

Management of *Phytophthora ramorum* at a Botanical Garden in Washington State, USA

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In March 2015 *Phytophthora ramorum* was detected at The Bloedel Reserve, a 150 acre botanical garden in Kitsap County, WA. Infected plants were destroyed and the soil in an area surrounding these plants was steam-sterilized to a depth of 15 cm during the summer of 2015. An IPM program was developed in an effort to control the spread of *P. ramorum* and other *Phytophthora* species in the garden, reduce the risk of *P. ramorum* spread to the surrounding landscape, and minimize additional destruction of valuable plants and visual impacts to the garden. Several treatments were employed, including the use of *Phytophthora*-specific fungicides, removing host vegetation, soil steaming, replanting affected areas with non-host or host plant species that have shown some resistance to *P. ramorum*, and the use of *Trichoderma* biocontrol agents and mulch to reduce spread of disease from soil to plants. Surveys in the *P. ramorum* positive areas and perimeter were done during 2015-2018. Symptomatic foliage was collected and tested for *Phytophthora* using ELISA. Any ELISA positive samples were tested for *P. ramorum* with PCR. Isolates of *P. ramorum* were genotyped using microsatellite markers.

Many of the *P. ramorum* positives were detected on certain native hosts. In February 2016, the IPM strategy was therefore modified to include the removal of native host vegetation within the positive areas. Fungicides were applied in the positive areas during 2016-2018. The rate of ELISA+ plants was between 37% - 90% during this time period. The rate of ELISA+ samples has decreased in the positive areas since the peak of 90% in October 2016 and has stayed below the initial 72% measured in January 2016.

Seven NA1 microsatellite genotypes of *P. ramorum* were detected at Bloedel between March 2015 – February 2016. The two most commonly found genotypes were identical to the genotypes of *P. ramorum* from two nurseries in Washington State. The remaining five genotypes have only been detected at Bloedel and are very similar to the nursery genotypes. These are probably derived from the nursery genotypes rather than being new introductions.

Fungicide applications and long term continual removal of native host plants in the positive areas, and the reapplication of Plant Helper (*Trichoderma atroviride*) in areas that were identified as higher risk due to slope and proximity of prior positive sites has been continued until the present. The Plant Helper is applied as a soil drench and then covered with a mulch that is made from chipped alder wood and other vegetation, but not containing host plant material, on the Reserve. Expanding the use of *Trichoderma*s in the prior positive areas of the Reserve to include areas further from these known positive sites is being considered. Soil steaming was effective in the immediate areas of the positives that were detected, but there are extensive areas that should be protected from potential infestation, and there may be undetected infestations that could be mitigated by added populations of *Trichoderma* in the soil.