

### Acute Oak Decline in Britain

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Dieback and decline on pedunculate (*Quercus robur*) and sessile (*Q. petraea*) oak is recognised as a complex syndrome present in Europe at least since the early 1900s. However, recently a closer and discerning evaluation of the disorder in Britain revealed a discreet and distinctive condition called Acute Oak Decline (AOD), within the broader concept of oak decline. It is identified by weeping patches emanating from fissures between bark plates on trunks of established trees (>50 yrs-old). Beneath the outer bark extensive necrosis of the inner bark occurs frequently resulting in the formation of cavities. Using a draw knife to pare through three symptomatic bark panels (W\*L=47\*62cm<sup>2</sup> each), consecutively removed from one side of a felled tree and tracing the necrotic tissue using digital image analysis software, it was shown that 20% of the surface area in these panels was necrotic. Damage occurred throughout the phloem but decreased in the sapwood. The distribution of the necrosis occurred over the entire tangential arc of the panels causing severe disruption and damage to the vascular tissue with consequent dysfunction that would inflict considerable carbon starvation of roots and fluid stress on the tree. Larval galleries of the oak Buprestid, *Agrilus biguttatus*, were also present on the cambial-phloem interface. Similar disorders have previously been described in Europe but the causes remain unresolved or attributed to *A. biguttatus*. In AOD we hypothesised that tissue necrosis was caused by biotic factors. A study using conventional isolation techniques to determine putative biotic causal agents was carried out on 21 symptomatic and 9 healthy trees from 17 sites across England. A range of selective media was used to plate pieces of surface disinfested tissue. Various fungal species were isolated but at low incidence and frequency. By contrast, bacteria were isolated with high incidence. Most bacterial taxa proved to be novel species and in some cases novel genera were created to accommodate them. The bacterial species composition of healthy trees was significantly different to symptomatic ones (P=0.001). Healthy trees were characterised by mostly Gram-positive bacteria which were fewer in symptomatic trees but high levels of Gram-negative bacteria particularly members of the *Pseudomonadaceae* and *Enterobacteriaceae*, were present in symptomatic oak. Two Enterobacterial species *Brenneria goodwinii* and *Gibbsiella quercinecans*, were consistently isolated from symptomatic tissue but not healthy trees suggesting a possible causal role in lesion formation; whereas multiple *Pseudomonas* spp. were present in both healthy and symptomatic trees negating that probability. The pathogenicity of *B. goodwinii* and *G. quercinecans* is currently under investigation. Inoculation studies demonstrated the necrogenic ability of both organisms although there was interaction with the host wound response in some cases. *In vitro* polysaccharide and tobacco tests also gave supportive evidence of necrogenic capability. Although further work on necrosis still needs to be carried out we can conclude provisionally that *B. goodwinii* and *G. quercinecans* play a role in causing the tissue necrosis that characterises AOD.

**Keywords:** *Agrilus biguttatus*, bacteria, *Brenneria goodwinii*, *Gibbsiella quercinecans*, oak decline