Healthy wax cappings are dry and digestive biscuit coloured (Figure 15). During AFB infection, cappings become sunken and dark as the developing brood inside die (Figures 16 to 18).
- Cappings become perforated when adult bees nibble holes in them to try to remove the infected larvae underneath (Figure 16). These perforations tend to be jagged, off centre and irregular in shape. Perforated cappings alone should not be used as a diagnostic criterion, as they may be observed in other diseases or conditions, such as EFB, sacbrood and parasitic mite syndrome.
- Some cappings may become moist or greasy-looking and slightly darker in colour than other cells (Figure 18).
- At first only very few cells may show signs of disease and the colony will appear normal in other respects.

Figure 15: Healthy capped brood looks biscuit-coloured and is dry

Figure 16: With AFB, cappings may be moist or perforated from nibbling

Figure 17: AFB infected brood will become sunken

Figure 18: AFB infected brood cells become dark and greasy

- Eventually much of the sealed brood will become affected by the disease, causing a patchy or ‘pepper pot’ brood pattern (Figure 19).
- There may then be an unpleasant smell associated with decomposition.
- At the sunken capping stage, the dead larval remains are light to dark brown in colour and have a slimy consistency.
- If a matchstick is inserted and slowly withdrawn into a cell with a dark, slimy looking cell capping, the remains can be drawn out in a brown, mucus-like thread or ‘rope’ 10-30 mm long (Figure 20). This is a reliable test for the presence of AFB.
- Further drying leads to the final stage, which is a very dark brown, rather rough scale lying on the lower side of the attached cell and extending from just behind the mouth of the cell right back to the base (Figure 21).
- The scales are best seen if the comb is held facing the light: they reflect the light from their rough surfaces and can easily be seen, even when their colour is almost the same as the comb itself.
- The ropy condition is followed by a tacky stage as the larval remains in the cell gradually dry up and the colour changes to dark brown.
- The tongue-like proboscis of dead pupae may occasionally remain intact, protruding upwards from the bottom edge of the cell (Figure 22).

Figure 19: A severe AFB infection causes a pepperpot brood pattern

Figure 20: Remains of larvae that have died from AFB will make a long rope

Figure 21: Characteristic AFB scales found in a heavily infected colony

Figure 22: AFB larval remains (scale) with tongue-like proboscis

Distribution

AFB is widespread across Asia, North America, Australia and Europe. Within the UK, AFB may be found anywhere, and doesn't cluster in any specific geographic region. Fortunately, cases of AFB in the UK have been low in recent years, with less than 100 cases per year reported in the whole of England, Wales and Scotland.

For example, in 2023, there were a total of 82 colonies confirmed positive for AFB infection in the UK, with only 47 in England and Wales (Figure 23). Many of these were clustered close together.

Diagnosis

As with EFB, AFB is not definitively diagnosed with a visual inspection, as the signs of disease may be caused by other brood disorders. Suspect infections must be reported to NBU inspectors, who will make a primary confirmation in the field, using a lateral flow device (LFD).

The samples taken will then be send back to the laboratories at Fera Science Ltd for official confirmation. Occasionally, multiple samples, or a brood comb, may be sent to the laboratory for examination.

