Phytophthora Species Associated With Forest Soils in Central and Eastern U.S. Oak Ecosystems[1]

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Abstract

The existence of native and exotic species of *Phytophthora* in soils of eastern and central oak ecosystems is largely unknown. This informational void and the potential threat of *P. ramorum* to eastern oak species provided the impetus for a multiple state survey of soils associated with oak cover types. The initial survey was conducted from April to June 2004 in oak forests in Illinois, Indiana, Maryland, Michigan, Minnesota, Ohio, Pennsylvania, Wisconsin and West Virgina. Sampling sites were chosen to avoid areas impacted by oak wilt, recent storm damage or major defoliation. Although most stands contained a diverse community of tree species, oaks generally predominated. Stands were greater than 40 years of age and located on moist sites. Eight sites were usually sampled in each state. At each site, four soil samples were taken 1.5 m from the base of an oak tree in four cardinal directions. Sub-samples from each tree were bulked; five trees were sampled per site. As of January 2005, a total of 96 sites were surveyed and soils from 499 oak trees sampled. An oak leaf baiting procedure was used whereby soils from each tree were placed in a container, mixed and flooded with distilled water. Three- to seven-day-old *Quercus robur* leaflets were floated on the water surface to bait *Phytophthora*. Leaf samples that trapped *Phytophthora* were plated on PARPNH-medium. When initial isolations attempts failed, soils were dried at room temperature and the isolation procedure repeated. Twenty-three percent of the samples from individual trees yielded *Phytophthora*; *P. cinnamomi* was the most frequently recovered species (77 percent). Other species recovered included *P. europaea, P. cambivora, P. citricola* and yet undescribed species. A comparable survey was conducted during fall 2004 to establish a more complete assemblage of *Phytophthora* species so that studies of their role in forest health could be initiated.

Key words: oak decline, *Phytophthora cinnamomi, Phytophthora europaea, Phytophthora ramorum, Phytophthora* spp.

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Incidence of *Phytophthora* species in eastern oak forests

In total, 96 sites were surveyed and 499 oak trees sampled during spring 2004. *Phytophthora* species were isolated from 50 percent of the sites and recovered from 23 percent of the soil samples (*table 1*). During the spring sampling period at least seven species of *Phytophthora* were recovered with *P. cinnamomi* being the most frequently isolated species (76.5 percent). The second most common species was *P. citricola* (8.4 percent). Other species were less common and sporadically recovered. These include *P. europaea*, *P. cambivora* and two yet undescribed *Phytophthora* species. In prior oak forest surveys in Europe, 13 *Phytophthora* species were isolated, including five new species (Balci and Halmschlager 2003a,b; Delatour, 2003). Likewise, results of our spring survey suggest that various *Phytophthora* species exist in central and eastern oak forests, including several unknown species. Soil samples collected from Illinois, Minnesota, Michigan and Wisconsin gave fewer positive results. One reason for this discrepancy in isolation frequency could be due to the sandy soils associated with Lake State soils.

Isolation frequencies of *Phytophthora* spp. in relation to associated oak species

Soils yielding *Phytophthora* species were taken from the base of 11 oak species. Only soils from *Quercus falcata and Q. stellata* failed to yield any species of *Phytophthora.* To our knowledge *Q. coccinea, Q. muehlenbergii, Q. ellipsoidalis, Q. macrocarpa* and *Q. platanoides* are new host associations for *P. cinnamomi*. *Q. alba, Q. rubra* and *Q. velutina* are new associations for *P. europaea*.

The frequent recovery and widespread distribution of *P. cinnamomi* in hardwood forest soils within the survey areas has not been previously reported. The absence of *P. cinnamomi* in Illinois, Minnesota, Michigan and Wisconsin might suggest a climatic limitation to its survival in soils in colder regions or nonconducive soil types.

Table 1—The isolation frequencies of *Phytophthora* spp. in oak forest sites and soils from base of oak trees during spring 2004.

State	Sites	Positive sites	Total soil samples	Positive soil samples	*Phytophthora* spp.
Illinois	10	1	50	1	*P. citricola*
Indiana	8	6	40	20	*P. cinnamomi*
Maryland	12	6	62	14	*P. cinnamomi*, *P.* sp2
Michigan	6	0	30	0	-
Minnesota	8	2	40	3	*P. quercina 'like'*
Ohio	8	6	40	16	*P. cinnamomi*, *P. citricola*, *P. cambivora*, *P.* sp2
Pennsylvania	8	2	40	3	*P. cinnamomi*, *P. cambivora*, *P.* sp2
Wisconsin	8	3	40	3	*P. europaea*, *P. quercina'like'*, *P.* sp2
West Virginia	28	22	157	56	*P. cinnamomi*, *P. citricola*, *P. Europaea*, *P.* sp1, *P.* sp2
Total	**96**	**48 (50%)**	**499**	**116 (23%)**	

References

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