Phytophthora cinnamomi Associated with Mortality of Native Vegetation in South Africa

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ABSTRACT

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Isolations were made from dead and dying plants from native vegetation in mountainous areas of the South Western Cape Province of South Africa. *Phytophthora cinnamomi* was recorded on 11 genera from five families of native plants at 28 remote, apparently undisturbed sites. No sign of invasion of the native plant communities by *P. cinnamomi* was observed. *P. cinnamomi* appears to be indigenous to the mountains of this region.

Additional key words: indigenous hosts, Proteaceae, rivers

Phytophthora cinnamomi Rands is a destructive invader of native forests in southwestern Australia and in areas of southeastern Australia (8,10,21,22). In the South Western Cape Province of South Africa (SWCP), early reports of *P. cinnamomi* associated with cultivated indigenous Proteaceae (13,14) prompted a warning (4) that spread of *P. cinnamomi* to native vegetation might also lead to destruction of the indigenous vegetation in this region.

The unspoiled mountain ranges of the SWCP contain a sclerophyllous shrub vegetation called fynbos, the major component of the Cape Floristic Kingdom (5,12), and comprise one of the most floristically rich regions of the world (3,6). The montane ecosystems of the region are rugged with elevations to 2,000 m and an annual rainfall of 600–3,000 mm. The climates are Mediterranean or sub-Mediterranean (5). The mountains are protected against the activities of man not only for their botanical value but also because they form the catchments of the rivers, which are the major source of water for the region.

After *P. cinnamomi* was recovered from dying native plants at several remote mountain sites in 1977, more extensive sampling of dying plants in the mountain ranges was initiated. The results of those investigations are reported in this paper. Rivers draining some mountain catchments were concurrently sampled for *P. cinnamomi* as described elsewhere (16).

MATERIALS AND METHODS

Most the protected SWCP mountain ranges lying above forestry and agricultural activities were visited during 1977–1980. Dying plants were sampled

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opportunistically by members of parties involved in surveys and research in remote situations where no roads and often no footpaths existed. Because recovery of *P. cinnamomi* from plants dead for some time is generally very low, only plants that were dying or appeared to have died recently were sampled. Sixty-three samples of roots and accompanying root-zone soil were taken from such plants. Samples were placed in plastic bags to prevent desiccation and kept below 30 C. The general distribution of known hosts and visibly affected plants in the surrounding vegetation was noted. Isolations and identifications of *P. cinnamomi* from root and soil samples were made as described previously (15).

RESULTS AND DISCUSSION

All dying or dead plants observed in the mountain areas occurred as scattered individuals. Known hosts with no sign of disease were prevalent in surrounding vegetation. Diseased plants were not apparently associated with possible introduction points such as hiking or game trails, and in no case was there an evident pattern of mortality correlated with access routes. *P. cinnamomi* was isolated from 28 of 63 plant samples taken. The sites at which *P. cinnamomi* was recovered were distributed sporadically in mesic or wet mountain fynbos (7) (Fig. 1). Many of the sites were on remote mountain peaks. All lay above 800 m and were accessible only on foot.

P. cinnamomi was isolated from samples of 11 indigenous genera from five plant families (Table 1). Most of the records (24/28) were from the family Proteaceae. These hosts have been included in a recent host list compiled for this region (15).

The presence of *P. cinnamomi* in rivers flowing from the mountain catchment areas, and particularly the high concentrations recorded for some headwaters (16), suggest that the fungus is active in these catchments and that it is more prevalent than is indicated by the limited number of diseased plants recorded in this study. However, we observed no patterns of disease occurrence and spread similar to those reported for invaded plant communities in Australia (8,10,19–21) such as patch deaths, advancing fronts, or spread from likely points of introduction.

In Australia, *P. cinnamomi* has been very destructive to the native plant communities that it has invaded (8,18, 19,21), causing extinction of certain species and destruction of more than half of some plant communities within a few weeks. Native vegetation in the mountains of the SWCP contains many hosts of *P. cinnamomi* (5,15), some of which are highly susceptible to the pathogen (17); however, we observed no destructive effects in plant communities during this study. In fact, there was no evidence to support a hypothesis of invasion.

The origin of *P. cinnamomi* in these mountains is unknown. The pathogen occurs in agricultural and forestry areas of South Africa (15). It could have been introduced to Africa as early as the 15th or 16th century by traders (2) and could also have been brought to South Africa on plant material on many occasions before the implementation of quarantine regulations. It seems unlikely, however, that *P. cinnamomi* has spread from forestry and agricultural areas and established itself in the remote, undisturbed mountain sites without being destructive. A more likely explanation of the present findings is that *P. cinnamomi* is an indigenous component of the native ecosystems of these mountains.

Regardless of its origin, *P. cinnamomi* is present in the native vegetation of the mountain areas without causing appreciable damage. Control measures therefore appear unwarranted at this time, but monitoring for increases in mortality of native vegetation is necessary in areas where future recreational, conservation, or management activities might result in localized disturbance.