Figure 23: An example of AFB distribution in England and Wales in a year

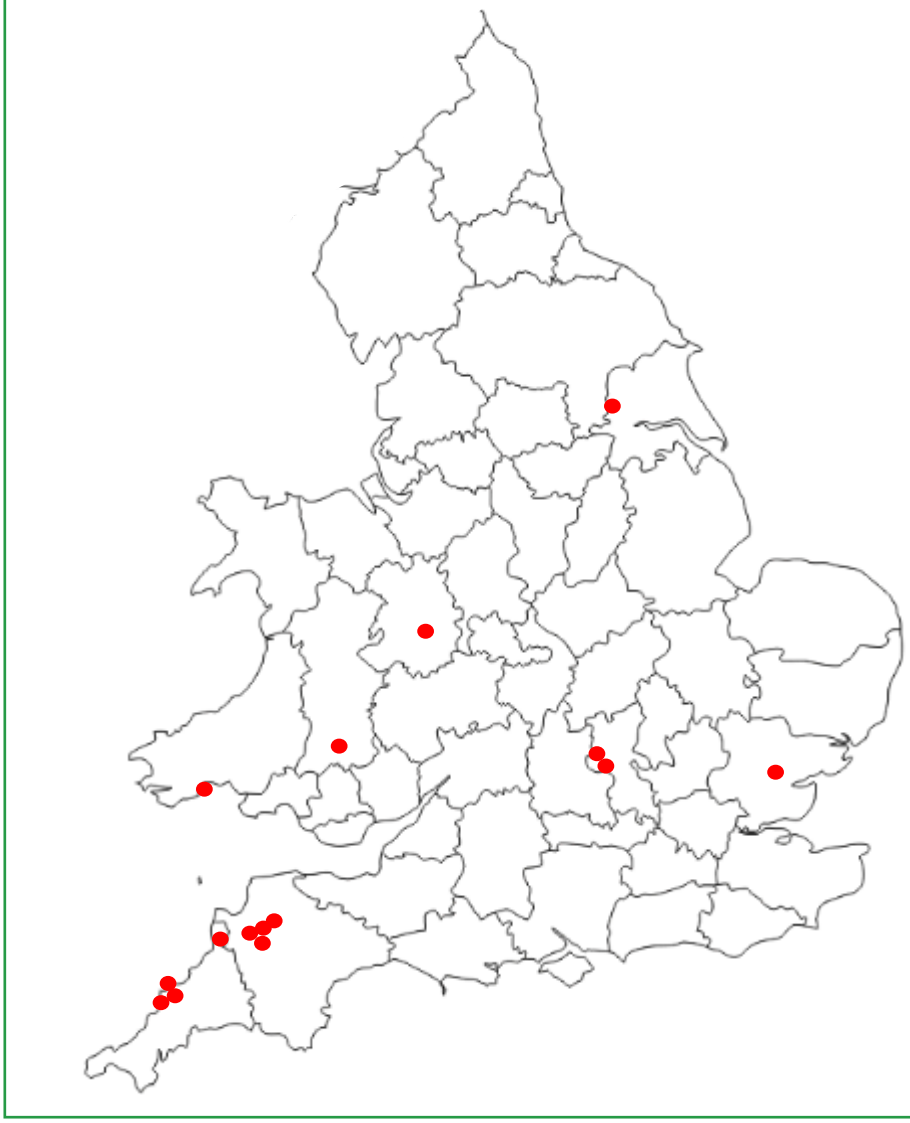


Figure 24: Sunken, discoloured cappings are a sign of AFB

Transmission

AFB can be transmitted in the same ways as EFB:

- **Bees**: AFB can be transmitted between colonies by the bees themselves through robbing or drifting, or via swarms.
  It can be transferred into apiaries through the sale of infected package bees or nucs.
- **Frames**: AFB may be present in wax, pollen or honey, so can be transmitted between colonies/apiaries through transfer of infected hive materials.
- **Clothing, tools & boxes:** AFB may be present on the surface of clothing, tools, boxes or other equipment. In this way they can be inadvertently transferred between colonies or apiaries.

Unlike EFB, AFB is a spore-forming bacteria. The spores are resilient and can remain in the environment for many decades. Therefore, even beekeeping equipment that has not been used for many years can contain viable AFB spores. These spores can cause infection unless old equipment is thoroughly disinfected before use.

What should I do if I suspect foulbrood in one of my colonies?

- If you suspect foulbrood, **please contact the NBU immediately** by emailing: NBU@apha.gov.uk or calling: 0300 303 0094. Alternatively, contact your local Seasonal or Regional Bee Inspector. Beekeepers in Scotland should contact Bees_Mailbox@gov.scot
- Self impose your own standstill on your apiary and don't move any equipment or bees until it has been inspected by an inspector.
- Please do not move any bees to or from the colony. Disinfect all equipment that may have come into contact with the suspect colony.
- Reduce the entrance on the suspect colony.
- If possible, take photos of the suspicious cells to show the Bee Inspector.

Controlling a foulbrood outbreak

Foulbrood apiary hygiene

General hygiene should be observed at all times (see page 27), but if dealing with an outbreak of EFB or AFB, then hygienic measures must be increased, and all equipment must be decontaminated.

Frames that have been in contact with EFB must be destroyed as the wax may contain the bacteria. Boxes, supers and other hive parts made of polystyrene or plastic must be scrubbed and submerged in a 0.5% sodium hypochlorite (bleach) solution for 20 minutes; or scorched with a blowtorch if they are made from wood.

AFB infected colonies are destroyed to prevent further spore production; this includes infected frames and wax. AFB spores are very resistant to many different types of disinfectant and to extremes of temperature. Spores can germinate even after many decades in honey, in old combs kept in store or in derelict hives, skeps or boxes. As AFB spores are persistent in the environment, meticulous disinfection of the apiary is needed after infection.

In cases of foulbrood, the bee inspector and the beekeeper will work together to disinfect the apiary.To learn more about cleaning a hive and other equipment after disease, please view our fact sheet on hive cleaning.

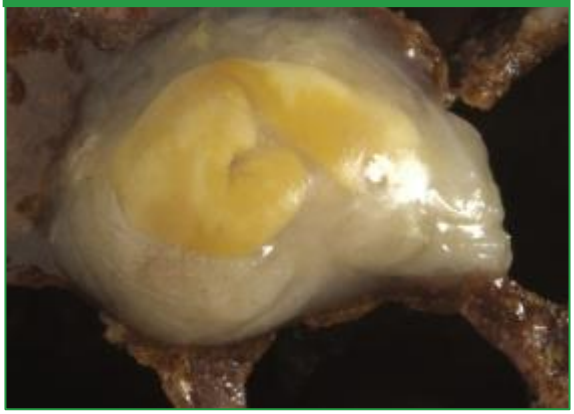
Brood checks

Under normal circumstances, colonies should be checked twice a year for signs of foulbrood. If there is an outbreak in an area, then disease checks should increase to at least three brood checks per year.

If foulbrood is found in the apiary, then disease checks must be performed four times a year thereafter for the next year, or at every inspection; especially for EFB, if it is persistent in the apiary.

For more detailed information performing apiary checks, see page 29.

Figure 25: Check larvae for signs of EFB bacteria in the gut during checks



Containment

Brood combs from infected colonies are inevitably heavily contaminated with bacteria or spores. If the scales go unnoticed, and infected combs are subsequently used or moved from colony to colony during routine beekeeping management, then infection has the potential to spread quickly. It is important to observe quarantine methods to prevent transmission of disease between colonies and apiaries.

Colony quarantine

Avoid moving any combs, bees or equipment from one colony to another. You can mark super frames and boxes so that they can be individually identified and returned to the same colonies after extraction. This is the most effective quarantine system and the most appropriate for colonies that are at particular risk – such as those that have been previously treated or those that have had close contact with infected colonies – but involves significant effort to carry out on a large scale. This has worked very successfully to bring large outbreaks under control.

Dead hives should have their entrances blocked as soon as possible.

Apiary quarantine

Avoid moving any bees, combs or equipment between apiaries, but allow some movement (e.g. super combs) within the apiary. This will not prevent spread within the apiary but involves less work to implement on a large scale than colony quarantine and also helps to prevent moving disease between apiaries.

