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Winter Protection for Containerized Nursery Stock

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Perennial woody plants that are adapted to regions with freezing winter temperatures have the ability to "harden off" or acclimate to cold temperatures. Whereas unhardy plant tissues are generally injured at about 28°F, hardy tissues can survive much colder temperatures.

The acclimation process is limited, however. It primarily affects stems, buds and evergreen leaves. The roots and adjacent tissues of many perennial species develop only limited cold hardiness. The minimum survival temperatures of roots of cotoneaster and Japanese holly, for example, are about 23° and 20°F, respectively. Because roots generally acclimate very little, protecting them from freezing is extremely important.

Even if killing temperatures occur infrequently, a killing freeze can destroy all of a grower's plants. Storage at 28° to 35°F should ensure the survival of all temperate zone containerized plants.

Growers should be aware that insulating dormant stock from cold temperatures can interfere with cold acclimation in roots and shoots. Plants do not continue to harden off during storage. Rather, they generally begin to gradually deacclimate. After removal from winter storage in spring, some species may need supplemental protection against frost damage.

Storage timing

In general, allow plants to go through several hard, nonlethal frosts before placing them into storage. Because hardiness varies greatly among species, growers must tailor storage timetables to specific crops. Allowing deciduous stock to defoliate before storage improves storability. Spraying stock before storage with a broad-spectrum fungicide labelled for that stock can reduce mold and mildew. Remove stock from storage as early as possible in spring, after the last killing frost.

Symptoms and causes of winter injury in containerized plants

Desiccation

One of the most common types of winter injury in containerized plants is dehydration, generally referred to as desiccation. A containerized plant has root contact with a much smaller volume of soil than a field-grown plant, so the amount of moisture available to its roots is more limited. The roots of containerized plants are also often exposed to colder temperatures than those of field-grown plants. This reduces their ability to absorb and transport water.

Containerized stock injured by desiccation normally grows sporadically or not at all in spring. Twigs and buds are generally dry, shrunken and shriveled. Injured foliage usually is brown or discolored, dry and brittle. Containerized evergreens such as junipers and rhododendrons are especially susceptible to desiccation.

Freezing

Freezing injuries to stems, buds and roots are common in containerized plants. Freeze-injured plants can exhibit several symptoms depending upon the minimum temperature reached, the duration of exposure to the minimum temperature and the relative sensitivity to freezing of the bark, wood, buds and roots.

Temperatures low enough can kill the entire plant. If only the buds survive, they can break and grow for a short time before wilting and dying. The new growth fails because damaged roots or stems are unable to supply it with food reserves or nutrients. Freeze-injured plants often grow apparently normally into June or July before suddenly wilting and dying.

To determine if a plant has been injured by freezing, place a moistened sample into a plastic bag

and keep it at room temperature for several days. Use a razor blade to cut into the tissues and examine them with a magnifying glass. Healthy tissues are white or green. Injured tissues are normally brown.

For buds, make a series of cross-sectional cuts starting at the tips and examine between cuts. Healthy buds are bright green. When examining roots, note that the roots of some species are naturally dark and that the wood of some plants does not brown uniformly after freeze injury.

Structures for winter protection

Greenhouses

Heated — Keeping plants at warm temperatures in heated greenhouses is the most expensive way to overwinter them. Heating and lighting costs can be very high, and watering, fertilization and other care must continue throughout the winter.

Actively growing plants also do not become dormant, yet many or most temperate-zone perennial plants require a period of winter dormancy for normal growth and flowering. Containerized stock intended for fall, winter or early spring planting in areas where freezing temperatures are expected should be dormant and cold hardy when shipped and planted. Temperate zone plants should not normally be overwintered in heated greenhouses.

Unheated — Unheated greenhouses are often used to store dormant stock in areas where freezing temperatures are relatively mild and short-lived, such as coastal Oregon and Washington. Under these conditions, temperatures in greenhouses generally remain above freezing.

In even the warmest Idaho growing regions, unheated greenhouses are suitable for only the hardiest containerized stock. Periodic losses due to freezing injury must still be expected.

Snow load is a concern in northern regions where greenhouse temperatures are too low to melt off the snow. Take steps to avoid excessive snow loads. Plants in unheated greenhouses may need periodic watering in winter.

Partially heated — A compromise method of greenhouse storage is to heat the houses just enough to keep plants at temperatures between 28° and 35°F and to prevent excessive snow buildup. Fans can be used to keep greenhouses from becoming too warm. Periodic irrigation may be required, but fertilization and lighting will not.

Hoophouses have been used successfully to overwinter nursery stock in northern New England and in the midwestern United States. Quonset-shaped structures are formed by stretching white plastic film over metal hoops that are set into the ground. The white film reflects solar heat and helps to maintain cool, uniform temperatures inside.

