

Managing acute oak decline



Pedunculate oak

Practice Note

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Oak trees in Britain have long suffered from dieback disorders but a new disease called acute oak decline is currently causing particular concern. A typical symptom of the disease is dark, sticky fluid bleeding from small cracks in the bark on the trunk of the tree. This stem bleeding may be extensive, with as many as 20 or more bleeding patches on an infected tree, and the canopy may become thin as the tree approaches death. Some trees die within four or five years of the onset of symptoms. Bacteria are thought to be the cause of the stem bleeds and tests to confirm this are underway. Currently, the condition appears to be most prevalent in the English Midlands but cases have also been reported in Wales. Woodland managers should survey, record and monitor infected trees and take the appropriate recommended action, which may include felling diseased oaks. Felled material should not be removed from affected sites unless the bark and sapwood have been removed and destroyed.

Introduction

Oak 'dieback' or 'decline' is the name used to describe poor health in oak trees. The symptoms of oak decline can be caused by a range of factors. These may be living ('biotic'), e.g. insect and fungal attack, or non-living ('abiotic') factors, e.g. poor soil and drought. The exact combination of factors causing the decline can vary between sites, as can the effects of the factors through time. Oak decline is not new; oak trees in Britain have been affected for the most part of the past century. Both species of oak native to the British Isles are affected, but pedunculate oak (*Quercus robur*) more so than sessile oak (*Quercus petraea*).

There are currently two recognised forms of oak decline in Britain – chronic oak decline, which has a slow effect, and acute oak decline, which has a fast effect.

Trees suffering from the chronic form develop symptoms relatively slowly, usually over decades. Symptoms include the thinning of the canopy – caused by the loss of twigs and fine branches – and, in severe cases, branch dieback. Trees suffering from decline may appear 'stag-headed'. Less often, trees may have a dark, watery fluid running down the bark. A key cause of recent chronic oak decline in Britain is believed to be root rot fungi, particularly *Armillaria*, *Phytophthora* and *Collybia fusipes*.

Acute oak decline is a more worrying condition because symptoms develop rapidly and result in high levels of tree mortality. Past episodes of acute oak decline have affected tree foliage and the two main causal agents were the defoliating caterpillars of the leaf roller moth (*Tortrix viridana*) and the powdery mildew fungus (*Erysiphe alphitoides*). Outbreaks tended to last for around 5–10 years, before stabilising, tailing off, and sometimes disappearing.

However, it now appears that a new episode of acute oak decline is occurring in Britain as there have been reports of a rapid decline in oak tree health – particularly in mature trees over 50 years old – and an increase in tree mortality in some areas. A key cause of this outbreak appears to be pathogenic bacteria and this is currently being investigated. This Practice Note describes the symptoms of acute oak decline and gives guidance on management options.

Symptoms of acute oak decline

In contrast to earlier episodes of acute oak decline in which the foliage of the tree was most affected, in this outbreak it is the trunk of the tree that is attacked. The main symptom is extensive bleeding of a dark, sticky fluid from small lesions or splits in the bark, caused by necrotic patches developing under the bark plates. Trees may also suffer from canopy dieback, in a similar way to those affected by chronic oak decline, but this can be

Figure 1 Severe canopy deterioration caused by acute oak decline.



severe and may not occur until the tree is near death (Figure 1). The time between onset of the first symptoms to death can be as little as 4–5 years. The condition also appears to be easily transferable and therefore it has the potential to have a serious impact on the health of large numbers of oak trees in Britain.

Bleeding patches are usually first seen on the trunk of the tree around 1–2 m above ground level but they can occur high into the tree canopy (Figure 2). Some trees may have more than 20 discrete bleeding lesions at different positions on the trunk. The bleeding usually appears in spring when the dark, sticky liquid seeps out and trickles down the trunk. This may stop at certain times of the year, allowing the shiny droplets to dry out to leave dark stains on the trunks. The stains may be washed off during heavy rain, making it difficult to identify affected trees. Dried fluid may also form a crust around the splits in the bark (Figure 3).

