# 57. Environmental and Mechanical Damage

*Thomas D. Landis*

## Hosts

All woody seedlings are susceptible to environmental damage, but seed sources or exotics from milder climates are especially vulnerable (fig. 57-1). Mechanical damage can adversely affect seedlings of all species.

***Figure 57-1***—Nonadapted seed sources are more susceptible to frost injury. The Douglas-fir seedlings with the reddish foliage were from outside the region and were frost-burned, whereas the local stock was not injured.

## Diagnosis

Diagnosing abiotic damage is difficult because whatever caused the damage may have taken place some time before. Many fungi colonize dead tissue, and they may be mistaken for the primary cause. Check weather records and ask local residents about severe weather incidents. Similar injury to several different species is often related to the environment. Check nursery beds for minor depressions, exposed areas, or changes in soil types.

Mechanical injury can usually be diagnosed by studying the damage pattern and consulting nursery personnel.

## Specific Problems

**Frost**—Frost usually results from unseasonably cold weather in the spring or fall when new growth is still succulent. Damage rarely occurs until the temperature of plant tissues reaches approximately 28 °F, although the severity of damage depends on seedling frost hardiness.

Frost-damaged foliage may vary from a pale, water-soaked color to brown or red, depending on the species and degree of injury (fig. 57-2). The stem cambium around the root collar is particularly sensitive to cold injury, even in apparently hardy seedlings (fig. 57-3).

***Figure 57-2***—Symptoms of frost injury appear within a few days of cold temperatures, such as this damage on western larch seedlings.

***Figure 57-3***—Stem cambial tissue around the root collar is susceptible to cold injury, even in apparently hardy seedlings.

Depressions in nursery beds may function as frost pockets. Frost damage may result in stunted, bushy seedlings when terminal buds are repeatedly killed.

Winter-Burn-Winter-burn is actually desiccation rather than cold injury. It occurs when transpiration rates exceed water uptake from cold or frozen soil. Container seedlings are especially susceptible if stored over winter in exposed locations.

Affected foliage turns bright red and appears scorched (fig. 57-4); tip dieback can occur in severe cases. Winter-burn is most common on conifers in exposed locations during warm, windy weather.

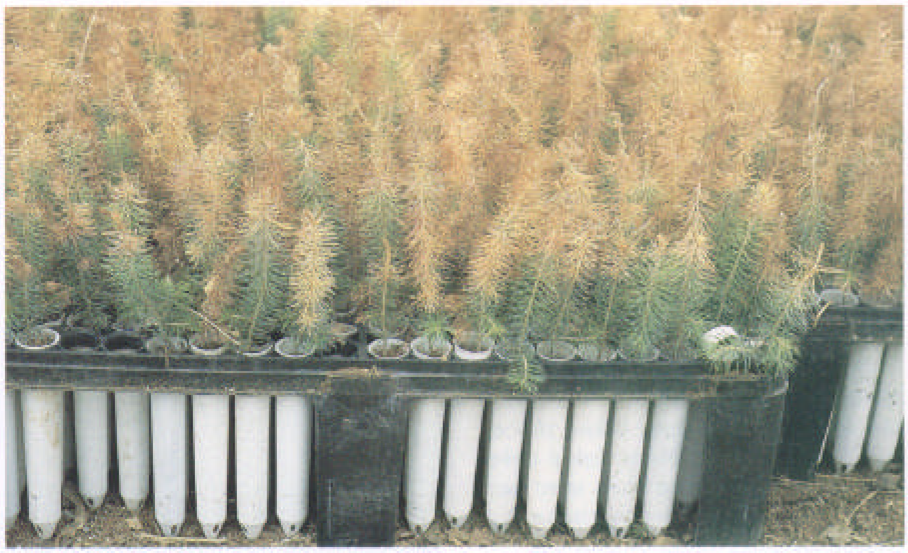

**Figure 57-4**—"Winter-burn" is actually foliar desiccation that results from exposure to drying winds when soils are frozen.

Frost-Heaving-Frost-heaving is a phenomenon that results from repeated freezing and thawing of the soil surface. Seedlings are physically lifted out of the ground and eventually topple over (fig. 57-5). The damage often occurs in patches and is common in wet, fine-textured soils that are exposed during cold weather. Small first-year seedlings and newly established transplants are most susceptible.

