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# STORAGE MOLD ON CONIFER AND HARDWOOD SEEDLINGS – UNIVERSITY OF IDAHO RESEARCH NURSERY, MOSCOW, IDAHO

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## ABSTRACT

Large numbers of molded conifer and hardwood seedlings were discovered during the spring at the University of Idaho (UI) Research Nursery. Many seedlings had extensive molding on foliage as well as necrotic stem lesions caused by colonizing fungi. The most common fungal associates included five species of *Cylindrocarpon*, several non-sporulating fungi, and two species each of *Fusarium* and *Pythium*. All associated fungi appeared capable of saprophytic and limited pathogenic colonization of seedling tissues under seedling storage conditions. Storing seedlings at below freezing temperatures, which is the most effective way to prevent molding, is not an option at the nursery because seedlings need to be available to customers on short notice throughout extended periods during the winter and spring.

## INTRODUCTION

During the spring, several different conifer and hardwood seedling species at the University of Idaho Research Nursery, Moscow were discovered with extensive mold that had developed during cold storage over the previous winter. Growers routinely keep stored seedlings for extended periods at above-freezing temperatures to enable the stock to be shipped to many clients on very short notice. Molded seedlings had

fungal mycelial growth of varying intensity over stem and foliar tissues. Necrotic stem lesions were often associated with superficial fungal growth (figure 1). Laboratory investigations were conducted to determine presence of potentially-pathogenic fungi associated with molded seedling tissues.

Figure 1. Hardwood seedling with superficial mycelial growth on its main stem. Necrotic stem lesions were evident near areas of superficial mycelial growth (arrow).

## MATERIALS AND METHODS

Seedlings with superficial mycelial growth were examined for presence of necrotic stem lesions. Stem lesion tissues were thoroughly washed under running tap water. Thin hand sections were made through the margins of lesions (where necrotic and healthy tissues met). Sections were surface sterilized in a 10% bleach solution (0.525% aqueous sodium hypochlorite), rinsed in sterile water, blotted dry, and placed on 2% water agar (WA). Plates were incubated in the dark at about 24°C for 48-72 hrs; selected emerging fungi were transferred to potato dextrose agar to facilitate identification. At least two hand sections were sampled from each necrotic lesion. Single spore cultures of associated *Cylindrocarpon* and *Fusarium* and spp. were made onto carnation leaf agar (Fisher et al. 1982); isolates of these fungi were identified using the taxonomy of Booth (1966) and Nelson et

al. (1983), respectively. *Pythium* isolates were identified using the taxonomy of Waterhouse (1968).

Microscopic examinations were also made directly from superficial mycelium growing on several molded seedlings. Selected sporulating isolates were transferred to WA and subsequently single-spored and identified as described above.

## RESULTS AND DISCUSSION

Several different groups of fungi were isolated from the edges of necrotic lesions and superficial mycelium on molded seedlings. The two major groups of sporulating fungi were *Cylindrocarpon* and *Fusarium*. There were also several isolates of non-sporulating fungi, which could not be identified, and low levels of *Pythium*.

The most common fungi associated with molded seedlings were *Cylindrocarpon* spp. Five different species were identified: *C. gracile* Bugn., *C. didymium* (Hartig) Wollenw., *C. tenue* Bugn., *C. obtusisporum* (Cooke & Harness) Wollenw., and *C. orthosporum* (Sacc.) Wollenw. These species are delineated on the basis of chlamydospore production and microconidia and macroconidial septations and dimensions (Booth 1966). For example, both *C. gracile* and *C. orthosporum* do not produce chlamydospores or microconidia, whereas *C. obtusisporum* produces both chlamydospores and microconidia. *Cylindrocarpon tenue* and *C. didymium* produce chlamydospores but not microconidia. This diverse community of *Cylindrocarpon* species was isolated from both conifer and hardwood seedlings and found colonizing necrotic stem lesion tissues as well as growing superficially on stems and foliage.

Two species of *Fusarium* (*F. avenaceum* (Fr.) Sacc. and *F. acuminatum* Ell. & Ev.) and *Pythium irregulare* Buisman were also isolated from stem lesions and superficial mycelium but at much lower levels than *Cylindrocarpon* spp.

All of the fungi isolated from molded seedlings were probably organisms infecting seedlings in the nursery. Storage mold pathogens often colonize foliage, stems, roots or soil while seedlings are being grown (Dennis 1993; Hocking 1971; James 1986, 1988, 1989, Lundquist 1992, Sutherland and Van Eerden 1980). Most of these fungi are not usually considered important nursery pathogens, although some of them are capable of eliciting seedling diseases under highly-conducive environmental conditions. Apparently, the conditions under which seedlings were stored at the UI Nursery were conducive to fungal infection and development because of extensive invasion of stems, resulting in necrotic lesions, that occurred. High humidity, above-freezing temperatures, and extended storage periods undoubtedly promoted vegetative growth by these fungi, resulting in spread among stored seedlings and increasing levels of disease (Hocking 1971; Sutherland and Van Eerden 1980; Venn 1980, 1981).

The most effective method of limiting damage by storage mold fungi is to keep seedlings at below freezing temperatures (as monitored within storage boxes) and to quickly thaw seedlings just prior to

outplanting (Hodges 1961; James 1986, 1988; Sommer 1985; Sutherland and Van Eerden 1980). However, this cannot be done at the UI Nursery because of the need to have stock readily available for shipment to the field throughout the winter and spring. Fungicides (applied to seedlings prior to placing them in storage) are sometimes used to reduce incidence and spread of common storage mold fungi (Barnett and Brissette 1988; Hallgren and Ferris 1995; Sutherland and Van Eerden 1980). However, problems of handling seedlings with pesticide residues often preclude treatment with chemical fungicides (Dennis 1993; Sutherland and Van Eerden 1980). It is also important to limit the amounts of soil and growing media that are distributed over foliage during packing because many organisms causing storage molds are likely inhabitants of soil or growing media (Hocking 1971; James 1986, 1988, 1989; Lundquist 1992; Sutherland and Van Eerden 1980). Periodic examination of stored seedlings during storage will alert growers of the potential for mold damage. If seedlings are beginning to mold, they should be removed and either stored at colder temperatures, treated with pesticides, or culled to prevent spread to other seedlings. Monitoring levels of molding of seedlings throughout the storage period will preclude discovery of extensive damage requiring discarding large amounts of stock.

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