Ramorum dieback of larch

Since 1995, the Oomycete pathogen *Phytophthora ramorum* has killed >1 million live-oak and tanoak trees in the USA. It has also spread rapidly across Europe, mainly within the ornamental nursery trade. From 2003 onwards it was found infecting rhododendron and woodland trees outside nurseries in Britain, but until 2009 numbers of affected trees were comparatively few (~100). Infection was limited to foliage or stems of Fagaceae (mainly *Fagus, Nothofagus, Quercus and Castanea*), all growing close to infected *Rhododendron ponticum*. However, in 2009 extensive dieback and mortality caused by *P. ramorum* was verified in Japanese larch, *Larix kaempferi,* growing in south west England and later in south Wales. Symptoms include needles with black or purple discolouration, as well as needle loss. Affected trees often have copious resin bleeding on the trunk, branches and side shoots, as well as dieback of branches and sometimes the entire crown.

Research evidence has revealed

- *P. ramorum* in Britain (and Europe) is a single lineage (EU1) almost exclusively of one mating type; it is also distinct from lineages in North America (NA1 and NA2).
- Over 100 species of trees, shrubs and herbaceous plants are susceptible to *P. ramorum* but only plants such as rhododendron, which support high levels of sporulation on foliage, cause epidemics resulting in lethal stem infections on trees.
- Infected larch needles support high levels of sporulation, leading to stem infections on larch and many other tree species, usually within 100m.
- Even when sporulating hosts (such as larch) are removed, *P. ramorum* persists in soil on affected sites for years, even apparently after surface burning.
- *P. ramorum* infects wood and bark to varying degrees raising more quarantine issues.

Known evidence gaps

- Susceptibility and sporulation potential of hybrid and European larch, compared to Japanese larch, is unknown.
- Aetiology: connection between needle infections and stem lesions is enigmatic.
- Common and extreme distances for aerial dispersal likely to initiate new infection foci.
- Safe protocols to handle infected bark and wood, to prevent infected material from moving into wood utilisation chain and horticultural trade.
- Adaptation to larch and risk of hybridisation with other Phytophthora species
- Confirmation of *P. ramorum* infection of larch foliage and bark is difficult; improved PCR based diagnostic tools are needed.
- Remote sensing techniques capable of accurately identifying all larch plantations in Britain to aid surveillance and disease detection.

Potential impact

Larch (mainly Japanese larch) comprises almost 10% of the conifer growing area of Britain (134,000 ha). Based on current disease findings over the past year, approx 1600 ha of larch in England and Wales (both FC and privately owned) have been felled to contain and prevent disease spread. Timber volumes of the felled larch equate to ~340,000m^3, and biosecurity measures are now in place to license log movements to authorised sawmills and wood processors, so potentially infected material is processed and the co-product safely disposed of to prevent further disease spread in line with EU plant health requirements.