**Figure 57-5**—Frost heaving lifts seedlings out of the ground by repeated freezing and thawing of the surface soil.

**Figure 57-6**—These young Engelmann spruce germinants were girdled at the root collar (see arrow) when the dark mulch reached damaging temperatures.

Heat-Stem lesions on the south side of the seedling are symptomatic of heat damage. This injury occurs when surface soil temperatures exceed 115 °F. Heat tolerance varies with species and stage of development; small, slow-growing seedlings, such as spruce, are particularly vulnerable. Dark mulches or dark soil surface areas increase the potential for injury (fig. 57-6). Seedling resistance increases as stem bark thickens.

Drought-Symptoms of drought include a graying of foliage and wilting of new shoots during hot, windy weather (fig. 57-7). Symptoms are visible only after plant moisture stress has already exceeded damaging levels. This injury is most common on coarse-textured sandy soils where seedling transpiration rates exceed moisture uptake. Small seedlings with shallow root systems are especially susceptible to drought injury. Drought-like symptoms are also frequent indicators of root disease or injury and may even occur in waterlogged soils when anaerobic conditions prevent normal root functions.

**Wind Abrasion**—Soil particles blown against stems cause wind abrasions, which occur most commonly on exposed, sandy soils. Stem lesions and callus tissue at

***Figure 57-7***—Severe and sustained drought can injure succulent seedling shoots.

the groundline are diagnostic characteristics (fig. 57-8).

**Mechanical**—Roots and stems can be injured by cultivation, root pruning, and weeding. The pattern of mechanical damage is usually obvious, and nursery personnel can help identify specific incidents. Harvesting seedlings, particularly with mechanical harvesters in wet, heavy soils, is a major cause of injury to root systems (fig. 57-9).

## Prevention

**Frost**—Acclimatization is the best prevention against cold injury. Design growing schedules to allow a natural "hardening" period before damaging fall frosts occur. Late applications of nitrogen fertilizer may prolong seedling succulence, whereas potassium fertilization has been reported to promote hardening. Some nurseries use drought-stressing to reduce height growth of conifer seedlings and induce dormancy during late


***Figure 57-8***—Callused lesion on lower stem caused by wind abrasion.

summer. Lath shelters or straw mulches can physically protect seedlings but are labor intensive. Frost protection to 25 °F can be achieved with sprinkler irrigation because water releases heat as it freezes on the foliage.

**Winter-Burn**—Orient snow fences and windbreaks perpendicular to prevailing winter wind to reduce exposure. Cover seedlings with bed frames, which are effective but expensive. Thick protective mulches provide protection but must be removed in the early spring to prevent mold damage to the covered seedlings.

**Frost-Heaving**—Use thick mulches to insulate seedbeds and to reduce frost action. Seedling growth schedules should encourage root growth on small first-year seedlings. Schedule root wrenching or pruning to allow adequate time for new root formation before winter. Leveling and raising seedbeds and selecting coarse-textured sandy soils will encourage drainage and reduce frost-heaving.

**Heat**—Schedule either fall or early spring sowing to allow small, succulent seedlings to develop a protective bark layer before soil

***Figure 57-9***—Mechanical damage often occurs in wet weather during the lifting operation.

temperatures reach damaging levels. North-south seedbed orientation and proper seedbed densities will also encourage mutual shading of seedlings. Reduce soil surface temperatures by shading seedbeds and using light-colored mulches that reflect sunlight and dissipate heat. Water should be applied frequently and lightly, as dictated by soil surface temperatures.

**Drought**—Proper irrigation will minimize moisture stress. Young seedlings require more frequent irrigation than older stock. Irrigate at night in arid climates. Organic matter increases the water-holding capacity of sandy soils, and seedbed mulches can be used to retard moisture evaporation and increase water infiltration rates. Windbreaks reduce transpirational losses by decreasing wind exposure.

**Wind Abrasion**—Use natural or artificial windbreaks to reduce wind speed and surface mulches to prevent soil erosion. Irrigate during windy periods to help stabilize surface soils. Seedbeds should be oriented parallel to prevailing winds.

**Mechanical**—Well-trained, conscientious machinery operators are the only true solution to mechanical damage. Precision tractor work such as root pruning, lifting, and cultivation should be performed when soil conditions are near optimum.

## Selected References

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