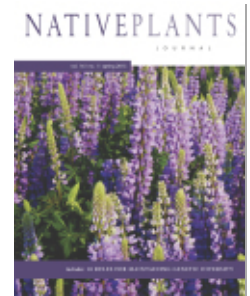




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First detection in the US: new plant pathogen, *Phytophthora tentaculata*, in native plant nurseries and restoration sites in California

Suzanne Rooney-Latham, Cheryl L Blomquist, Tedmund Swiecki, Elizabeth Bernhardt, Susan J Frankel



Native Plants Journal, Volume 16, Number 1, Spring 2015, pp. 23-26
(Article)

Published by University of Wisconsin Press

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First detection in the US: new plant pathogen, *Phytophthora tentaculata*, in native plant nurseries and restoration sites in California

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ABSTRACT

Phytophthora tentaculata Kröber & Marwitz (Pythiaceae) has been detected in several native plant nurseries in 4 California counties and in restoration sites on orange sticky monkey flower (*Diplacus aurantiacus* (W. Curtis) Jeps. subsp. *aurantiacus* [Scrophulariaceae]), toyon (*Heteromeles arbutifolia* (Lindl.) M. Roem. [Rosaceae]), coffeeberry (*Frangula californica* (Eschsch.) A. Gray [Rhamnaceae]), and sage (*Salvia* spp. L. [Lamiaceae]). These findings are the first detections of *P. tentaculata* in the US and the first ever on these host plants. *Phytophthora* species are a known problem in horticultural nurseries, but little attention has been placed on native plant or restoration nurseries. The potential for plant pathogens to be outplanted along with native plant nursery stock is very high, posing a threat to neighboring forests.

Rooney-Latham S, Blomquist CL, Swiecki T, Bernhardt E, Frankel SJ. 2015. First detection in the US: new plant pathogen, *Phytophthora tentaculata*, in native plant nurseries and restoration sites in California. *Native Plant Journal* 16(1):23–26.

KEY WORDS

Diplacus aurantiacus subsp. *aurantiacus*, *Heteromeles arbutifolia*, *Frangula californica*, *Salvia*, native plant nursery propagation, reforestation, forest pathogens, plant disease prevention, Pythiaceae, Scrophulariaceae, Rosaceae, Rhamnaceae, Lamiaceae

NOMENCLATURE

Plants: USDA NRCS (2014)

Fungus: *Phytophthora* database, <http://www.phytophthoradb.org> (Park and others 2013)

Recent detections of plant pathogens in California native plant nurseries and restoration sites are raising concerns about forest pathogens being introduced from native plants outplanted from restoration nurseries. These concerns are prompted by the detection of *Phytophthora tentaculata* Kröber & Marwitz (Pythiaceae) in several native plant nurseries in 4 California counties and in reforestation sites on orange sticky monkey flower (*Diplacus aurantiacus* (W. Curtis) Jeps. subsp. *aurantiacus* [Scrophulariaceae]) (Figure 1), toyon (*Heteromeles arbutifolia* (Lindl.) M. Roem. [Rosaceae]), coffeeberry (*Frangula californica* (Eschsch.) A. Gray [Rhamnaceae]), and sage (*Salvia* spp. L. [Lamiaceae]). These findings are the first detections of *P. tentaculata* on these host plants and the first ever in the US (Rooney-Latham and Blomquist 2014). The pathogen causes root rot and stem cankers, resulting in collapse and death of infected plants.

In Europe and China, *P. tentaculata* has been found on *Apium* L. (Apiaceae), *Aucklandia* Decne. (Asteraceae), *Chicorium* L. (Asteraceae), *Chrysanthemum* L. (Asteraceae), *Delphinium* L. (Ranunculaceae), *Gerbera* J.F. Gmel. (Asteraceae), *Lavandula* L. (Lamiaceae), *Santolina* L. (Asteraceae), *Origanum* L. (Lamiaceae), and *Verbena* L. (Verbenaceae) in both nurseries

and commercial fields (Meng and Wang 2008; Martini and others 2009; USDA APHIS 2010; Wang and Zhao 2014).