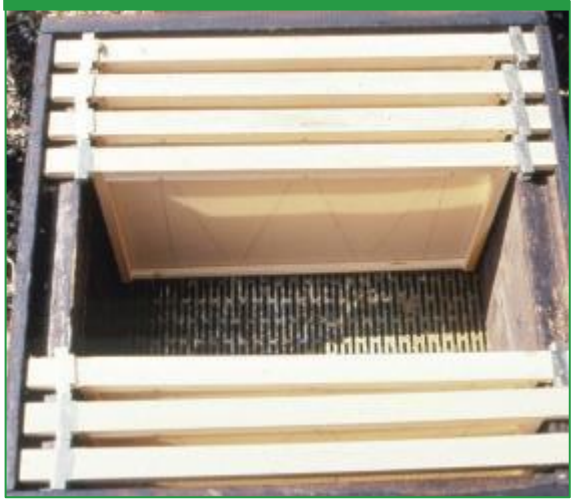
Swarm collecting

When collecting swarms, it is best to site them away from other apiaries until they are confirmed to be free from EFB. Swarms should be hived into boxes with fresh, not drawn, foundation. Adult bees in a swarm will have a full honey stomach. On fresh foundation, they will need to consume the contents of the honey stomach to create fresh wax. This results in a pause in brood rearing and a reduction in risk of potential infection.

Swarms should be left in a quarantine apiary for six weeks, and brood should be regularly checked for signs of EFB. Colonies derived from swarms should not be moved out of the quarantine apiary until they are confirmed to be free of EFB, after regular brood checking.

Figure 26: Swarms are a potential source of foulbrood

Figure 27: Swarms should be placed onto fresh, not drawn, foundation



EFB Control

EFB is a notifiable disease under the ‘Bee Diseases and Pests Control Order’ (for England and Wales) and is subject to official control by the examination of colonies for signs of disease, and the compulsory treatment or destruction of infected colonies.

Weak colonies and colonies with a high level of EFB infection are destroyed. However, strong colonies, or those with a low level infection can be treated with a shook swarm, between April and September. The ABI will assist the beekeeper with whatever action is taken. For further information on colony care after a shook swarm, please view our shook swarm fact sheet.

AFB Control

AFB is a notifiable disease under the ‘Bee Diseases and Pests Control Order’ (for England and Wales) and is subject to official control by the examination of colonies for signs of disease, and the compulsory treatment or destruction of infected colonies.

Control of the disease is through compulsory destruction of infected colonies, which is an effective measure. This eradication policy has been effective since first introduced in the 1940s, bringing the incidence of AFB down from several thousand infected colonies per year to less than 100 per year in the past decade.

Sacbrood virus

Cause

Sacbrood virus (SBV) is a common and widespread virus across the world, and it is found throughout the UK. This virus is so common that it is likely that most beekeepers will encounter it at some point. In the UK, SBV was one of the three most common diseases found (chalkbrood and parasitic mite syndrome being the other two)[5] during inspections performed by the NBU between 2006 and 2016.

In most diseased colonies, relatively few larvae are visibly affected, and it rarely causes measurable harm. However, signs of sacbrood may be mistaken for EFB or AFB.

Disease progression

The virus replicates in the hypopharyngeal glands of infected adult bees. It can shorten the lifespan of adult bees but causes no visible symptoms. They then secrete the virus into the food they feed to the developing larvae, which become infected when they ingest the contaminated food. Larvae are susceptible up to eight days of age. The virus prevents them from shedding their last larval cuticle (skin), causing fluid to accumulate between the body of the larva and its unshed skin, resulting in death.

Recognising signs of SBV

Sacbrood virus causes the unmistakable symptom of gondola-shaped larvae protruding from their cells (Figure 28). Larvae that have become infected with SBV fail to pupate and die just after capping. As the virus prevents larvae from shedding their skin, their bodies fill up with fluid. If the larval remains are ruptured, the contents are a granular, brownish liquid and more-or-less watery depending on the state of decomposition of the larva.

The outer skin of affected larvae becomes thick and can be easily removed from the cell intact (Figure 30). It is common to find uncapped cells containing larvae that have died from sacbrood as the bees will uncap the cells and attempt to remove the diseased larvae. Often, in capped cells where a larva has died from sacbrood, the capping will be nibbled by the bees (Figure 29).

The infected larvae lose their pearly white colour and turn yellow during the first stages of decomposition. As decomposition progresses the remains turn brown and begin to dry out. At the final stages, larvae will rot down into a dry, dark scale.

Figure 28: SBV infected larvae have a characteristic gondola shape

Figure 29: Nibbled cappings can be a sign of diseases, such as sacbrood

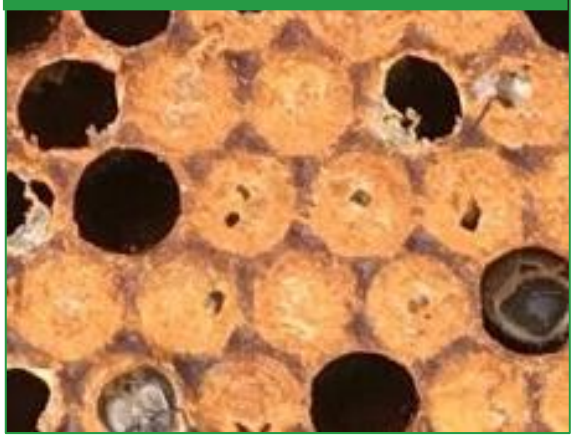


Figure 30: A SBV infected larva is easily removed from its cell

Transmission

The virus can be spread by adult bees through robbing, and to a lesser extent by drifting[6].

Queens may also transfer the virus onto their offspring via their eggs, and it may be spread between bees in the colony via the faecal-oral route.

The virus can remain viable in honey or pollen for a month, so it can be transmitted by the movement of frames between colonies.

Treatment

There is no specific treatment for sacbrood. It tends to be well managed by the bees themselves and, in *Apis mellifera* at least, does not lead to serious colony losses.