Dormant stock is stacked tightly together inside. A heat source, such as a portable, forced-air gas furnace mounted on a pallet or skid, is used to keep the temperature of the house at or above about 28°F.

Portable fans may be needed to cool hoophouses on sunny days. Even unheated and partially heated greenhouses trap solar heat on clear days. Temperatures inside them can rise to 60°F or higher even when the outside air temperature is below freezing. These warm temperatures interfere with dormancy and cold acclimation in many woody plants. Plants in storage should be kept as close to 32°F as possible. White greenhouse coverings help to reflect heat and reduce temperature fluctuations.

Lathhouses, shadehouses and barns

Lathhouses, shadehouses and barns protect plants from crushing snow loads and drying winds and keep them at relatively uniform cold temperatures. Reducing temperature fluctuations is important because freezing injuries occur more often when temperatures fluctuate than when they are steady.

In locations where very low or long-term freezing temperatures occur, unheated structures may not by themselves provide enough protection for containerized stock. When plants are mulched, however, the structures not only reduce heat loss and temperature fluctuations but also keep the mulch dry.

Supplementary heat can be used in barns. Foam or fiberglass insulation will reduce heating costs and maintain more stable temperatures. Containerized plants stored in lathhouses or barns may need periodic irrigation.

Walk-in refrigerators and freezers

Walk-in coolers provide a nearly ideal storage environment for overwintering plants. Both air temperature and humidity can be precisely controlled, regardless of the outside environment. Refrigerated storage units are normally kept at 32° to 35°F and freezers at 28° to 31°F. Supplementary heaters may be needed to keep the storage units above about 28°F.

Whether to use refrigerator or freezer storage depends upon the plant because some plants lend themselves better to one storage method than the other. Most plants store reasonably at 32° to

35°F. Refrigerator and freezer storage help to keep stock dormant and cold hardy. Reforestation seedlings, in particular, generally survive and grow better and more consistently when overwintered in cold storage (preferably a freezer) than in less-controlled environments.

Labor costs for coolers may be lower than for protection programs that involve handling mulch, plastic films and straw bales. The drawback to large cooling facilities is their expense.

Mulching

Sawdust, wood chips, bark chips, straw, pine needle straw and other insulating materials have long been used to protect plants from freezing injuries. Container nurseries as far north as Alberta, Canada, successfully use mulch to overwinter stock.

The easiest way to mulch containerized plants is to pack them tightly together in upright positions. Spread mulch over them until it reaches several inches above container edges. Bales of straw or hay placed along the perimeter of storage areas help insulate containers at the outside, where most freezing injury occurs. Irrigate plants before storage.

Some growers bury their plants completely in mulch to provide better insulation and protect stems and buds from desiccation. Defoliated deciduous stock seems to respond better to this treatment than evergreens do.

Remove mulches as soon as possible after the last expected killing frost. Research in Vermont has shown that plant survival decreases rapidly when uncovering is delayed past mid-April.

Be cautious when using dry straw, sawdust or other flammable substances as mulches. These materials are fire hazards. No smoking should be allowed around them.

Mulch sandwich

Plants growing upright in round, uniformly sized containers can often be stored on their sides under "mulch sandwiches" (Fig. 1), which can be used either outdoors or inside unheated structures.

Start by forming a rectanglar enclosure of straw or hay bales stacked two or three high. The bales will keep the containers from rolling and insulate the outside containers.

Lay the containers on their sides and stack them 2 to 3 feet high, depending upon container size. Face layers of containers in opposite directions to form stable stacks. Place a layer of empty containers on top for increased insulation.

After stacking the containers, cover them with a mulch sandwich. To make the sandwich, first cover the containers with a layer of nonporous plastic film then apply mulch at least 1 foot deep over the plastic. Because it is lightweight and available in bales, straw is generally better for sandwiches than are sawdust, wood chips or similar materials. Fluff up the loose straw as much as possible in order to increase the dead air space and reduce weight.

Cover the mulch with nonporous plastic film to hold it in place and prevent it from becoming saturated with water. The top layer of plastic must be white in order to reflect sunlight and reduce heat buildup. Foam sheets can be used in place of the plastic film layers and will improve insulation. For upright containers, provide some type of support to prevent the mulch and snow from crushing plants.

Sandwiching mulch between layers of plastic film increases its value as insulation, helps keep stock clean, reduces the amount of mulch needed and reduces the labor necessary to remove and clean stock. Sandwiches also prevent mulches from becoming saturated with water and freezing, which delays removal and cleaning of plants in spring. The sandwich technique has been used successfully in northern New England and is more effective than foam or plastic blankets.

Rodents in mulches

Mulches offer excellent cover for mice and other rodents that damage and kill plants by chewing bark off of woody stems and eating foliage and young twigs. Both traps and poison bait are used for rodent control.

