

COLD INJURY DURING DORMANCY

A storm from Alaska arrived in the Pacific Northwest on February 1, 1989, and brought near-record cold to many normally, temperate areas. In addition, high winds in some areas removed insulating snow covering from plants outdoors and damaged protective structures.

The temperatures and wind in the Northwest were not as severe as the low winter temperatures and winds that hit the Central U.S. on January 10, 1982 (27F in Illinois) or on December 24, 1983 (-21F in Illinois); and, the low temperatures in 1982 resulted in surprisingly little winter injury to plants in the Central U.S. However, the low temperatures in 1983 resulted in major losses. Bachtell and Green (1985) suggested that the 1983 damage was more severe than the 1982 because temperatures dropped gradually before the record cold of January 10, 1982; but, two years later, there was no gradual temperature drop before the record cold of December 24, 1983.

Due to the poor acclimating conditions, including the late summer moisture stress followed by the exceedingly moist, warm period that stimulated budbreak in October and November, the plants were especially prone to winter injury when record cold (-21F) hit Illinois on December 14, 1983
(Bachtell and Green, 1985).

Another major difference between the winters of 1981-1982 and 1983-1984 in Illinois was that February 1984 temperatures were much higher; there were 8 days in February 1984 when the temperature reached 50F. During this period of unusual warmth, some plants broke dormancy. A record temperature in the Central U.S. of 0F was recorded on March 10, 1984. This extreme cold may have injured the plants that had started growth; the number of plants injured in March 1984 compared to the number injured earlier that winter (in December 1983) was relatively small.

At the OSU North Willamette Experiment Station, during the last week in January the mean maximum temperature 6 inches above the ground was 57F and the minimum was 31; but, during the subsequent week, the first week in February, the mean maximum temperature was 30 and the mean minimum was 13F. The warm weather immediately preceding the cold period possibly increased potential damage to plants: Some plant shoots and buds had likely deacclimated to some extent, and some new root growth may have occurred in which cases freeze damage would be expected. The rate at which plants deacclimate after midwinter and the temperature at which

they do so varies. Northern species often deacclimate and break dormancy later than do Southern species.

The minimum winter 88-89 temperature measured 6 inches above the ground (container height) at the OSU North Willamette Experiment Station was 4 degrees Fahrenheit on February 5, 1989.

In looking at soil and container root zone temperatures during the first week of February, soil temperatures dropped to 26F at 2" depth, but only to 36F at 8" depth.

Reported root damaging temperatures range from 27F for boxwood down to -9F for several species including *Potentilla fruticosa*, *Picea glauca*, *Picea omorika*, and the PJM rhododendron hybrids (Green and Fuchigami, 1985).

There should be little damage to roots of field-planted and landscape-planted plants. But, plants with less cold tolerant root systems above ground, exposed, or in containers with no protection could have been freeze-damaged -especially the less mature, young roots at the periphery of the root system.

FREEZE-DAMAGE: Some species are more hardy than others or develop sufficient cold acclimation early in the autumn and retain it long enough to withstand low temperatures.

Cold acclimation of a given plant species fluctuates during dormancy; unusually warm weather in autumn will retard acclimation, and **warm weather in winter or early spring will induce partial deacclimation.**

Different tissues or parts of a plant vary in cold tolerance: Flower buds are less hardy than leaf buds and roots are consistently less resistant to freezing than are stems. In some plants, the difference in hardiness between the roots and the shoots can be as much as 50 degrees F. For example, in *Pyracantha coccinea* Roen. *Lalandei*, stems can survive -15F when fully acclimated; older, woody roots are killed at 2F; and, young roots are killed at 22F (Steponkus, et al. 1976). FROZEN ROOTS deteriorate rapidly after thawing (become flaccid and appear water-soaked and discolored) and provide a potential entry for root rot fungi. Plants with freeze-damaged roots often wilt and decline after growth resumes in the spring.

A further complication is **the difference in cold tolerance of different tissues or parts of a plant at different times of the fall-winter-spring.** In stems, the living xylem is hardier in the fall than is the phloem, but in midwinter the xylem is often several degrees less resistant than the adjacent cambium or phloem tissues. Black heart describes the darkening of the xylem of the smaller branches on trees and shrubs, and possibly of the main trunk at the soil line, damaged by freezing temperatures in midwinter.

On a clear night, temperatures near the soil surface may be 5 degrees centigrade colder than temperatures in the plant canopy or below the soil surface, especially in the absence of mulch or snow cover. Dead bark called "**Frost Collars**" is common on freeze-injured stem bases. As dead

bark at the frost collar dries after thawing, it commonly splits; such injury may extend around the stem base and "girdle" the stem.

Winter sun scald may occur on sunny days in winter when a tree trunk may be warmed as much as 18 degrees Fahrenheit above air temperature, especially on the exposed southwest portion of the trunk. If the bark temperature drops quickly, freezing injury or death of the bark and cambium occur. Though it is generally called "sun scald", it is actually a freezing injury. Damaged bark and cambium dry out, crack, separate from the wood, and eventually fall away. Trees with smooth bark are most susceptible to this type of injury.

Frost cankers or bark splitting are low temperature injuries that may be confined to small localized areas on the trunk or branches near crotches or near the soil line. The inner bark and cambium tissues in these areas mature and cold acclimate later than the twigs and branches. If low temperatures occur in the fall before these tissues are hardened, damage is likely.

Frost cracks are longitudinal separations of the bark and wood that occur primarily on the south and west sides of the trunk; exposure to the afternoon sun heats the south and west side more than the remainder of the tree and a greater difference of temperature occurs when the temperature drops suddenly during the night. Outer layers of bark cool most rapidly and are subjected to tension, causing shrinkage and cracking to occur after the sudden temperature drop. Shading the trunk, painting it with white latex, or taking other action to prevent sudden temperature fluctuations will reduce sun scald and frost cracks.

Winter drying of evergreen foliage may be severe during sunny weather in midwinter-early spring when water evaporates from leaves and stems while the soil is cold or frozen; roots extract insufficient water from cold soil and none from frozen soil. Early stages of foliage desiccation are scorching of the leaves, primarily along the tips, margins and interveinally. This may give the impression of severe injury, however, scraping the bark usually reveals green tissue and thus a potential for normal growth in the spring.

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