The colony should be able to handle the infection without intervention, but if the disease is persistent, there are a small number of management options available:

It may help to remove most of the diseased combs and replace them with clean comb.

Colonies with persistent sacbrood infections may benefit from either requeening the colony with a younger queen to break the possible transmission route of virus from queen to brood, or caging the current queen for ten to fourteen days to stimulate a short brood break[7]; preventing re-infection of larvae that are at the susceptible age.

Prevention

Good hygiene on the part of the beekeeper will help prevent spread of the virus between the hives. Honey and frames from an infected colony should not be transferred to other colonies. Sacbrood virus can remain viable in honey, pollen and old comb for up to four weeks at room temperature, but exposure to sunlight and heat can destroy the virus.

Heating honey to a minimum of 70°C for ten minutes is sufficient to inactivate sacbrood virus, as is direct exposure to full sunlight for five to six hours at room temperature. Putrefaction (decay) also speeds up the rate of virus destruction, so any virus present in decomposing larvae will be deactivated seven to ten days after larval death[8].

Figure 31: This frame was found to be heavily infected with SBV and featured classic SBV signs, such as nibbled cappings and exposed gondola-shaped larvae

Chalkbrood

Cause

Chalkbrood is a caused by a fungus called *Ascosphaera apis*. The fungus grows best at temperatures slightly below optimal brood rearing, which is why chalkbrood is often associated with chilled brood. Chalkbrood is fatal to infected larvae and can result in a decline in bee numbers and honey production, but it does not typically cause the demise of a colony.

The fungi germinate in the larval gut when the colony temperature falls below 32°C for more than two hours[9]. Drone brood appear to suffer more from chalkbrood, as they are at the periphery of the brood nest and more likely to become chilled.

Chalkbrood is one of the three most prevalent diseases in the UK (the others being sacbrood and parasitic mite syndrome).

Disease progression

When ingested by a larva, the fungal spores germinate in the midgut and produce mycelia. Mycelia is the collective term for groups of hyphae; a network of fungal threads produced by the fungi, that it uses for feeding. The mycelium is responsible for reproduction and forms fruiting bodies, which will generate more spores.

The spores that germinate in the larval gut produce enzymes that damage the larva, causing it to die. The mycelia then break through the cuticle and the larva turns spongy and white, at first, then becomes hard and chalk-like.

The larvae may then turn grey, black or brownish green when the fruiting bodies of the fungi produce infectious spores on the surface of the larva.

Recognising signs of chalkbrood

Chalkbrood infected larvae will initially be covered by fluffy, white fungus and then dry out and shrink down to form a distinctive ‘mummified’ chalk-like appearance. Like some other brood disorders, there may be perforated cappings. Workers will uncap and remove infected chalkbrood cells, resulting in an uneven or ‘pepperpot’ brood pattern. Infected larvae often take on the hexagonal shape of the cell itself before shrinking in size (Figure 32), at which point, the bees are able to remove them from the comb.

Chalkbrood mummies removed by the workers can be found on the floorboard or outside the entrance (Figure 33). They are distinctive but could feasibly be confused with mould. However, when rubbed between two fingers, mouldy pollen will break up easily, whereas a chalkbrood mummy will not and is hard to crush between the fingers.

Although the larvae become infected during the early stages of life, they won’t exhibit signs until just before, or up to two days after capping. Workers uncap and remove the majority of infected cells, so only a small proportion of the infection may be visible.

Figure 32: Chalkbrood infected larvae that have sunken down in their cells

Figure 33: Chalkbrood mummies outside an infected hive

Transmission

Each chalkbrood mummy can produce millions of infectious spores that stick to the brood cells, hive components and adult bees. While adult honey bees are not susceptible to infection, they can transmit the pathogen within the hive and to other colonies. Food sharing between adult bees allows fungal spores to be carried by foraging bees and subsequently passed to susceptible larvae.

The spores, which are highly infectious, are spread through robbing and drifting of worker bees, and via contaminated equipment or hive products such as wax, honey or pollen. Chalkbrood spores are tough and may persist in the environment for fifteen years.

Treatment

There are no specific treatments available for chalkbrood, but it is suggested that requeening from a different stock may benefit colonies suffering from repeated or severe infections, as some honey bee strains of are naturally more resistant to chalkbrood.

Management techniques to reduce infection with chalkbrood include keeping hives clean, replacing storage and brood combs at least every three years, and keeping hives well ventilated and dry. During spring and summer, enlarging the colony entrance to improve ventilation may help. While in autumn and winter, reducing the volume of the brood chamber may help control chalkbrood.

Chalkbrood spores persist particularly well in pollen; so, removal of stored pollen from infected hives and provision of a protein substitute may help reduce infection levels in an affected colony.

Placing pollen traps on colonies has been found to worsen chalkbrood infections, so these should be avoided. It is also suggested that a pollen/protein deficit could aggravate the condition.

Spores are very persistent in the environment, so it is important to use clean equipment and not to transfer material between colonies if infection is present. Chalkbrood spores may be found in pollen, honey and wax and can be transmitted to other colonies by transfer of these products, so this should be avoided.

Prevention

Follow precautions to prevent chilled brood: see the chilled brood section on page 23 for further details.

In addition, it will help to arrange your colonies to avoid drifting to prevent infected bees from spreading the disease. For more information on drifting; see the section on general apiary hygiene on page 27.

Figure 34: This frame has a chalkbrood infection

Parasitic mite syndrome

Cause

Parasitic mite syndrome is caused by the *Varroa* mite, *Varroa destructor*, in combination with the virus, deformed wing virus (DWV). Parasitic mite syndrome, also known as varroosis, is one of the three most prevalent diseases in the UK (the others being sacbrood and chalkbrood).