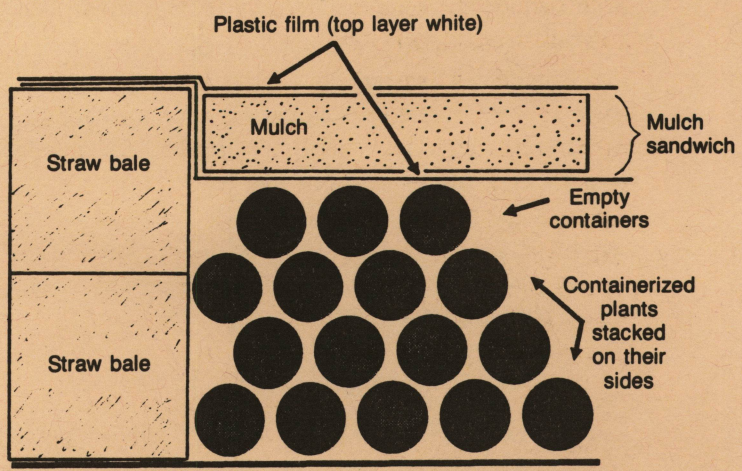

Fig. 1. Recommended method of mulching containerized nursery stock for winter protection.

Containers are stacked 2 to 3 feet high, either upright or on their sides. Supports must be placed over upright containers to prevent the weight of mulch and snow from crushing plants. Straw bales hold the containers in place and protect the edges from freezing. The top layer of plastic film must be white to reflect heat and maintain uniformly cool temperatures.

Placing bait at stations is more effective than scattering it. Empty plant containers tipped on their sides and short lengths of pipe at least 2 inches in diameter can be used to create tunnels and shelters that make effective bait stations. The artificial shelters and tunnels should be partially buried in the mulch in and around the containerized plants.

Plastic or foam sheets

Many types of synthetic films and fabrics are available commercially and have been used effectively for mulching plants such as field-grown strawberries. They have also been used to protect containerized plants in mild climates such as the Willamette Valley of Oregon. Films and fabrics seem best adapted to regions where freezes are relatively mild and infrequent. When used alone, they are unlikely to provide reliable winter protection for containerized plants in Idaho.

Single layers of nonporous plastic films provide a little insulation from freezing temperatures and reduce temperature fluctuations in covered plants and media, but they can trap heat, which interferes with cold acclimation. Only white plastic film is acceptable for winter covers because clear or black films trap solar heat and increase temperature fluctuations.

Porous agricultural fabrics made from nonwoven synthetic fibers reflect sunlight, help to reduce temperature fluctuations and do not trap as much heat as plastic films do. However, they offer less insulation.

Recently, thin foam sheets or blankets have been introduced commercially. They provide more insulation than plastic films do, and those with reflective surfaces help to reduce temperature fluctuations.

They have not been tested in Idaho, but studies in other states indicate that foam blankets would probably provide only marginal winter protection for containerized plants in most Idaho regions. Research in Vermont showed that three layers of ¼-inch foam blankets provided the same protection as a 1-foot-thick straw and plastic film sandwich. Some plastic sheets and films are flammable and must be used with caution.

Keeping plants healthy

Healthy plants are better able to withstand stresses than unhealthy plants. Plants weakened by drought, poor nutrition, insects, disease or excessive shading will not survive winter storage as well as those that have received proper care. Avoid excessive or late nitrogen fertilization because it forces late, lush growth that does not acclimate properly and is more susceptible to fungal diseases while in storage.

Protection against desiccation

All plants continue to lose water by transpiration and evaporation in winter. Containerized plants, especially evergreens, are particularly susceptible to desiccation injury. Ensure that containerized stock receives adequate irrigation throughout the fall and winter. Mulched containerized plants generally cannot be watered so they should be thoroughly irrigated before storage. Moistening the mulch before application can reduce desiccation problems.

Lathhouses, shadehouses, barns and snow fences are often used to protect nursery stock from drying winds. Antidesiccant and antitranspirant sprays reduce water loss from plants either by causing stomates on their foliage to close or by forming a waxy layer on stems, buds and foliage. These materials are commonly used to protect overwintering evergreen plants. Always follow label directions when applying them.

Reforestation seedlings

At one time, seedling trees grown in plastic tubes and Styrofoam blocks were overwintered in their containers by placing them under mulch inside shadehouses. The method was generally unsatisfactory because of desiccation and freezing injuries to roots and crowns. Although Styrofoam blocks insulate roots better than plastic tubes do, the insulation is usually insufficient to protect seedlings from freezing injuries.

Most reforestation seedling producers today remove seedlings from containers in late fall, wrap the plants in plastic, package them into cardboard boxes and place them in freezer storage at 28° to 31°F until shipping in the spring.

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