At Bend, Oregon Nursery

Pythium and nematode species implicated in root rot

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A variety of pathogenic organisms commonly infest forest soils and eventually affect the quality of nursery stock. Recurrent root-rot problems at the Bend, Oregon nursery prompted efforts to uncover the causes and determine possible remedies.

Sooner or later, forest nursery soils become infested with populations of pathogenic organisms that may drastically reduce the quantity and quality of the nursery stock that can be produced. Cultivation practices-such as heavy fertilization and plentiful moisture-coupled with the close spacing of seedlings produce an abundance of fine, succulent roots on which pathogenic organisms thrive. These organisms attack the seedling roots, and they multiply in the soil with each succeeding crop until few plants escape damage. In the South and elsewhere, recent practices emphasizing fumigation at recurring intervals have not only controlled most root diseases but have also given good weed control (7, 12).

Earlier Studies

The literature abounds with accounts of the organisms isolated from nursery soils and diseased

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2Research on *Pythium* supported in part by the Georgia Forest Research Council.

plants *(4, 6, 11). Fusarium spp., Pythium spp., Phyt.ophthora spp., Sclerotium bataticola,* , and various nematodes have been associated with root diseases. Inoculation studies have shown that *Fusarium* and *Pythium* invade fine roots. However, the identification of specific organisms and measurements of their relative abundance are often influenced by the isolation techniques used and may not truly represent the role that any given fungus plays in the total disease picture.

Recurring root-rot at the Bend, Oreg. Nursery stimulated efforts to find the cause and to investigate possible remedial measures (9). Earlier studies had implicated *Fusarium oxysporum* as the cause of root rot of ponderosa pine. Crop rotation, the addition of sawdust to the soil, and irrigation to reduce soil temperature were suggested as possible control measures. Apparently, sawdust incorporated in the soil at a rate of 10 tons per acre reduced seedling diseases temporarily.

Since 1966, when an agar medium was developed which effectively selects *Pythium* and *Phytophthora spp.* from soil, considerable attention has been given to the presence of these pathogens in nursery soils (5). *Pythium* spp. were found to be generally distributed in nursery soils, and often related to root and seedling mortality. Many nurseries in the South and Southeast had unexpectedly high populations of parasitic *Pythium spp.* The presence of these fungi, plus the known association of *Fusarium* spp. with seedling mortality, suggest a possible *FusariumPythium* complex known to exist with other crops (8).

Methods

In April 1970, 67 soil samples from the Bend Nursery were sent to our laboratory for *Pythium, Phytophthora,* and nematode assays. They were assayed for Py*thium* and *Phytophthora* spp. by four different methods: The apple technique (1), a baiting technique with citrus leaves (3), modified Kerr's medium (5), and a gallic acid medium (2). Populations in terms of propagules per, gram (ppg) of ovendry soil were determined by both the Kerr's medium and the gallic acid medium but are reported here only for the Kerr's medium because both methods gave similar results. Nematodes were separated from the soil by the sugar flotation method, and numbers were determined by a standard procedure. Because the main purpose of this report is to record the presence of pathogenic organisms, other than Fusaria, common to nursery soils, no attempt has been made to relate populations and organisms to specific nursery areas.

Results and Discussion

No phytophthora spp. were recovered from the samples. However, *Pythium* populations were relatively high in most of the 67 soil samples:

Propagules per gram	Number of samples
1-9	3
10-19	8
20-29	6
30-39	16
40-49	14
50-59	4
60-69	7
70+	9
Average	48

Pythium ultimum was isolated from 87 percent of the samples, *P. debaryanum-irregulare* from 6 percent, *P. aphanidermatum* from 2 percent, and unidentified *Pythium spp.* from 2 percent. Py*thium acanthicum, P. periilum, P. rostratum, P. spinosum, P. torulosum,* and P. *vexans* were isolated from less than 1 percent of the samples.

The nematode population was relatively low, with only a few stubby-root and lesion nematodes recovered (table 1). Thus it would appear that nematodes are not contributing significantly to root deterioration in this nursery. However, we should point out that nematodes do not survive in soil during shipment as well as fungi, and hence our results from the nematode assay may not reflect true populations in the areas sampled.

TABLE 1.—*Rate of recovery of nematodes in the 67 soil samples from the Bend, Oreg., Nursery*

Nematodes	Nematodes/100 cc soil					
	0	4	8	12	16	20+
	Number of soil samples					
Stubby-root	38	15	5	4	1	4
Lesion	66	1	0	0	0	0

The history of the root-rot problem at the Bend Nursery illustrates the difficulty in pinpointing the actual causes of root mortality. Isolations from diseased fine roots of nursery stock invariably result in the recovery of *Fucariuyn* spp. to the near exclusion of *Pythium* species. The newer techniques of soil isolation often show high *Pythium* populations in areas where Fusaria and other fungi are the principal or-

ganisms isolated from diseased roots. This pattern seems to indicate that the *Pythiums,* which attack only very succulent fine roots, open the way for greater root damage from *Fusarium spp.* Also, poor mycorrhizal development as a result of high soil temperatures, heavy fertilization, and other practices may deprive. fine roots of the protection that mycorrhizal structures naturally afford (10).

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