The USDA New Pest Response Guidelines lists *P. tentaculata* as a threat to nurseries and forests (USDA APHIS 2010). To prevent long-distance movement of this new pest, the USDA APHIS New Pest Advisory Group determined that *P. tentaculata* is “actionable and reportable,” and any detection must be reported to USDA APHIS by state agriculture departments.

Phytophthora tentaculata is not the only *Phytophthora* species found on plants in restoration nurseries and restoration sites. Recent investigations into the decline of reforestation plants in Alameda and San Mateo Counties and source nurseries recovered other *Phytophthora* species from symptomatic and asymptomatic native plants and nursery soil. These included *P. cactorum*, *P. cambivora*, *P. cryptogea*, *P. inundata*, *P. megasperma*, *P. multivora*, *P. nicotianae*, *P. plurivora*, and *P. quercetorum*. Although pathogenicity has not yet been confirmed on all of the hosts from which they were isolated, these detections suggest that movement of *Phytophthora* species in native plant nursery stock is more common than previously recognized.

Phytophthora ramorum Werres, de Cock & Man in't Veld, the cause of sudden oak death, provides an example of severe



Figure 1. The orange sticky monkey flower on the left is healthy; the one on the right shows a discolored main stem, a symptom of *Phytophthora tentaculata* infection. Photos by Suzanne Rooney-Latham, California Department of Food and Agriculture

ecological damage caused by a pathogen introduced to wildlands by way of nursery plants and demonstrates the problems regulated *Phytophthora* species can cause for the nursery industry (Mascheretti and others 2009; Osterbauer 2010; Grünwald and others 2012). Damage was first recognized in California forests in the mid-1990s. Since then, USDA Forest Service aerial surveys have shown that *P. ramorum* has killed more than 3 million trees in California. It has also cost the nursery industry millions of dollars in direct losses, lost sales, and costs for quarantine compliance. International trade has also been affected as more than 65 countries have placed restrictions on the movement of plant material from the US (Sansford and others 2009).

PHYTOPHTHORA TENTACULATA IN NURSERIES

Like other *Phytophthora* species, *P. tentaculata* produces swimming spores that move in splashing water and runoff. The pathogen can spread quickly between closely spaced nursery plants, especially if runoff puddles beneath pots. A comprehensive system of clean production practices is needed to prevent introduction and spread of *P. tentaculata* and other *Phytophthora* species. One such systems approach to best management practices is described in the Oregon Safe Procurement and Production Manual (Griesbach and others 2012). Primary components of a clean production system include use of new or clean pots, pathogen-free potting mix, pathogen-free planting stock (seed, cuttings, or other propagules), proper cleaning and sanitation measures, and elevating containers above native soils. Because *Phytophthora* species thrive in saturated soil and standing water and are then spread through runoff, proper water management is critical. Additional assistance in implementing management practices is available from cooperative extension or state and local agricultural departments.

CONCLUSION

Currently, the full extent of *P. tentaculata* and other *Phytophthora* species in conservation nurseries and restoration sites in California and other states is unknown. *Phytophthora* species are a chronic problem in horticultural nurseries, but little attention has been placed on native plant or restoration nurseries (Landis 2013). Reforestation stock may not be subject to the same standard of cosmetic perfection as ornamental nursery stock; consequently, there may be a higher likelihood of diseased plants being accepted for outplanting. Restoration nurseries provide planting stock for wildland settings so any associated pathogens can be moved into new locations and can

cause lasting environmental damage. The inadvertent outplanting of infected rare and endangered plant species poses an especially serious risk to remaining wild populations and limited habitat areas, which may become permanently infested. Although reforesting native landscapes is generally a positive intervention, responsibility must be taken by the grower of the plants and the contractor of the reforestation efforts to prevent the spread of new, damaging exotic plant pathogens in propagative material.

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Edited by Daniel J. Nadenicek *University of Georgia*
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ISSN: 0277-2426, e-ISSN: 1553-2704, 2/year

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