When *Varroa* feeds on developing brood, it acts as a vector for transmission of DWV. Individual bees infested with *Varroa* during their development usually survive to emergence, but will suffer from physiological damage as adults, such as a shorter lifespan, reduced weight upon emergence, and an increased susceptibility to infections.

As colonies become more heavily infested with mites, levels of DWV increase in the colony. At high levels, DWV kills pupae and causes deformed wings in adult bees. This condition signifies the terminal decline of the colony.

Disease progression

A number of studies demonstrate that parasitism by *Varroa* interferes with the normal immunity of the bee, making them less able to tolerate infection with the virus, meanwhile the direct effects of the mite feeding from the developing bee results in a physical wound and a reduction in overall weight of the bee which further weakens the bee. DWV is vectored into pupae by the mites, where it replicates rapidly, causing death or deformed wings.

Recognising signs of parasitic mite syndrome

Due to the loss of pupae, an uneven, ‘pepperpot’ brood pattern will occur. As brood dies, there may be an insufficient number of young bees coming through to tend the brood, so neglected brood may become apparent. There may also be a lack of eggs and early brood stages.

Bees with deformed wings and shortened abdomens will become more common as the virus levels increase and there will be numerous *Varroa* mites observed on adult bees, on worker and drone pupae and on the hive floor.

Brood abnormalities such as bald brood, patches of neglected and dead ‘emerging’ brood, often discoloured brown and partly cannibalised by the bees will be apparent.

Treatment

Treatment and prevention of parasitic mite syndrome involves year-round management of *Varroa* mites. There are treatments and husbandry techniques that are effective at keeping mite levels below a threshold where it can damage colonies. For more comprehensive information about parasitic mite syndrome, and how to prevent it, please read our advisory leaflet entitled 'Managing *Varroa*’.

Figure 35: Damaged brood showing signs of severe mite infestation, also known as ‘parasitic mite syndrome’

Bald brood

Cause

Bald brood is a common disorder where honey bee pupae are not capped and continue development exposed on the frame within the colony. It is not caused by a disease, but is sometimes found in the presence of the honey bee pest, wax moth (*Achroia grisella* and *Galleria mellonella*), when their larvae tunnel under the brood cappings on the comb.

Another potential cause of bald brood is frames that are positioned too close to each other within a colony. The bees will uncap brood to make room for movement between the frames, resulting in bald brood.

Disease progression

Bald brood is not a disease and is usually referred to as a brood disorder.

Recognising signs of baldbrood

When bald brood occurs, developing pupae will be clearly (Figure 36), or partially (Figure 37), visible in their cells. The opening of the affected cell will be circular and slightly raised at the edges; not ragged or nibbled. The developing brood will look plump and healthy, and there will be no signs of cannibalism. If there are opened/partially opened cells with ragged edges and unhealthy/cannibalised pupae, then the colony may be suffering from a disease.

When a result of wax moth larvae tunnelling through the comb, the cells become damaged in the pattern of wax moth's travel; usually straight lines across the frame. Cells may have a raised edge protruding from the comb surface. Although it may appear shocking, the exposed pupae typically continue to develop normally and emerge as fully formed adult bees.

Figure 36: In this frame of bald brood, the pupae are completely visible

Figure 37: In this frame of bald brood, the pupae are only partially visible

Prevention

There is no treatment for baldbrood; the brood will go on to develop normally. However, it can be prevented by controlling wax moth infestation and ensuring that frames are always returned to the hive in the same position that they came from.

Chilled brood

Cause

In a healthy colony, the adult bees maintain the brood nest temperature to ensure that the larvae develop properly and remain healthy. When there is an insufficient number of adult bees to maintain all of the brood at the optimal temperature of 34.5°C, the brood at the edges of the brood nest become neglected and a phenomenon referred to as 'chilled brood' may occur.

The peripheral brood cells are the most likely to be affected, and larvae will die in their cells. Those that survive may become more susceptible to chalkbrood, which thrives at a temperature that is slightly lower than 34.5°C.

Although the condition is called 'chilled' brood, it not necessarily caused by cold weather. Chilled brood may occur when the cluster contracts when it's cold, but the cause is often due to a drop in the adult population and may be due to disease or colony splitting.

Disease progression

Chilled brood is not a disease and is usually referred to as a brood disorder.

Figure 38: Chilled brood may look dried out and flaccid

Recognising signs of chilled brood

Chilled brood will turn yellow, brown or black rather than their normal pearly white, and lose their plump, glossy appearance. Eggs and larvae of all ages can be affected on the same comb.

Figure 39: Chilled brood will turn brown and black

Prevention

When making up nucs or splits, there must be plenty of emerging brood and nurse bees in both the old and the new colony to avoid chilled brood. Chilled brood is more likely to occur in the colony or nuc that is not in the original location, as the foragers will return to the original location of the colony. Shaking off bees from a few brood frames into the relocated colony will help avoid chilled brood; although foragers will return to the original colony, the younger nurse bees will remain to care for the brood.

Moving colonies can also result in loss of adult bees causing chilled brood. When moving bees, it is necessary to wait until sunset and the foragers have returned home to close up the entrance and move the bees a minimum of 3 miles away. Otherwise, they will return to their original location, resulting in a loss of part of the adult population from the colony.

Queen problems

The characteristic domed cappings of sealed drone brood are present in virtually all colonies during the summer months on areas of drone comb, usually situated at the edge of the brood nest. However, problems with the queen can cause drone brood to be reared in worker cells along with, or in place of, worker brood.

Such drone brood is usually very irregular; capped pupae may be interspersed with either vacant cells or cells containing larvae at different stages of development. There are two possible causes: a drone-laying queen or laying workers. Both causes are a sign that something has gone wrong with the queen.

Figure 40: An abundance of drone brood indicates a failing queen

Causes

Although, strictly speaking, not a disease, queen problems rank highly as a problem suffered by beekeepers, and can cause terminal colony dysfunction. Across many countries 'poor queens' are listed as a top-ranking concern among beekeepers and is a commonly cited cause of colony loss[10].