The splits in the bark are longitudinal, typically 5–10 cm long, and they form in the cracks between the bark plates. They may occur close to each other (around 10–20 cm apart) or they may be more widely spaced. At the bleeding point underneath the outer bark, the inner bark breaks down, leaving a fluid-filled cavity. A cross-section taken through this point usually reveals the cavity between the outer bark and the heartwood (Figure 4a). In longitudinal section black flecking may be seen in the inner bark (Figure 4b). In some cases there may be signs of callusing in an attempt by the tree to heal the cavity (Figure 4c).

Figure 2 Profuse bleeding extending into the canopy of the tree.



Figure 3 Dried fluid crusted in bark splits.

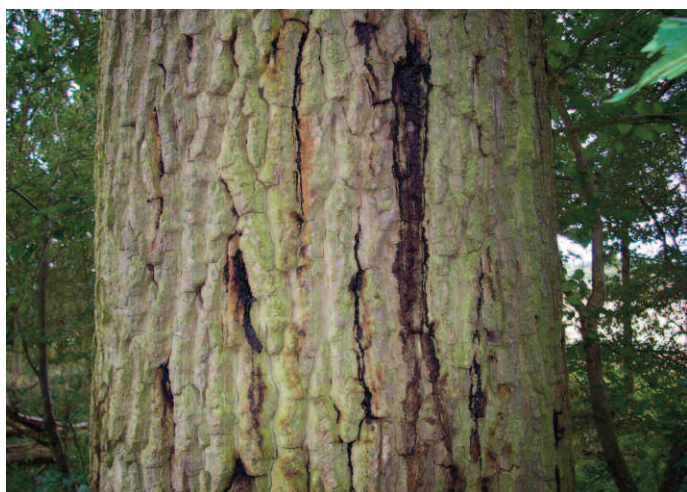
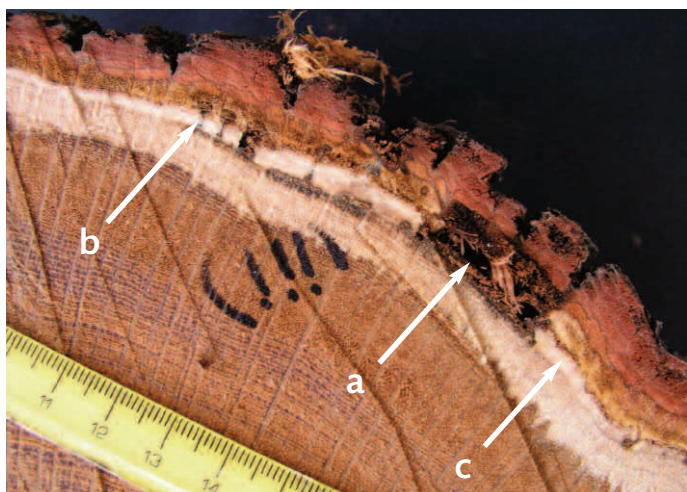


Figure 4 Cavity formation (a) and black flecking in the inner bark (b) of a log cross section. Callus formation (c) is also apparent.



Attack by wood-boring beetles

Some of the trees affected with acute oak decline have also been infested by the wood-boring larvae of the buprestid beetle (*Agrilus biguttatus*). This beetle is known to cause bleeding on oaks throughout Europe and in Britain it is considered to be a pest. Up until the early 1990s however, it was rare and only associated with very mature or veteran oaks. Since then, it has been found infesting oaks with dieback in increasing numbers.

The beetles appear to be opportunistic and are not considered to be the cause of acute oak decline. They take advantage of the tree's weakened state and infest it, further debilitating it and even hastening tree death. Evidence of an attack can only be seen after the infestation has occurred. The larvae feed on the inner bark, pupate to form the adult beetles which leave the tree via 'D'-shaped exit holes (Figure 5). Sometimes these occur in close proximity to stem bleeds (Figure 6).

Figure 5 D-shaped exit hole caused by *Agrilus*.



Figure 6 *Agrilus* exit hole associated with stem bleeding.



Distribution of affected trees

The extensive stem bleeding typical of acute oak decline has been reported on oak trees in urban, parkland, farmland and woodland environments in many places in England and Wales – particularly in the Midlands. Figure 7 shows sites where symptomatic trees reported to Forest Research have been identified on the basis of site visits or photographic records collected between 2006 and 2009. The establishment of acute oak decline on a particular site begins with a small number of trees being affected, followed by a relatively rapid increase in numbers until more than half the oaks on the site can have symptoms of extensive stem bleeding.

