

Science & Research Projects Manager Harriet Rix shares some of the latest research on diseases affecting UK oak trees

Acute Oak Decline (AOD) and **Chronic Oak Dieback** (sometimes called Chronic Oak Decline (COD)) are two concerning diseases affecting the UK's iconic oak trees. Both seriously affect the health of oak trees, and both can eventually kill the tree. AOD inflicts blisters and black bleeds on the trunk and branches of the tree, while COD targets the tree's 'central nervous system', its roots, truncating its ability to take up water and nutrients and forcing leaves and branches to dieback. They can be found together on the same tree, but more often they're separate diseases.

While both diseases were identified in the UK about 30 years ago and are now widespread across the Midlands and South East England, scientists have been working hard to understand how they work and why they are having such serious impacts on oak trees. But the causes of these two diseases have proven to be mysterious. Last week, a group of experts gathered to share a raft of recent research, hoping to cast some light on these issues.

Bacteria and beetle: the intriguing drama behind acute oak decline

Acute oak decline is intriguing because many different organisms are now known to act together on the tree to cause it.

The current hypothesis is that a bacterium called *Brennaria goodwinii* is attracted to the presence of nitrogen on the leaves of the tree. It spreads down the trunk and produces chemicals which attract the *Agrilus bigguttatus* beetle to the tree. The beetle lays eggs underneath the bark of the trunk, which hatch into larvae and start munching.

The presence of the beetle tells the *Brennaria* to release proteins that soften the wood of the trunk – a bit like biological washing powder. This both feeds the bacterium, which eats the softened wood, and helps the beetle get established in larval galleries – holes inside the cambium (the growing part of the tree just underneath the bark).

In most cases, the tree would start to produce the toxic chemicals and tannins that make up its immune system, and these would kill the *Brennaria* and be enough to stop the beetles causing real damage. However, in this case other bacteria, most notably one called *Gibbsiella quercinecans*, work together to weaken the tree's immune response.

Under attack from all sides, a cavity forms in the tree so quickly that the tree cannot isolate the infected area from the rest of the tree as it normally would. The rot therefore spreads further into the tree, into its sapwood (the soft, recently formed layers of wood between the heartwood and the bark) and xylem (the tubes that suck water up from the ground to the leaves).

When transpiration is strong the sap heading up the xylem will ooze out of the cavities that have been formed and form the distinctive black bleeds down the tree.

Another pathogen tag-team: honey fungus and Phytophthora

In the case of COD, the pathogens associated with the disease include *Armillaria* (Honey-fungus) and the destructive water-mould *Phytophthora*. (Cool fact – 'phytophthora' in Greek means 'the plant-destroyer!') The mystery in this case is that it's not certain what the primary pathogen is. Oaks affected with Chronic Oak Dieback will shed their canopy of leaves, and display wounds or lesions on

their roots. Affected trees can continue to decline for over a century, but it is unlikely that they will ever recover.

Oak trees are under environmental stress

Unusually in the tree disease world, the research shared last week suggests that the cause of both these oak diseases could be a weakening of oak trees as a result of environmental stresses, rather than a specific pathogen. One possible common cause of stress is nitrogen levels. In sites where both AOD and COD occur, the levels of nitrogen salts in both the canopy floor and the air tend to be higher. Nitrogen salt deposits on leaves encourage bacterial growth, and higher nitrogen in the soil affects tree-friendly fungal networks so that they no longer offer the nutritional support they usually provide oaks. This could be one reason that the tree starts to be attacked by pathogens.

What is causing this increase in nitrogen levels which is affecting our oak trees so much? Agriculture is by far the largest source of nitrogen salts in the UK, and so it may be that oaks are being affected much more seriously than we think by intensive farming.

What can we do?

In happier news, there are some things people who care for and manage trees can do.

Firstly, learn and check for the symptoms of AOD in your local trees, which include:

- one or many **dark weeping** patches on the stem; **dark fluid** running down the tree trunk
 - evidence of **fluid which has dried and caked** on tree stems; patches of decay in the live tissue beneath areas which are 'bleeding'
 - 'D-shaped' exit holes approximately 4mm wide and 3mm high caused by the *Agilus biguttatus* beetle, and underneath the surface, networks of tunnels, or larval galleries. Find more detail on the [Forest Research AOD page](#).
1. Report signs of these diseases on the [Observatree tree monitoring system](#) (do this whenever you have concerns about a tree disease or pest).
 2. If you know any land managers or farmers, share this blog and encourage them to use fewer fertilisers.