Queen problems can include: virgin queens not getting mated, poorly mated queens that start drone laying early in their lives, queens that stop laying early in life (which may result in laying workers), a shortened lifespan, queen supersedure and queens that appear to go missing with no apparent cause.

It is frustrating, but there appears to be no obvious, single causative agent involved in the common problem of poor-quality queens.

Known causes of poor queens include grafting of larvae that are too old (over three days of age)[11], and extremes of temperature during transport (queens should be kept at between 15 and 38 °C during transport)[12], and, possibly, infection with *Nosema ceranae*.

Varroa mites are rarely found parasitising queen cells, and mites are rarely found on adult queens, so it is unlikely that *direct* parasitism by *Varroa* is a contributor to poor queens. However, mites may be indirectly involved as high numbers can impact the overall functioning of a colony.

Figure 41: A healthy, well-mated queen is essential to normal colony function

Recognising signs of queen problems

Queen problems may manifest in a number of different ways, depending on the nature of the problem. If the queen is lost or damaged, there will be a lack of brood and the colony may become more defensive than usual.

When a queen runs out of sperm, she will be unable to produce worker brood and will begin producing only drone brood (Figure 40). She will need to be replaced with a new queen.

When colonies lose their queen and have no young worker brood from which to rear a replacement, the workers may develop functional ovaries and begin to lay eggs. These eggs, being unfertilised, develop into drones. Signs are similar to those of the drone-laying queen, except that the brood pattern is often less compact. Also, there may be several eggs present in some cells, most often on the walls as well as at the bottom of the cell (Figure 42).

Figure 42: A sign of laying workers is the presence of many eggs per cell

Prevention

Care is always needed when performing a colony inspection to prevent damage to the queen. For example, damage to her rear legs can prevent her from laying, even if she remains otherwise healthy. Damage can be avoided by finding and carefully caging the queen for the duration of inspections. To improve queen handling, it may be helpful to practice handling drones first.

Figure 43: Heavy Varroa infestation will harm normal colony function

If rearing your own queens by grafting, ensure you choose very young larvae of no more than one day old. Queens from larvae that are grafted older than 24 hours old have a lower body size and weight than those from younger grafted larvae[13], probably because the older larvae have eaten an insufficient quantity of royal jelly, resulting in sub-optimal queens.

After queens emerge, they must be well mated in the first two weeks of life. If they fail to mate, or are insufficiently mated, due to bad weather during this period, they will not be able to produce consistent brood to sustain the colony. In the first two weeks of life, the queen bee performs mating flights, where she will mate with a number of drones and store all the sperm in an organ called a spermathecae; this supply must last her lifetime. If she does not amply fill this organ, she may become a drone layer early on in life.

Treatment

Any colony suffering from a missing or drone-laying queen should be re-queened. However, colonies with laying workers are very difficult to requeen, and are usually in poor condition. It is generally advisable to unite them with a strong colony or to destroy them.

When re-queening with purchased queens, carefully follow all instructions provided by the supplier to give the queen the best chance of success.

Summary of brood diseases

Disease or disorder	Typical signs	Management options
Healthy brood	• Uncapped larvae are pearly white, segmented and sit in a 'C' shape • Capped cells are digestive biscuit coloured, dry and uniform	
European foulbrood	• Affects mainly unsealed brood • Discoloured yellow larvae lying in abnormal positions • Larvae have 'melted' appearance • Some dark sunken cappings may be present, but will not rope	**Statutory notifiable disease** • NBU will shook swarm or destroy affected colonies
American foulbrood	• Affects only sealed brood • Moist, dark, sunken and/or perforated cappings • Uneven brood pattern • Scales on bottom walls of open cells • Brown decomposing larvae that 'rope'	**Statutory notifiable disease** • NBU will destroy affected colonies
Sacbrood	• Perforated cappings • Larvae become yellow-brown fluid filled sacs • Watery contents will not 'rope'	• Comb replacement • Queen trapping • Re-queen colony
Chalkbrood	• Affects only sealed brood • Perforated cappings over cells containing hard white or mottled grey chalk like remains	• Improve ventilation • Comb replacement • Replace stored pollen with pollen substitute • Avoid pollen traps
Parasitic mite syndrome	• Perforated cappings, neglected brood, bald brood • Dead pupae, may be cannibalised • Visible mites • Adult bees with deformed wings	• Active & ongoing control of *Varroa* mite levels in colonies
Bald brood	• Partially or fully open cells of healthy-looking pupae • Signs of wax moth may be present	• Control wax moth • Maintain correct position of brood frames in colony
Chilled brood	• Dead brood usually present in all stages • Unsealed brood turns very dark brown or black	• Ensure adequate number of workers when splitting
Queen problems	• Only drone brood present or no brood present • Multiple eggs per cell • Aggression	• Re-queen colony

General apiary hygiene

Apiary hygiene

Good routine apiary hygiene is important to help prevent transmission of diseases. Apiary hygiene consists of regular comb rotation, cleaning and sterilisation of equipment and refraining from transferring materials between apiaries.

For more information on general apiary hygiene, please refer to our fact sheet:

www.nationalbeeunit.com/assets/PDFs/3_Resources_for_beekeepers/Fact_Sheets/Fact_03_Apiary_Hygiene_and_Quarantine.pdf

Regular cleaning and disinfecting of tools, equipment and suits is an important part of apiary hygiene. Clean hive tools and gloves between each colony inspection, using soda crystals in hot water and a scrubbing brush or scourer to remove propolis and debris.

It is also recommended to use nitrile or washing-up gloves for colony inspections that can be changed between apiaries. Leather gloves are not recommended as they are difficult to properly clean and disinfect.