Management practices can create potential disease hazards by altering

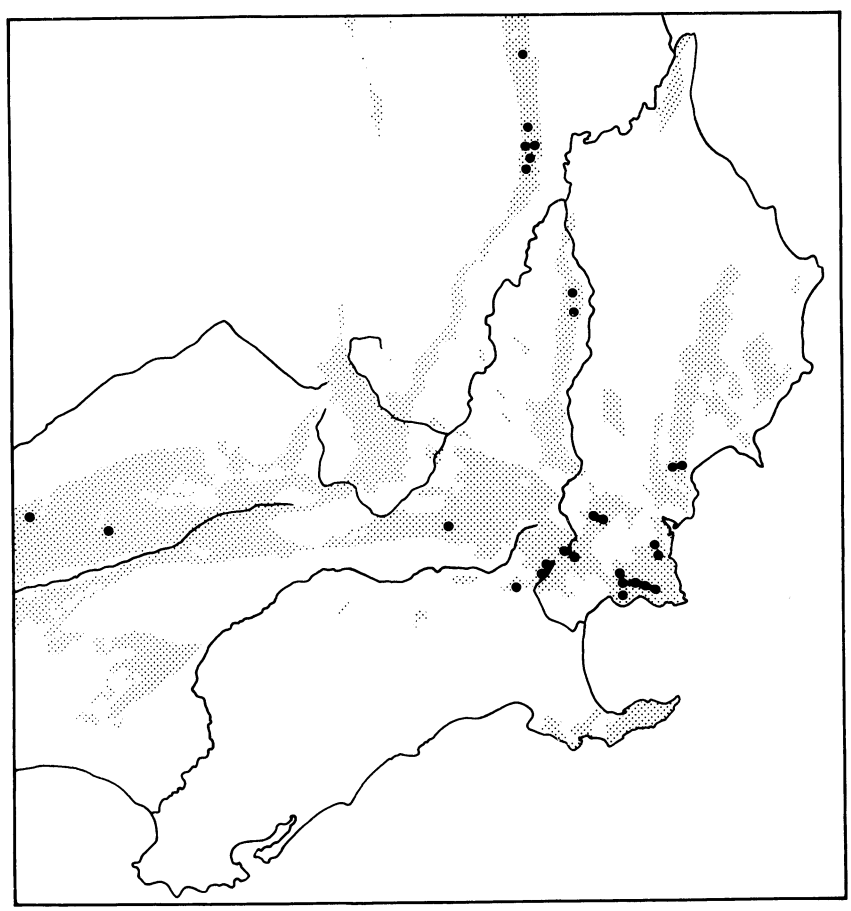

Fig. 1. Map of the South Western Cape Province and its major rivers, showing the distribution of sites where *Phytophthora cinnamomi* occurred on dying plants (dots) in mesic and wet mountain fynbos vegetation (stippling).

Table 1. Indigenous hosts at 28 sites in mountain catchments of the SWCP from which *Phytophthora cinnamomi* was isolated

Hosts	No. of sites
Cupressaceae	
Widdringtonia cedarbergensis Marsh	1
Ericaceae	
Erica sp.	1
Fabaceae	
Priestleya sp.	1
Proteaceae	
Aulax pallasia Stapf	1
Leucadendron argenteum (L.) R. Br.	1
L. gandogeri Schinz ex Gand.	1
L. laureolum (Lam.) Fourc.	2
L. rubrum Burm. f	1
L. salicifolium (Salisb.) I. Williams	1
L. salignum Berg.	2
L. reflexum Buek ex Meisn.	1
Mimetes argenteus Salisb. ex Knight	1
M. hottentotticus Phill. & Hutch.	3
M. splendidus Salisb. ex Knight	3
Orothamnus zeyheri Pappe ex Hook.	4
Protea sp.	1
Protea nitida Mill.	1
Serruria kraussii Meisn.	1
Rosaceae	
Cliffortia grandifolia Eckl. & Zeyh.	1

drainage and providing soil conditions that favor Phytophthora root disease (11). In Western Australia, *P. cinnamomi* caused increased losses in forest ecosystems in situations where soil was excessively disturbed and drainage was disrupted (1). In South Africa, changes in the health of the surrounding vegetation should therefore be assessed when operations such as road making, drain construction, and trail and track formation are undertaken in previously undisturbed areas. A study should also be made of the effects of major disturbances in several SWCP mountain catchments where dams are being built to meet increased water requirements. This could provide data on whether soil and drainage disturbance can shift the environmental balance in the mountain catchments to the extent that *P. cinnamomi* becomes destructive.

Alteration of the natural fire regime with certain prescribed burning practices has significantly increased Phytophthora root rot in Western Australian forests (11) by changing the understorey composition and by providing favorable soil conditions through removal of the litter layer (9). Fire is also used in the management of fynbos in mountain catchments of the SWCP (12), and the effects of prescribed burning on the status of *P. cinnamomi* in the catchments should be considered in current evaluations of these procedures.

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