Management of Foliar Infection of Rhododendron by *Phytophthora ramorum* With Film Forming Polymers and Surfactants[1]

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Abstract

Phytophthora ramorum, causal agent of sudden oak death (SOD) and ramorum leaf blight, remains a persistent problem of regulatory concern within the horticultural industry. Damages to nurseries have been realized as a result of enforced quarantine and sanitation efforts designed to prevent the spread and establishment of this invasive pathogen. Additionally, the introduction of *P. ramorum* to heritage gardens provides a treatment challenge when the goal to prevent local spread conflicts with the preservation of plant collections. There is a need for the development for alternative treatments that may prevent *P. ramorum* infection, particularly of foliar tissues from which sporangia are produced.

Film-forming polymers (FFPs, also commonly marketed as anti-transpirants) and surfactants are promising treatments to prevent *P. ramorum* infection of rhododendron. Five FFPs (Anti-Stress 2000, Moisturin, Nature Shield, Nu-Film P, and Vapor Gard) and three surfactants (Tergitol NP-7, Zonix, and an unregistered AGAE product) were screened with detached leaf assays utilizing rhododendron cv. Roseum Elegans. Anti-Stress, Nu-Film, and a Zonix and Nu-Film combination were retained for additional experiments testing for utility at managing *P. ramorum* on horticultural rhododendron.

To test durability of protection of leaves from infection, potted 1-gal. rhododendrons cv. Roseum Elegans were sprayed with Zonix, Anti-Stress, or Nu-Film and maintained with overhead irrigation in a container yard for 4 weeks. Plant leaves from each treatment were removed at weekly intervals and challenged in detached leaf assays. A second trial included an additional treatment of Zonix combined with Nu-Film. Overall, the Zonix treatments provided the least amount of protection and Nu-Film and the combination treatment provided the most protection; however, all treatments declined in efficacy over the 4 weeks, especially in Trial 2.

The capacity for these treatments to protect rhododendron plants from foliar *Phytophthora* infections was then tested from two different sources of inoculum naturally occurring in nurseries: (a) exposure to infested surface waters and (b) aerial spread from infected plants. For (a), potted 2-gal rhododendron plants were sprayed with DI-water, Anti-Stress, Nu-Film, or a Nu-Film and Zonix mixture. Fourteen branches per treatment were removed and dipped in a *P. ramorum* zoospore suspension for 4 minutes. Branches were incubated for 7 days at 68 °F, and leaf lesion area was measured.

For objective (b), potted 2-gal rhododendron plants were sprayed with DI-water, Anti-Stress, Nu-Film, or a Nu-Film and Zonix mixture. Plants were arranged in groups on pallets under shade cloth in a container yard. At this time, detached leaves infested with *P. plurivora* in the laboratory were clipped to flags and placed within the upper canopy of plants to act as a primary inoculum source. New, untreated field-

[1] A version of this paper was presented at the Sixth Sudden Oak Death Science Symposium, June 20-23, 2016, San Francisco, California.

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inoculated rhododendron plants were also placed in the center of each group of test plants to act as an inoculum source. Plants and inoculum were left in the container yard until mid-May, after which we collected all symptomatic leaves and plated them in selective media to confirm infection by *P. plurivora*.

In the dip trial (objective a), plants treated with DI-water (control) had the greatest number of *P. ramorum*-positive branches and the greatest lesion area. All treatments significantly reduced average lesion area relative to controls. For aerial spread between plants (objective b), infection rates for test plants in the container yard were low. Plants treated with DI-water (control) had the greatest number of infected leaves per plant; the least amount of infection was observed on plants treated with Anti-Stress and the Nu-Film and Zonix mixtures.

Lastly, these compounds were tested to examine how they affected sporulation and lesion development when applied post-infection. Wounded leaves were inoculated with *P. ramorum* zoospores 1 day prior to application of Zonix, Anti-Stress, Nu-Film, or a Nu-Film and Zonix mixture. After 10 days, lesion sizes were measured and the numbers of sporangia produced per leaf were counted. All treatments, except for Nu-Film, significantly reduced the number of sporangia produced. None of the treatments caused a significant reduction in symptom development relative to controls.

From these studies, it appears that either an Anti-Stress 2000 or a Nu-film P and Zonix combination may prove valuable in preventing the establishment and spread of *P. ramorum* in nurseries and ornamental gardens due to reductions in infection and sporulation. These materials are already used in the nursery industry, although the anti-transpirants are not labeled for use as pesticides. The surfactant Zonix is labeled for use as a biofungicide on ornamentals and vegetable crops in most states. Nu-Film should also help prevent the washing off of Zonix from plant foliage by rainfall or overhead irrigation. In contrast to conventional chemical treatments (e.g. mefenoxam), these compounds pose a reduced risk for the development of resistant isolates and allow for the detection of infected plants while minimizing the risk of further inoculum spread.