Boxes and supers can be disinfected by using a blowtorch for wooden boxes, or 0.5% sodium hypochlorite (household bleach) for polystyrene or plastic hive parts. A pre-wash with soda crystals in hot water will help remove propolis and organic matter that may interfere with the disinfecting process.

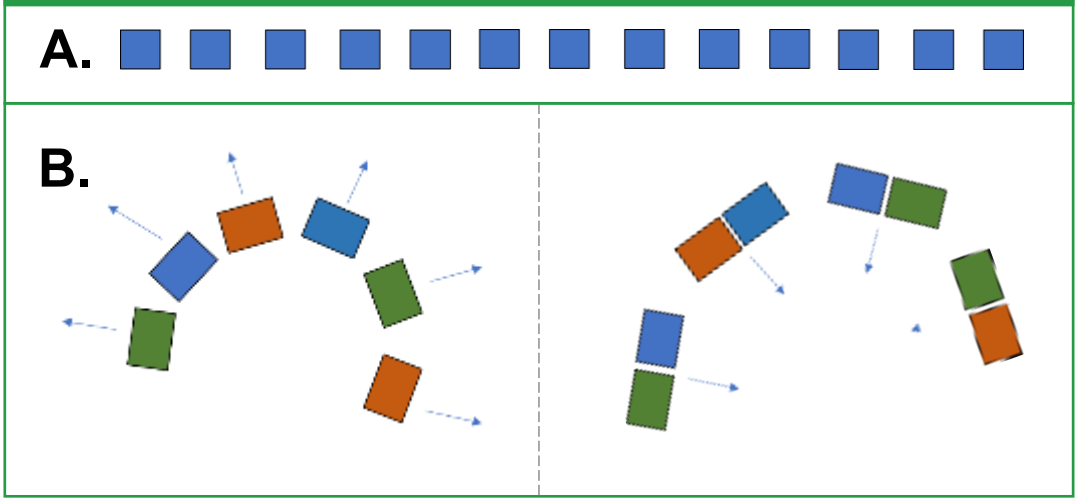
Bee suits should be cleaned regularly on a hot wash.

10 best practices

1. Avoid transferring frames between colonies
2. Don't split colonies without first checking for signs of brood disease
3. Inspect colonies at least twice a year and check specifically for brood disease
4. Never bring colonies, combs or equipment into the apiary unless you are certain they are from a disease-free source
5. Never buy old combs, and replace combs regularly
6. Always disinfect second-hand hives and equipment thoroughly before use
7. Control robbing in the apiary; never leave combs, honey or feed exposed for bees to rob
8. Never feed honey from another source to your bees
9. When a colony dies, seal it immediately to prevent robbing
10. If a colony is not thriving, examine the brood for signs of disease

Figure 44: Avoid spillages during feeding to prevent robbing

Figure 45: A simple schematic demonstrating an orientation of hives that encourages drifting (A) as opposed to orientations that discourage drifting (B)

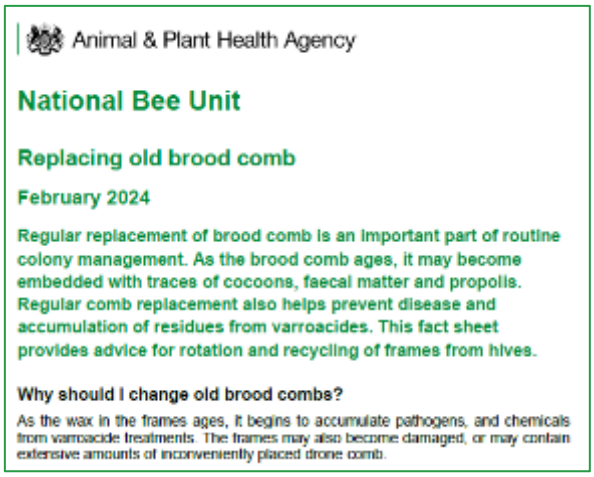


Prevent drifting

Arrange hives to prevent drifting. Drifting occurs when bees from one colony return to a neighbouring colony. This is especially common with drones.

Bees are more likely to drift between colonies where there are no visual cues to distinguish between colonies, for example, a long line of colonies that are all the same height and colour, with their entrances facing the same direction (Figure 45a).

It is preferable to arrange colonies in a semi-circular fashion, or other configuration that is not a straight line and try to use hives of different colours and heights (for example; Figure 45b).



Animal & Plant Health Agency

National Bee Unit

Replacing old brood comb

February 2024

Regular replacement of brood comb is an important part of routine colony management. As the brood comb ages, it may become embedded with traces of cocoons, faecal matter and propolis. Regular comb replacement also helps prevent disease and accumulation of residues from varroacides. This fact sheet provides advice for rotation and recycling of frames from hives.

Why should I change old brood combs?

As the wax in the frames ages, it begins to accumulate pathogens, and chemicals from varroacide treatments. The frames may also become damaged, or may contain extensive amounts of inconveniently placed drone comb.

Comb rotation

Regular comb rotation is an important part of apiary hygiene. Minimum comb rotation consists of swapping out brood frames for fresh frames after 2 to 3 years of use. When brood disease is present, combs can be replaced to reduce the overall pathogen load in the colony, especially for the foulbroods, where brood frame destruction is necessary to prevent re-infection.

Routine comb rotation should be performed carefully so that brood rearing in the colony is not disrupted. For more information on routine comb rotation, please refer to our fact sheet.

For more information on comb rotation, please refer to our fact sheet:

www.nationalbeeunit.com/assets/PDFs/3_Resources_for_beekeepers/Fact_Sheets/Fact_21_Replacing_Old_Brood_Comb.pdf

How to perform a brood inspection

In order to identify any potential diseases as soon as possible, it is recommended to perform regular colony inspections throughout the season. The recommendations for a successful brood inspection are as follows:

- Before inspecting, familiarise yourself with the differences in appearance between healthy brood and diseased brood. Consider bringing this leaflet or a smartphone with you into the apiary to assist with identification.

