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WINTER INJURY ON WOODY ORNAMENTALS

Weather conditions during the past few winters in Connecticut have been conducive for injury to woody ornamentals. The impact of these conditions is often evident in ornamental plantings in the landscape as well as in woodlands and natural areas throughout the state (Figure 1). The factors that contribute to winter injury are diverse and results often do not appear on woody ornamentals until the following spring and summer. In addition, the extent and severity of the injuries that develop are often more extreme on plants weakened from drought stress, transplant, or from other environmental and site-related stresses.

Figure 1. Mature rhododendron with symptoms of winter injury.

CAUSAL FACTORS:

Winter injury is associated with many environmental factors that have little in common other than they occur during the winter. Examples of these diverse factors include dramatic temperature fluctuations, multiple freeze-thaw cycles, lack of snow cover, unusually warm mid-winter temperatures, extended periods of extreme or abnormally cold temperatures, cool summers followed by warm autumns and sudden drops in temperature, and drying winds.

An example to illustrate how winter injury can occur involves the process of how woody plants prepare for cold temperatures and enter winter dormancy. This process is gradual—as day lengths shorten and temperatures drop, woody plants gradually acclimate to winter temperatures. In this process, all freezable water is removed from living plant cells and it crystallizes between the cells where it will not damage tissues. The only water that remains in the cells is not freezable, so it will not damage the cells. Under normal fall conditions (i.e., when there is a consistent and gradual drop in temperature), cold acclimation is usually complete before freezing weather begins. When this occurs, freezing temperatures are seldom harmful to most woody ornamentals. However, if a woody plant is not exposed to conditions that favor cold acclimation or if late-season growth is still active, those plants are unable to withstand freezing conditions and are injured. Damage can occur in the sapwood, cambium, or phloem

or can be confined to the immature, succulent shoots. In many cases, the damage is not evident until growth begins in the following spring.

Winter injury is important in of itself, but it also predisposes and weakens plants--this makes them more vulnerable to secondary or opportunistic pests. Among these secondary problems are unusually high incidences of branch and twig diebacks such as those caused by *Botryosphaeria* spp. and *Phomopsis* spp., fungi that are normally not considered aggressive pathogens.

As previously mentioned, the symptoms of winter injury are often not evident until a considerable time after the injury has occurred. This can make accurate diagnosis very difficult. On many needled and broadleaved evergreens such as arborvitae and rhododendron, respectively, the symptoms of winter injury may not appear during the winter, but may begin to appear as the spring unfolds. Symptoms may continue to worsen as the plants begin to grow—this can often result in confusion about the actual cause of the damage. For example, when the sapwood of a lilac is damaged by freezing (Figure 2), the symptoms may not be evident until the spring or early summer following the time when the injury initially occurred. Symptoms develop on branches that had "leafed-out" looking apparently normal, which then suddenly collapse and die for no obvious reason. However, the symptoms can be attributed to damage sustained by the sapwood during the previous winter, which cannot provide the amount of water needed by developing leaves and flowers.

Winter injury can occur on a wide range of plants. However, it is often particularly problematic on evergreens in the landscape. These include broadleaved evergreens such as rhododendron, mountain laurel, and holly and needled evergreens such as hemlock, arborvitae, chamaecyparis, pine, and juniper. Deciduous trees and shrubs such as flowering cherry and almond, maple, and dogwood are also damaged by winter injury, as are ground covers such as ivy and pachysandra.

Figure 2. Freeze damage to the sapwood of lilac. Note brown discoloration (arrow).

SYMPTOMS:

Symptoms of winter injury are variable and depend upon the type of plant, its general vigor, and the extent of the damage. Woody plants that are damaged by winter injury will often show tip and branch dieback, foliar browning, sun-scalding, and bark splitting. One common type of winter injury is excessive drying. This is quite common on evergreens and results from factors that create a water deficit in a plant. This type of injury occurs when water evaporates from leaves or needles on windy or warm, sunny days during the winter or early spring. Drying occurs because this water is not replaced since the roots cannot take up enough water from cold or frozen soil.

On broadleaved evergreens such as leucothoe, rhododendron, and mountain laurel, a marginal or tip browning and

longitudinal rolling along the mid-vein characterize the most familiar leaf symptom. In some cases, entire branches or shrubs can be affected (Figures 3, 4, 5, and 6).

Figure 3. Leucothoe with symptoms of winter injury.

Figure 4. Close-up of leucothoe leaves with tip necrosis.

Needled evergreens exhibit a slightly different symptom, with browning of the tips or center portions of needles, chlorotic flecking, needle drop, and tip and twig dieback (Figures 7, 8, and 9). In extreme cases, an entire shrub or tree may turn brown or appear off-colored (Figure 10).

Figure 5. Close-up of brown, rolled rhododendron leaves affected by winter injury.

Figure 6. Japanese holly with brown, desiccated leaves showing symptoms of winter injury.

Figure 7. Chamaecyparis with winter injury at branch tips.

Figure 8. Arborvitae with desiccated needles at tips.

Figure 9. Spruce showing browning and desiccation of needles on the last flush of growth.

Figure 10. Recently planted balsam firs with needle browning and drop due to winter injury.

On deciduous trees and shrubs, bark may be injured or split by cold weather. Cracks and dead areas can appear in the bark and the bark begins to peel away from the trunk as the tree grows in spring and summer. This type of damage is common on many of the thin-barked species such as crabapples, cherries, and maples (Figure 11). Frost cracks during dormancy result from the expansion and shrinkage of bark and wood, which causes internal mechanical stress and cracking and splitting of wood, and slipping of bark at the cambium layer.

Figure 11. Crack (arrow) in bark of crabapple associated with winter injury.

Extremely cold winter temperatures can also result in damage to flower and leaf buds (Figures 12 and 13). Buds can also be damaged by periods of unusually warm winter temperatures, which trigger them to begin to break dormancy. When the normal temperatures return, these tender buds are injured. As a consequence of both types of injury, deciduous trees and shrubs may not flower or may fail to leaf out properly in the spring. Cold temperatures occasionally cause sub-lethal or lethal damage to sapwood and cambial tissues. This type of injury usually does not appear early in the season but causes new branches to suddenly wilt and begin to die back by early to mid-summer. Injured tissues apparently cannot keep up with the water demands of actively growing plants and the plants collapse.

Figure 12. Azalea with dead twigs and flowers associated with winter injury.

Figure 13. Close-up of dead flower buds (arrows) on azalea with winter injury. Note that the leaves around the buds are healthy.

MANAGEMENT AND REMEDIATION STRATEGIES:

Although the weather cannot be manipulated and there are no "cures" for winter injury once the damage is done, there are steps that can help to minimize the effects of winter injury.

- Select the appropriate site for planting and use sound cultural practices to maintain vigor.
- Select native plants or match plants to the site. For example, avoid planting broadleaved evergreens in open, windy locations where they will be subjected to drying winter winds.
- Maintain adequate soil moisture in the root zone before the soil freezes. This can be accomplished by giving the plants (esp. broad and needled evergreens) a deep watering before the ground freezes in the fall. Mulching can also be beneficial since it helps to increase moisture retention during the winter.
- Avoid late summer and early fall fertilization. This can stimulate and encourage plant growth late in the season, which may not acclimate properly for cold winter temperatures.
- Prune and remove any dead twigs or branches since they can serve as sites for secondary invaders or opportunistic pests.
- Provide physical protection from water loss and drying winds. This is especially important for new transplants or plants in exposed locations. Protection can be provided by installing burlap wraps and by using applications of anti-transpirants to evergreens in order to minimize water loss from needles or leaves.

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