We are unable to supply this entire article because the publisher requires payment of a copyright fee. You may be able to obtain a copy from your local library, or from various commercial document delivery services.

From Forest Nursery Notes, Summer 2013

85. © Nitrogen fertility influences growth and susceptibility of rhododendrons to *Phytophthora ramorum*. Hummel, R. L., Elliott, M., Chastagner, G., and Riley, R. E. HortScience 48(5):601-607. 2013.

Nitrogen Fertility Influences Growth and Susceptibility of Rhododendrons to *Phytophthora ramorum*

Rita L. Hummel[1], Marianne Elliott, Gary Chastagner, Robert E. Riley, Kathy Riley, and Annie DeBauw

Washington State University, Puyallup Research and Extension Center, 2606 W. Pioneer, Puyallup, WA 98371

Additional index words. foliar disease, *Rhododendron* 'Cunningham's White', *Rhododendron* 'English Roseum', *Rhododendron* 'Compact P.J.M.', nursery production, ammonium nitrate

***Abstract*. Growth and susceptibility of evergreen *Rhododendron* 'English Roseum', 'Cunningham's White', and 'Compact P.J.M.' to *Phytophthora ramorum* in response to biweekly nitrogen (N) fertilizer application at rates of 25, 75, and 150 mg N per 11.4-L container was evaluated during two growing seasons. At the end of both growing seasons, horticultural evaluation of the different plants showed that 150 mg N-fertilized cultivars had superior shoot growth, visual quality, leaf color, and the highest leaf N concentration, whereas the 25-mg N cultivars were inferior for these characteristics. Plants fertilized with the 75-mg N rate were typically intermediate to the 150- and 25-mg N plants for the measured characteristics. During the first growing season, the number of flower buds on 'Cunningham's White' and 'English Roseum' was not influenced by N rate but the second season bud numbers increased with increasing N fertilizer. Foliar susceptibility to *P. ramorum* was influenced by N fertilizer application rates in the most susceptible cultivars, 'English Roseum' and 'Cunningham's White', in which lesion size and infection frequency both increased at higher N rates. The results were variable in 'Compact P.J.M.', the most resistant cultivar.**

The environmental impact of container nursery production practices has come under increasing scrutiny in recent years (Majsztrik et al., 2011). Fertilizer applications to containerized plants typically exceed requirements and irrigation is often excessive, resulting in nutrient leaching, runoff, and potential contamination of surface and groundwaters (Biernbaum, 1992; Chen et al., 2001; Lea-Cox et al., 2004; Majsztrik et al., 2011). Research has shown that marketable containerized plants can be produced using lower N rates and less water (Cabrera, 2003; Ku and Hershey, 1997; Majsztrik et al., 2011; Ristvey et al., 2007; Scagel et al., 2011). The Best Management Practices (BMP) Guide (Yeager et al., 2007) describes fertilization and irrigation strategies nurseries can follow to prevent environmental contamination.

In addition to reducing the potential for N pollution, lower N applications may reduce the incidence of plant disease. Under some conditions, high N rates have been reported to increase disease levels in plant disease pathosystems (Halsall et al., 1983; Mittelstrab et al., 2006). The exotic oomycete plant pathogen *Phytophthora ramorum*, the causal agent of sudden oak death, has caused significant damage to forests in coastal northern California and millions of dollars in losses in the nursery industry in California, Oregon, and Washington (Dart and Chastagner, 2007b; Hansen et al., 2005a, 2005b; Werres et al., 2001). Many *Phytophthora* species cause root diseases on their hosts; however, *P. ramorum* can colonize the roots of hosts such as rhododendron without causing symptoms (Vercauteren et al., 2013). *Phytophthora ramorum* causes symptoms on the aerial portions of its hosts. On many ornamental and forest plants, *P. ramorum* only causes leaf spots or shoot dieback in contrast to the lethal stem cankers found on oak (*Quercus* spp.), tanoak (*Notholithocarpus densiflorus*), and beech (*Fagus* spp.).

In 2000 to 2002, scientists demonstrated that the spread of *P. ramorum* was associated with the movement of nursery stock, and control efforts were established by the U.S. Department of Agriculture Animal Plant Health Inspection Service (APHIS). These efforts focused on surveying nurseries and eradicating the pathogen (APHIS, 2010; Dart and Chastagner, 2007a). However, the repeated recovery of *P. ramorum* from production and retail nursery sites suggests nurseries can potentially act as reservoirs for the pathogen (Dart and Chastagner, 2007b; Tjosvold et al., 2002). Thus, regulators, researchers, and industry have come to the realization that an integrated approach will be essential to effectively and sustainably limit the spread of *P. ramorum* by nursery stock (Dart and Chastagner, 2007b).

There are currently no data available to support or refute how N fertility affects disease severity of *P. ramorum* on nursery hosts. *Phytophthora ramorum* is the model organism of choice because it is a driving force behind current BMP reforms. *Rhododendron* is the most logical model plant to use in pathological studies of *P. ramorum* because *Rhododendron* spp. account for most of the plants associated with positive nursery finds in North America (APHIS, 2012; Dart and Chastagner, 2007a). *Rhododendron* species and hybrids are also important hosts of *P. ramorum* in Europe (De Dobbelaere et al., 2009; Werres et al., 2001).

In this study, we use the *P. ramorum*–rhododendron pathosystem as a model to investigate the dynamics between N application rates and disease development. Specifically, we tested the hypothesis that higher N fertility would result in increased disease incidence and severity.

Materials and Methods

Plant material. Three rhododendron cultivars shown to vary in their susceptibility to *P. ramorum* (M. Elliott, unpublished data; Tooley et al., 2004), 'English Roseum' (highly susceptible), 'Cunningham's White' (moderately susceptible), and 'Compact P.J.M.' (moderately resistant), were purchased from a wholesale nursery as 2-year-old #1 (2.8-L, 15 cm diameter × 21 cm tall) container-grown plants. On 3 Apr. 2008, they were transplanted to #3 (11.4-L, 25.5 cm diameter × 22.5 cm tall) containers in a 100% douglas-fir bark substrate amended with Scotts Micromax micronutrient mix at a rate of 1038 $g \cdot m^{-3}$. Plants were randomized on a gravel nursery bed and irrigated daily with overhead sprinkler irrigation but were not fertilized to allow for depletion of residual fertilizer in the substrate. After 8 weeks, just before the start of N treatments, all plants were moved to a drip irrigation system. Water was applied through an emitter consisting of a 56-cm length of 3.2-mm microtubing with holes laser drilled in a preset spacing of 9 cm that was formed into an 18-cm diameter circle around the stem of each plant. The circular emitter was attached through a tee-fitting to a non-perforated 3.2-mm microtube that was attached to a pressure-compensating drip emitter originating on the 12.7-mm irrigation main line. This arrangement allowed for uniform distribution of water to the surface of the growth substrate. Water was applied daily at 0800 HR until plant growth and increasing temperatures necessitated twice-daily applications at 0800 and 1400 HR. Containers were watered to minimize leaching, leaching fraction (volume of leachate/volume of water applied) not to exceed 0.1, by monitoring leachate volumes and adjusting irrigation as needed.

Received for publication 29 Nov. 2012. Accepted for publication 19 Mar. 2013.

This research was supported in part by the Washington State University College of Agricultural, Human, and Natural Resource Sciences' Emerging Research Issues for Washington Agriculture Grant Program.

Mention of a trademark, proprietary product, or vendor does not constitute a guarantee or warranty nor does it imply approval to the exclusion of other products or vendors that also may be suitable.

[1]To whom reprint requests should be addressed; e-mail hummelrl@wsu.edu.