

STORAGE MOLD OF BAREROOT DOUGLAS-FIR SEEDLINGS
SWAN LAKE RANGER DISTRICT,
FLATHEAD NATIONAL FOREST
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During June, 1989 several boxes of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) 2-0 seedlings at the Swan Lake Ranger District, Flathead National Forest, contained excessive amounts of mold when they were opened prior to outplanting. Seedlings were netted together with extensive growths of grey-black mycelium (Fig. 1). Attempts were made to identify fungi which were associated with the molding of seedlings. Several extensively molded seedlings were examined carefully under the microscope and sporulating fungi were identified using a standard taxonomic guide (Barnett and Hunter 1972). Tufts of mycelium were aseptically transferred to potato dextrose agar plates which were incubated for several days at either 24°C or 5°C, after which associated fungi were identified.

Several groups of fungi were commonly associated with the molded seedlings. They included *Botrytis*, *Rhizopus*, *Aspergillus*, *Penicillium*, *Epicoccum*, and at least one type of non-sporulating fungus with dark grey mycelium. This latter fungus grew especially well at lower temperatures (5°C) and not at all at the higher temperature. This fungus resembled that which had been previously associated with the molding of Engelmann spruce seedlings (James 1986). Most of these fungi were common saprophytes, although *Botrytis* can be an aggressive pathogen under cool, moist conditions (James 1984).

Extent of conifer seedling molding while in storage is related to amounts of soil that is deposited on foliage during packing (Hopkins 1975) and the temperatures at which they are stored (Hopkins 1975; Sutherland and others 1989). The examined Douglas-fir seedlings had some soil on their foliage, although not excessive amounts. Inside box temperatures for November and early December 1988 (Table 1) indicated that they were most often stored at 1-2.5°C above freezing. At such low temperatures, growth of most fungi is severely limited (Sutherland and others 1989). However, some will continue to grow even at low temperatures. For example, the unidentified dark grey mold grew quite well in the laboratory at just above freezing. In order to completely restrict growth of potential storage mold fungi, seedlings must usually be

stored at temperatures 2-3° below freezing (Sutherland and others 1989). If stock is frozen for most of its storage period, it should be thawed gradually and watched closely for molding during the thawing process.

Controlling storage temperatures is usually the most effective and economical means of preventing storage mold of conifer seedlings. Removing molded seedlings from storage and dipping them with fungicide is usually not recommended because it is too expensive and often not effective. If possible, storage temperatures should be kept below freezing and not allowed to fluctuate greatly. Another precaution would be to wash excess soil from roots before packaging since this soil is often a major inoculum source of fungi causing molding.

Table 1.--Temperatures (°at which Douglas-fir seedlings (Lot 4180M) were stored during November and early December 1988.

Date	Temperature*	Date	Temperature*
11/5	50.2	11/16	33.2
11/7	34.4	11/17	34.0
11/8	33.3	11/18	33.9
11/9	33.2	11/21	33.2
11/10	33.6	11/22	33.9
11/11	33.5	11/25	34.3
11/14	33.9	12/1	32.5
11/15	33.4	12/2	33.1

*Inside box temperature (°F).

LITERATURE CITED

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Figure 1.--Molded Douglas-fir seedlings from the Swan Lake Ranger District, Flathead National Forest. Several different fungi were isolated from molded seedlings.