

CHAPTER TWENTY-EIGHT

Heat Injury

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The surfaces of nursery beds in the spring and summer can reach temperatures lethal to seedlings unless measures are taken to prevent the buildup of heat. There are two general types of heat injury; seedlings may suffer from one or both. Injury from direct heat causes the cells of the plant to collapse and the plant to topple over and die. Indirect injury causes disturbances in the plant's metabolic processes, such as the denaturation of proteins. Its symptoms are less immediately obvious and more difficult to identify than those of direct heat injury. Effects of indirect injury are widely variable; plants may suffer only minor reversible damage, or they may die. No statistics are available on the extent of seedling losses from heat injury.

Heat damage may be confused with:
Cutworm damage
Damping-off
Frost heaving
Fusarium hypocotyl rot
Seedcorn maggot damage

Occurrence

Injury usually occurs on the stem just above the ground, where the buildup of heat is greatest. Sometimes heat injury occurs on cotyledons just as they emerge from the soil. Heat injury in older

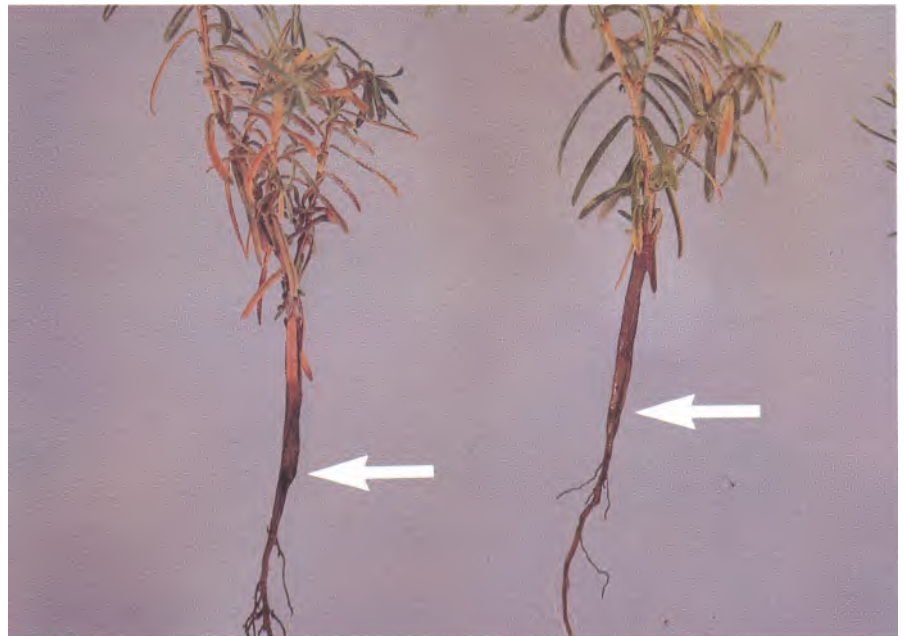


Figure 28-1. Heat damage to stems of 1+0 seedlings at the groundline. Damage to phloem tissue prevents photosynthates from reaching roots, causing an enlargement of stem tissue above the damaged area.

seedlings is rare, both because the lignification of their stems provides some protection, and because the development of shoots causes the canopy to close on seedbeds, significantly reducing the buildup of heat on the ground. Numerous studies indicate that injury is likely to occur at temperatures above 49 degrees C (120 degrees F). Temperatures in excess of 60 degrees C (140 degrees F) will quickly lead to death.

Symptoms

Direct heat injury in a young seedling (4 to 6 weeks old) first becomes apparent when the basal

part of the stem takes on a water-soaked appearance. This is caused by the rupture of cortical cells. With continued exposure of the seedling to heat, a lesion forms on the lower stem. It looks like a white streak or spot, and has given rise to the name "whitespot disease" for heat damage. If temperatures remain high, the lesion expands until it encircles the stem, constricts it, and finally causes the seedling to topple over.

In seedlings older than 4 to 6 weeks, heat-damaged areas are dark and sunken. Seedlings of that age have usually produced enough secondary xylem to hold them erect unless the constriction is too deep. Such seedlings can sometimes live

for several months after heat damage because even a deep constriction does not stop upward movement of water to the leaves. However, since swellings above the constriction impede phloem transport of photosynthates to roots, seedlings eventually die (Figure 28-1).

Management

All coniferous species grown in nurseries in the Pacific Northwest are susceptible to heat damage as young seedlings. The principal method for protecting seedlings against heat injury is to irrigate them so that the evaporating water

**Heat damage symptoms
appear:
1+0
Late spring through summer**

cools the seedbeds (Figure 28-2). Besides cooling the soil surface, sprinkler irrigation during the hottest part of the day can lower the air temperature 10 to 15 degrees F or more, cooling the foliage of seedlings and reducing their overall heat stress. However, the frequency and length of irrigation needed for effective protection varies with temperature, seedling development, soil type, and tree species. Seedling nurseries should develop their own guidelines for cooling seedlings with irrigation.

Shading is an effective method of protecting seedlings from heat injury. However, materials for shade frames are expensive, and installing and removing them is labor-intensive.



Figure 28-2. Losses from heat can be minimized by shading seedlings or cooling them with water. Photo courtesy of Alan Kanaskie.

Selected references

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