Figure 7 Distribution of acute oak decline in England and Wales.



Cause of acute oak decline

Recent outbreaks of acute oak decline are now known to have involved pathogenic bacteria. It is thought that the bacteria cause the necrotic patches under the bark that leads to stem bleeds, however more trees need to be examined in detail to confirm this. It is not yet known how the disease is spread between trees, but bacteria present in the fluid seeping from the trunks could potentially be a source of infection.

It is difficult to make fully-informed recommendations about the management of infected trees until the exact cause of acute oak decline is more fully understood. Research is currently underway to improve understanding, identify the extent and severity of damage caused by the disease, and whether this is affected or exacerbated by environmental factors such as drought. Until more information is available, the following courses of action are recommended.

Managing acute oak decline

It is essential that you first determine the cause of any symptoms of ill health in oak trees so that the correct management practices can be applied. A number of pests and pathogens can cause stem bleeding (e.g. *Phytophthora*, see box below) and confirming cases of acute oak decline is difficult if it is based on visual symptoms alone. Bark samples may need to be taken from the tree for laboratory testing for an accurate diagnosis.

Survey, record and monitor

It is important that managers and users of woodlands are vigilant of the health of oak trees and if incidences of acute oak decline are suspected they should be monitored and reported (see page 6). This should be done by surveying and recording the number of symptomatic trees and the severity of their condition in the following way:

- Record the number and location (using either Ordnance Survey grid references or, more preferably, 10 point GPS readings) of symptomatic trees. Note the distribution of the trees relative to site features (e.g. low-lying territory, slope, water courses, roads, public access points).

Phytophthora diseases of trees

Management advice for dealing with acute oak decline is generally different to that for treating *Phytophthora* diseases of trees. *Phytophthora* is a destructive fungal-like organism that can cause stem bleeding on oak and many other tree species. *Phytophthora citricola*, *Phytophthora cinnamomi* and *Phytophthora cambivora* attack various species of oak in Britain, mainly causing bleeding on the trunk up to 1–2 m above ground level. In most cases the lesions are found to be linked with root or tree collar infections. Two other species of *Phytophthora* are currently causing concern because of their possible impact on the health of oak and other trees in Britain – these are now subject to statutory control and are notifiable. *Phytophthora ramorum* is the cause of a disease known as ‘sudden oak death’ which has caused extensive damage to trees in parts of the USA. Although this has now also been found in parts of Europe and in Britain, it appears that native British oaks are not as susceptible as American oaks. *Phytophthora kernoviae* is a more recent discovery and it can also cause damage to trees – particularly beech. Oak is more resistant to attack. Both of these *Phytophthora* species have affected trees mainly in southwest England.

For more information: www.forestry.gov.uk/phytophthora

- Record the severity of their condition. Severity can be indicated by the number and size of bleeding patches on the stem, the distance between bleeding patches and the condition of the tree canopy. Apart from having a record of the number of symptomatic trees it is also important to be aware of the proportion of affected and unaffected trees on the site, so this should be estimated (e.g. 10% of oaks affected).
- Take photographs to indicate the extent of damage on each tree. Close-ups of symptoms are useful but an overall picture showing the condition of the canopy and stem is usually more informative. Photographs taken over successive years allow changes in the condition of the trees to be analysed. Include pictures of any mushrooms near tree wounds, the base of the trunk, or on the ground around the roots.

Decide on a management option

General advice is to leave infected trees in place and continue to monitor, unless there is immediate concern about safety. If possible, cordon the trees off to prevent access. Try to minimise any contact with bleeds to reduce the possibility of transferring the disease from tree to tree.

However, if only a limited number of trees appear to be infected on a site, and most are of the same oak species, it may be prudent to fell and destroy the infected individuals – to keep infection levels low and reduce the risk of infecting healthy trees.

Felling infected trees

You should follow the good practice set out below if felling is the appropriate option:

- Avoid felling when conditions or trees are wet as this may increase the chances of spreading the pathogen(s).
- Strip the outer bark and sapwood of heavily infected and dying or dead trees after felling and burn on site. Rapid destruction of stripped bark is recommended to prevent the possibility of spreading the disease.