Figure 46: Healthy eggs

Figure 47: Healthy larvae

Figure 48: Healthy cappings

- Wear a clean bee-suit and have a lit smoker close to hand.
- Inspect the ground outside the entrance and the removeable *Varroa* floor (if inserted) for signs of dead/diseased brood, as the nurse bees will remove some of them from the hive.
- Remove the hive roof and place it upturned on the ground behind the hive, close to where you are working. Situate it so that it does not block your route or constitute a trip hazard if you need to leave the hive for a moment.

Figure 49: Make it a habit to check outside the hive entrance on each visit

- If there are supers on the hive, place them on top of the upturned roof. Keep the crown board over the supers to prevent robbing. Be gentle when prizing the boxes apart as banging or bumping them will aggravate the bees.
- Remove the queen excluder and check the underside for the queen. If she is present, place her back into the colony, or into a queen-cage for safekeeping for the duration of the inspection. Place the queen excluder upturned on the supers if you have two brood boxes. Place the top brood box above the queen excluder on the supers while you inspect the bottom box (the queen excluder will prevent the queen from escaping from the underside of the brood box if she is in it).

- To begin inspecting a brood box, remove the outer most frame closest to you. Check that the queen isn't on it before putting it aside so that you can operate inside the brood box.
- As you move between the frames, gently use your hive tool to prize apart frames that are stuck together. A gentle approach is recommended to prevent aggravating the bees.
- Methodically examine one frame at a time. When you find a frame of brood, it will be necessary to shake off the bees to properly inspect the brood.

Figure 50: It is necessary to knock the bees off frames and back into the box to be able to inspect the brood

- Before shaking off the bees, ensure the queen isn't on it and move her to a safe place if she is. Then, firmly holding the frame by both lugs (Figure 50), give it a sharp downward shake into the hive, being careful not to bang it against the box or other frames. It may take some practice to do this in a way that clears most of the bees from the frame.
- Carefully examine the open brood for signs of EFB (pages 6 and 7) and the capped brood for signs of AFB (page 11 and 12).
- Probe any suspect cells with a matchstick. AFB remains will rope when a matchstick is inserted into an infected cell and pulled out. Matchsticks can also be used to pull out scales and probe their consistency — rubbery scales may be EFB, while hard scales may be caused by AFB. Dispose of the matchstick in the smoker.
- Continue until all frames have been examined, and gently reassemble the hive. Don't forget to return the queen to the hive if you have caged her during inspection.

Figure 51: Use a matchstick to test any suspect brood cells

- If you have encountered any suspect symptoms, ensure you disinfect all equipment used and put your bee suit into the wash when you finish up, then contact the NBU immediately after you finish the inspection. Beekeepers in Scotland should contact Bees_Mailbox@gov.scot.

If you suspect foulbrood, contact the NBU:

NBU@apha.gov.uk | 0300 303 0094

Beekeepers in Scotland should contact:

Bees_mailbox@gov.scot

Useful contacts

National Bee Unit (NBU)
York Biotech Campus, Sand Hutton, York,
North Yorkshire, YO41 1LZ
Tel: 0300 303 0094
Email: nbu@apha.gov.uk
www.nationalbeeunit.com

Bee Diseases Insurance Ltd (BDI)
National Beekeeping Centre, NAC
Stoneleigh Park
Warwickshire CV8 2LG
Tel: 08718 112337
www.beediseasesinsurance.co.uk

Bee Farmers' Association (BFA)
36 The Green
Long Whatton
Loughborough
Leicestershire LE12 5DB
www.beefarmers.co.uk

British Beekeepers' Association (BBKA)
National Agricultural Centre,
Stoneleigh Warwickshire,
CV8 2LG
Tel: 024 7669 6679
www.bbka.org.uk

Department of Agriculture, Environment and Rural Affairs
Northern Ireland (DAERA)
Dundonald House,
Belfast BT4 3SB,
Northern Ireland
Tel: 02890 24488
www.daera-ni.gov.uk

European Community and UK Legislation
The Stationery Office
51 Nine Elms Lane London
SW8 5DR
Tel: +44 0870 600 5522
www.legislation.gov.uk

International Bee Research Association
1 Agincourt Street,
Monmouth, NP25 3DZ
Tel: 02920 372409
https://ibra.org.uk

Office of the Chief Veterinary Officer
Welsh Government Offices,Picton Terrace
Carmarthen, SA31 3BT
Tel: 01267 245 007
www.gov.wales.uk

Science and Advice for Scottish Agriculture
SASA, Roddinglaw Road
Edinburgh, EH12 9FJ
Tel: 0131 244 8890
www.sasa.gov.uk

Veterinary Medicines Directorate
Woodham Lane
New Haw
Addlestone Surrey
KT15 3LS
Tel: 01932 336911
www.gov.uk/government/organisations/veterinary-medicines-directorate

Useful websites

Scottish Beekeepers' Association
www.scottishbeekeepers.org.uk

Ulster Beekeepers' Association
https://ubka.org

Welsh Beekeepers' Association
www.wbka.com

World Organisation for Animal Health
www.woah.org/en/home

References and further reading

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Further reading

For information on adult bee diseases, please refer to our advisory leaflet:

www.nationalbeeunit.com/assets/PDFs/3_Resources_for_beekeepers/Advisory_leaflets/Common_pests_diseases_2017.pdf

For information on the widespread honey bee parasite, *Varroa destructor*, please refer to our advisory leaflet:

www.nationalbeeunit.com/assets/PDFs/3_Resources_for_beekeepers/Advisory_leaflets/APHA_Managing_Varroa_2020_ELECTRONIC_ONLY-1.pdf

Animal &
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Llywodraeth Cymru
Welsh Government

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