

## Distribution and etiology of aerial stem infections of *P. ramorum* and *P. taxon C* at three woodland sites in the UK

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*Phytophthora ramorum* and *Phytophthora* taxon C are recently invasive pathogens in woodlands in southern Britain. *P. taxon C* is a newly discovered taxon, shortly to be named *P. kernovii* sp. nov. Both species can aggressively infect foliage and shoots of *Rhododendron ponticum* and then spread aurally to attack the inner bark of tree stems, especially *Fagus sylvatica* and some *Quercus* species, causing bleeding lesions. Three woodlands in south-west England with extensive naturalised understory *R. ponticum* infected with *P. ramorum* and/or *P. taxon C* were investigated for spread of these pathogens onto trees.

Following a preliminary survey, 127 trees with 'suspicious' external stem symptoms were investigated for *Phytophthora* by isolation. Overall, 18/49 (37%) of trees investigated at Site 1 yielded a *Phytophthora*, 24/63 (38%) at site two and 10/15 (67%) at site 3. *P. ramorum* was isolated from aerial stem lesions on *F. sylvatica*, *Q. cerris*, *Aesculus hippocastanum* and *Nothofagus obliqua*. *P. taxon C* was isolated frequently from beech and a *Liriodendron tulipifera*. *P. citricola*, an established endemic, was regularly isolated from *Acer pseudoplatanus*, and may also have spread from the adjacent diseased rhododendron. *P. ilicis*, another recently invasive aerial *Phytophthora*, was obtained from stems of two Chinese *Ilex* species. Surprisingly, *P. gonapodyides*, a weak parasite and common soil inhabitant, and *P. cambivora*, an established endemic collar pathogen, were also obtained from aerial bark lesions on several beech trees.

26 mature (50-140 cm diam) *F. sylvatica* were investigated for processes of local spread and infection. These included proximity to rhododendron, pattern and mode of spread within a tree, and tree response. Three trees were infected with *P. ramorum*, 22 with *P. taxon C* and one with both *Phytophthoras*. Aerial bark lesions, ranged in size from small ca 3 cm diam. fresh infections to lesions of >1m diam. These occurred from near ground level to 11m. One tree had completely girdling lesions for over 6 m of its length.

The study indicated: (i) intact beech bark can be penetrated and infected by *P. ramorum* zoospores and probably by *P. taxon C* zoospores; (ii) direct contact or close proximity (< 3m) to infected rhododendron is a major but not universal factor in infection; (iii) rainwater accumulation and run-off at branch forks may account for a minority of infections; (iv) simultaneous multiple infection of stems is occurring; (v) vertical spread may occur within a tree; (vi) *P. ramorum* and *P. taxon C* can penetrate and be recovered from the underlying wood; (vii) the tree may respond to a bark lesion by attempting to wall it off with callus; (viii) *P. taxon C* (at least) may pump water out of the xylem into the inner bark; (ix) stem lesions sometimes extend 10-20 cm below ground level; (x) some trees are multiply infected by *P. taxon C*, *P. ramorum* and *P. gonapodyides*; (xi) developing lesions are soon invaded by unknown basidiomycetes and ascomycetes.

Wider risk issues arising from these observations will be discussed.