CHAPTER EIGHT

Storage Molds

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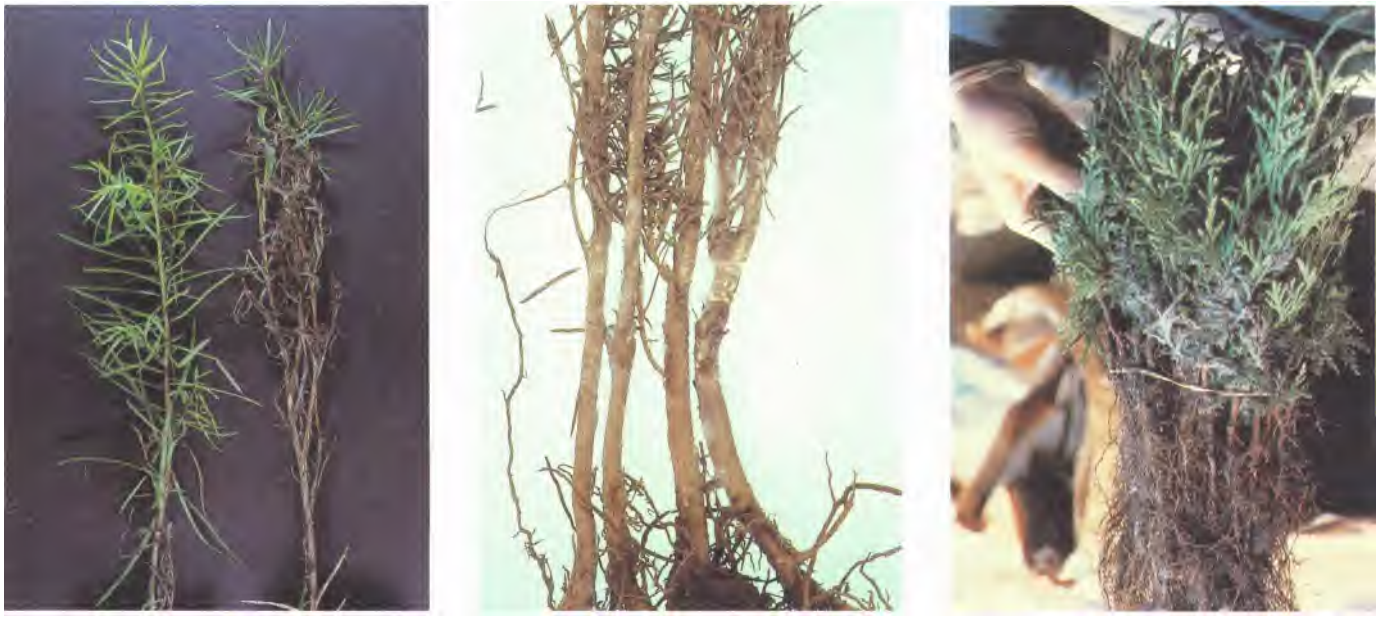
Various mold fungi commonly grow on seedlings that are stored between lifting and transplanting to the field or another nursery bed. All tree species are affected, and many different fungi have been implicated. Most fungi reported on moldy seedlings are saprophytes or weak parasites in nursery soils.

Symptoms

Mold usually begins on older, senescent or dead needles in the lower crown of seedlings. The appearance of the mold mycelium depends on the species of fungus, but is often off-white to gray, forming thin webs between needles (Figure 8-1). The mold may spread throughout the entire foliage mass and is occasionally seen on roots and stems as well. The discovery of moldy seedlings is alarming, but often the fungi cause less damage than appearances would seem to indicate. Mold development does point to poor storage conditions, however, and these may induce physiological changes that reduce the growth capacity of seedlings.

Storage mold may be confused with: Mycorrhizae

Occasionally mold fungi colonize and kill healthy needles and even stems. A simple "fingernail test"—a scraping of the bark on the stem of a seedling—quickly reveals the extent of damage. Bark that is soft, watery, and discolored is probably dead. When needles are colonized but stems and buds remain healthy, seedlings will generally survive, although first-season growth may be affected. Mold observed on roots is most commonly from beneficial mycorrhizal fungi and is no cause for concern. However, root pathogens such as *Pythium* and *Phytophthora* can increase in storage and cause serious damage, especially if temperatures are above 3 degrees C (37 degrees F). Again, the fingernail test will quickly distinguish healthy from killed root tissue.



A B C

Figure 8-1. Dead foliage and stems caused by mold fungi that developed on Douglas-fir (A and B), and cedar (C) during storage.

Management

Sanitation and storage environment are the two most important variables in controlling the development of mold. Seedlings already diseased in the nursery beds should be separated from healthy ones before packing. Trees infected with *Botrytis* or *Phytophthora* may contaminate whole bags of seedlings in storage. Soil is a primary source of mold fungi. Seedlings that are carelessly lifted and packed, with excess wet soil still clinging to roots and scattered through the foliage, are more likely to mold than clean seedlings.

Temperature and moisture are critical for the development of mold. Temperatures must be above freezing for fungi to grow, and growth increases dramatically as temperatures rise above 5 degrees C. Limited mold development may occur at lower temperatures, particularly after prolonged storage, but will seldom damage seedlings. Good temperature control, especially in densely packed lots of seedlings, is essential to maintaining the health of seedlings in storage. Mold fungi also need free water for spore germination and colonization of needles. Seedlings packed dry have less mold than wet seedlings, but it is difficult to dry seedlings and keep them dry without desiccating them during storage. It is best to pack seedlings moist to reduce water stress, and prevent mold development with strict control of temperature.

Freezer storage of seedlings eliminates the risk of mold development during the storage period, but seedlings are still at risk during the cooling-down and thawing processes. Continuous monitoring of seedling temperatures is important regardless of how seedlings are stored. Sensors should be placed in areas of least air circulation as well as in more-accessible locations to assure that conditions are uniform.

Selected references

Hopkins, J.C. 1975. A review of moulding of forest nursery seedlings in cold storage. Canadian Forestry Service, Pacific Forest Research Centre. Report BC-X-128. 16 p.

Venn, K. 1980. Winter vigour in *Picea abies* (L) Karst. VII. Development of injury to seedlings during overwinter cold storage. A Literature Review. Meddr. Norsk Inst. Stogforsk. 35:483-530.