Monitoring *Phytophthora ramorum* in Soil, Leaf Litter, Rain Traps, and Watercourses in an Historical Cornish Garden[1]

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Abstract

Phytophthora ramorum was identified as the cause of a leaf blight on rhododendrons in an historic garden in Cornwall in 2003. A programme of measures was set in place to eradicate the disease from the garden and several sites were selected to monitor the effect of these measures on the recovery of *P. ramorum* from soil, leaf litter, rainwater and watercourses. The results from two monitoring sites are presented plus the results of leaf baiting of the watercourses. After the removal of the infected rhododendron at Site 1 and the application of a composted mulch over the soil surface, *P. ramorum* was no longer detected in the soil samples. At another site (Site 4), which consisted of a clump of several large 'Cornish Red' rhododendrons, removal of the host was not practical, and instead, the lower branches were removed to encourage airflow through the canopy. Although the detection of *P. ramorum* in soil samples has gradually declined at this site, fallen leaves have continued to harbour the pathogen, with some seasonal variation showing lowest recovery during the summer months. Recovery of *P. ramorum* from watercourses was also lowest in the summer and greatest in the spring.

Key words: *Phytophthora ramorum*, rhododendron, soil, rainwater, watercourses.

Introduction

Phytophthora ramorum was first identified as causing infection on a number of rhododendrons in the garden in July 2003. A programme of work was initiated to eradicate the disease without destroying the important historical features of the garden. Several monitoring sites were established to assess the effects of the work on the recovery of *P. ramorum* from soil, leaf litter, rainwater and watercourses.

Materials and Methods

In December 2003, a grid of eight $1m^2$ quadrats was marked out on the ground at a site (1) below a canopy of *Quercus ilex*, camellia and a rhododendron infected by *P. ramorum*. Rain traps were also set up to collect rainwater passing through the canopy. Initially, these were at ground level, but later they were raised to 1m above ground level. Low-level rain traps were reintroduced in October 2005, this time with rhododendron leaf baits included. Soil and/or leaf litter samples were collected from

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each $1m^2$ quadrat at roughly monthly intervals until June 2004 when the infected rhododendron was removed. The number of quadrats was then increased to 12 and sampling continued until February 2005 when a layer of composted mulch, about 10cm deep, was spread over the soil surface. The soil and mulch layer were then sampled separately until April 2006.

A further infested site (4) was identified in May 2004. This consisted of a clump of several 'Cornish Red' hybrid rhododendrons which formed a major feature of the gardens. Grids (four groups of three $1m^2$ quadrats) were marked out beneath the canopy and high-level rain traps were set up at three points. Low-level rain traps were introduced in October 2005, adjacent to the high-level traps. Soil and fallen leaves were sampled from each quadrat at roughly monthly intervals until December 2006. Rainwater was also collected from the rain traps at each site at each visit. The soil, fallen leaves and rainwater samples were examined for the presence of *P. ramorum* at the Central Science Laboratory, York, using techniques described elsewhere (Lockley and others, this volume). Several small pools and some larger ponds were also tested for the presence of *P. ramorum* using rhododendron leaf baits, consisting of small ($1cm^2$) pieces of rhododendron leaf contained in a muslin bag. Baits were left in the water for periods of 7-10 days.

Results and Discussion

P. ramorum was detected in soil/leaf litter at Site 1 mainly during the winter months and in one quadrat in May. Once the composted mulch had been applied, *P. ramorum* was no longer detected in the soil, although it was occasionally found in the mulch. Low-level rain traps at Site 1 were positive for *P. ramorum* in March and April 2004, and between November 2005 and May 2006. High-level rain traps gave positive results in June and December 2005 and again in March 2006.

Isolations from fallen leaves at Site 4 consistently yielded *P. ramorum*. Initially in the summer 2004, only 40 to 50 percent of quadrats were positive, but by November 2004, *P. ramorum* was isolated from 100 percent of samples. Levels of infection decreased in August and September 2005, but recovered again and remained high until May 2006. Samples collected in June and September 2006 showed a marked reduction in infection before levels rose again in December 2006. Despite the high levels of infected leaves recovered from quadrats on the ground, the soil samples (with the exception of a few quadrats) generally failed to yield *P. ramorum*.

Baiting of watercourses generally showed low levels of *P. ramorum* in the summer and winter, but samples taken in the spring and, to a lesser extent, in the autumn, were frequently positive for *P. ramorum*.

Seasonal variations in the recovery of *P. ramorum* have been demonstrated in this garden. The low level of infection found in fallen rhododendron leaves at Site 4 during August and September contrasted with much higher levels found over the rest of the year. Interestingly, these higher levels of detection were not accompanied by obvious increases in foliar symptoms, which were mainly confined to young, soft growth in the spring. This period coincided with the most frequent recovery of the pathogen from watercourses in the gardens.

The measures taken at Site 1 to minimize the disease (removal of the infected rhododendron and application of composted mulch over the soil surface) appear to have been successful. *P. ramorum* has not been recovered from the soil or mulch at that site since December 2005. At site 4, the removal of lower branches in autumn 2004 to allow greater flow of air through the interior of the 'Cornish Red' appears to have had little effect on leaf infection, although soil infection has gradually declined.

The low-level rain traps have been more successful in trapping *P. ramorum* than high-level traps, probably because they are prone to rain splash from the soil surface, but the inclusion of rhododendron leaves in these traps may have contributed towards greater recovery of *P. ramorum*.

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Literature Cited

Lockley, D.; Turner, J.; Humphries, G.; Jennings, P. 2007. Monitoring *Phytophthora ramorum* and *P. kernoviae* in soil and rainwater samples collected at two sites on a Cornish estate This volume.