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# *THELEPHORA TERRESTRIS* ASSOCIATED WITH STUNTING OF CONTAINER-GROWN DOUGLAS-FIR SEEDLINGS USDA FOREST SERVICE NURSERY, COEUR D'ALENE, IDAHO

R.L. James

## ABSTRACT

Dwarfing and chlorosis of container-grown Douglas-fir seedlings at the USDA Forest Service Nursery, Coeur d'Alene, Idaho was due to occlusion of drainage holes on styroblock containers by the common nursery saprophytic/mycorrhizal fungus *Thelephora terrestris*. Mycelial growth was so extensive that root egress and water drainage were greatly impaired. The problem is usually controlled by proper sterilization of reused containers, primarily by hot water immersion. This may be supplemented with bleach and/or fungicide treatments if the problem persists.

## INTRODUCTION

Many different maladies potentially affect conifer seedling crops in container nurseries. Some are caused by abiotic factors such as temperature and moisture extremes; others are related to cultural treatments like chemical toxicity. However, probably the most important damaging agents in container nurseries are pathogenic fungi that elicit many types of diseases on most conifer species (James 1984; James et al. 1991). Several of these fungi are aggressive pathogens under greenhouse conditions. Greenhouse environments are very conducive to infection and spread by pathogens as well as disease development in susceptible crops (James 1984; James et al. 1987). Although particular pathogens have a history of causing problems in nurseries, some fungi occur irregularly. When uncommon organisms cause important seedling diseases, diagnosis and development of satisfactory control methods may be difficult.

During 2003, portions of container-grown Douglas-fir (*Pseudotsuga menziesii* Franco var. *glauca* [Mayr] Sudw.) seedling crops at the USDA Forest Service Nursery, Coeur d'Alene, Idaho, were very stunted and somewhat chlorotic when compared to surrounding seedlings (figure 1). Demarcation between affected and non-affected seedlings was distinctly associated with specific containers; in some cases affected seedlings became necrotic and limited mortality occurred (figure 2).

Although dwarfed, chlorotic seedlings may be indicative of root diseases (James 1984; James et al. 1987, 1991), patterns of the problem indicated that something specific to particular containers was involved. When affected containers with seedlings were examined, definitive occlusion of drainage holes with fungal mycelium was evident on their undersurfaces (figure 3). Mats of fungal mycelium occluding drainage holes were extensive enough to restrict root egress and prevent water drainage (figure 4). This plugging of drainage holes with fungal mycelium was characteristic of all examined containers with dwarfed, chlorotic seedlings.

According to growers, the problem was unusually severe. Therefore, steps were to taken to identify associated fungi and recommend procedures to reduce severity in the future.

Figure 1. Styroblock tray with poor growth and dwarfing of container-grown Douglas-fir seedlings - USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Figure 2. Comparative growth of container-grown Douglas-fir seedlings with and without fungal occlusion of container drainage holes - USDA Forest Service Nursery, Coeur d'Alene, Idaho. Note necrosis of some affected seedlings.

Figure 3. Undersurface of a styroblock container with drainage holes obstructed by fungal mycelia - USDA Forest Service Nursery, Coeur d'Alene, Idaho.

Figure 4. Extensive occlusion of drainage hole by fungal mycelia prevents egress of seedling roots and water drainage -USDA Forest Service Nursery, Coeur d'Alene, Idaho.

## MATERIALS AND METHODS

One of the most severely-affected containers was sampled for the fungi associated with drainage hole occlusions. Mycelium from 20 occluded drainage holes were aseptically placed in sterile, distilled water. This fungal material was agitated and rinsed three sequential times in new baths of sterile, distilled water. The goal was to remove as much surface contamination as possible. Normally this is done with a disinfectant such as bleach. However, since bleach was probably toxic to the fungi trying to be isolated, several rinses in sterile, distilled water had to suffice.

After rinsing mycelia, they were aseptically dissected and small pieces 2-3 mm in length and transferred to 2% water agar. Plates were incubated on a lab bench at about 24°C for 2-3 days. Hyphal tips were aseptically cut from emerging fungi and transferred to potato dextrose agar to facilitate identification. Despite the series of rinses used to reduce surface contamination, many of the isolations were extensively contaminated with bacteria. However four axenic cultures were obtained; morphologically and microscopically they all appeared to be the same fungus.

## RESULTS AND DISCUSSION

The fungus isolated from affected containers did not produce spores in culture. However, there were definitive clamp connections on hyphae, indicating

that the fungus was a Basidiomycete (Burt 1914; Weir 1921). Colony pigmentation was dark brown. Based on these characteristics and previous experience with similar fungal growth on the undersurface of styroblock containers (James 1984) and bare root seedling beds (James 1988), the fungus was tentatively identified as *Thelephora terrestris* Eer. (Burt 1914; Farr et al. 1989; Weir 1921).

*Thelephora terrestris* is a common fungus in bare root and container forest nurseries (Hepting 1971; Sutherland and Van Eerden 1980; Zak and Marx 1964). The fungus is mycorrhizal, particularly on bare root seedlings (Hacskaylo 1965; Hepting 1971). It has been called the "smothering fungus" (Sutherland and Van Eerden 1980) because if may completely cover slow-growing seedlings, particularly when seedlings are small and grown in portions of seedbeds that remain wet for prolonged periods. In most cases, *T. terrestris* does not invade seedling tissues and cause tissue necrosis like typical pathogens (James 1988). Also, it does not usually cause important molding of seedlings during cold storage.

Occurrence of *T. terrestris* on styroblock containers to the point of causing seedling problems has been rare. Restriction of adequate water drainage causes prolonged waterlogging and reduces oxygen exchange in root systems. Such conditions often lead to root colonization by specific fungal pathogens, particularly *Cylindrocarpon* (James et al. 1994) and *Pythium* spp. (James 1982, 1986). At some nurseries, workers manually scrape *T. terrestris* mycelium from the bottom of containers following seedling extraction, prior to hot water immersion. Hot water is usually toxic to fungi residing on containers, including *T. terrestris*. However, if some inoculum survives, this may provide the basis for fungal buildup on the next seedling crop. Exposing containers to a bleach solution in addition to hot water may help reduce future problems. If seedling stunting occurs, it may become necessary to treat the undersurfaces of containers with fungicides, such as Cleary's 3336®, or to mechanically break apart occlusions. In any event, careful and frequent inspections of seedlings are important to determine anomalies early.

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R.L. James is Plant Pathologist, USDA Forest Service, Northern Region, Forest Health Protection. Address: USDA Forest Service, 3815 Schreiber Way, Coeur d'Alene, ID 83814; email rjames@fs.fed.us.