- You can chip the bark on site but the bark chipper should be disinfected before leaving the site (see Table 1). Chips should be left in piles and allowed to decompose naturally to minimise the risk of the bacteria being spread.
- Do not use bark chips or other parts of infected trees (e.g. leaves, bark, wood) for mulch, compost or soil conditioner.
- Do not use felled symptomatic trees to create a source of deadwood habitat on newly-planted sites .
- Do not move logs and branches off the site after felling without first stripping them of bark and sapwood. Logs can be planked on site to facilitate this.

Using the timber from infected trees

Caution should be exercised about the potential uses of wood from infected trees because it is not yet known if the disease affects timber properties. It is also unknown whether, or for how long, the bacteria can survive in the wood of affected trees. If kiln-drying the timber to reduce moisture content, use a high temperature (>60 °C) conditioning period at the end of the drying cycle to minimise the possibility of any bacteria surviving.

Pruning

Pruning infected trees is discouraged, unless dead branches pose an immediate health and safety risk. It can increase the risk of disease spreading and weaken the tree by reducing its capacity to contain or overcome the bacterial infection. It may also make trees more susceptible to secondary infections.

Biosecurity

Felling and pruning equipment should be disinfected after use. Pruning equipment should be cleaned and disinfected after use on an infected tree before moving on to the next tree. The soles of footwear and vehicle or bicycle tyres should be cleaned before leaving the site by removing mud and debris and spraying with disinfectant (see Table 1 for suitable disinfectants).

Table 1 Disinfectants suitable for cleaning footwear and equipment after use on sites with infected oak trees.

Disinfectant	Concentration	Exposure time	Health and safety*
Virkon	5%	Spray and allow to dry	Virkon material data sheet
Ethanol or industrial methylated spirits (methanol)	70%	Spray and allow to dry	Ethanol and ethyl alcohol material data sheet
LYSOL® spray	Undiluted	Spray and allow to dry	LYSOL® spray material data sheet

*All disinfectants should be used in accordance with the recommended safety precautions (refer to the material safety data sheet for each product).

Replanting options

General guidance in the face of both acute and chronic oak decline is that we should continue planting oak trees, but be especially careful to match trees to site conditions and plant trees of local provenance and origin. Until more is known about the exact cause of the condition and which oak species are susceptible, avoid replanting the entire site with the same oak species as diseased trees, and choose a mixture of broadleaves – including no more than 25% of the susceptible species. It is not yet known whether young nursery trees can be infected with the disease that causes acute oak decline and as yet there is no evidence of this occurring in Britain. However, be wary of collecting and planting acorns or young trees from infected sites as a precaution. Be especially cautious about using planting material from infected sites for plantings elsewhere.

Let people know

Consider letting woodland visitors and walkers know about the condition of affected oaks by putting up information notices at access points to the woodland. See the box below for suggested information to include in a public notice about acute oak decline.

Useful sources of information

Reporting affected trees

Oak trees with symptoms of extensive bleeding should be reported to the Tree Health Diagnostic Advisory Service based in Forest Research, who can also help with diagnosing the cause of stem bleeding (there may be a charge for this service).

Telephone: 01420 23000

Email: ddas.ah@forestry.gsi.gov.uk.

Publications

Forestry Commission Information Note (FCIN022)

Dieback of pedunculate oak

Online resources

www.forestry.gov.uk/planthealth

www.forestry.gov.uk/phytophthora

www.forestresearch.gov.uk/oakdecline

www.forestresearch.gov.uk/ddas

Information to include in a public notice about acute oak decline

Some of the oak trees in this woodland are suffering from a disease known as **acute oak decline**.

One of the main symptoms of this disease is extensive stem bleeding. Scientists from Forest Research (the research agency of the Forestry Commission) are currently investigating the causes of the problem.

You can help to protect healthy oak trees and prevent spreading this disease in the following ways:

- Avoid contact with trees showing symptoms such as stem bleeds and dead or dying branches.
- Do not touch the bleeding areas on tree stems.
- If you have been walking or cycling in an area where there are diseased trees, clean soles of walking shoes and bicycle tyres before entering areas where trees are not yet affected.
- Do not remove dead wood, branches or infected bark from the wooded area.

Thank you for your co-operation. For more information, visit: www.forestresearch.gov.uk/oakdecline

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