ORNAMENTALS NORTHWEST ARCHIVES
July-August 1988
Vol.12, Issue 4
Pages 5-6

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SUCCESSFUL STORAGE OF BAREROOT CONIFER SEEDLINGS IS DEPENDENT ON PRESTORAGE FACTORS

Conifer seedlings are often lifted (dug) and then placed in cold storage before being outplanted in plantations or containers. Storing the seedlings allows the nursery more flexibility in lifting and shipping, and uniformly scheduling the work load. Also, outplanting sites are not always ready for planting when seedlings are lifted.

Bareroot conifer seedlings can be transplanted almost anytime of year if proper environmental conditions and handling techniques are used. While there are generally few problems associated with bareroot conifers seedlings stored for short-terms (less than a few days), storing bareroot conifer seedlings for a long-term or overwinter is most successful when seedlings are at maximum winter hardiness; dormant seedlings having acquired maximum cold tolerance have greatest storage potential.

Prestorage and storage factors affecting survival and growth of the outplanted seedling include lifting date, dormancy, prestorage handling, packaging, storage temperature, water relations, mold control, and storage duration.

Lifting and storage are critical periods in the seedling production cycle. Many outplanting failures can be traced to problems during these periods.

Lifting date: While conifer species will differ in their optimum lifting date, quality, dormant, cold-acclimated seedlings will best withstand storage.

A classical definition of dormancy is the absence of plant tissue growth under favorable environmental conditions. A conifer that has "set" terminal buds is often called dormant, even though mitotic activity in the bud continues and maximum stress tolerance may not have developed. Although a seedling may be dormant, it is possible that it may not have cold-acclimated, or it may not have retained sufficient cold tolerance to survive long-term cold storage.

The seedling lifting date will affect stock quality and storability.

For Douglas-fir, cold-acclimation (development of cold tolerance or cold hardiness) of the dormant seedling commences with exposure to successively lower temperatures in the fall; maximum cold hardiness is attained from December through February.

Continual exposure of dormant conifers to fluctuating low winter temperatures acts to release dormancy. In cold storage where temperature is rather constant, dormancy release progresses at a much reduced rated compared to outdoors. This slowing of dormancy release is, in part, why long term or overwinter cold storage of bareroot conifer seedlings is successful.

Estimating the optimum lifting date is difficult. Techniques that help estimate lifting date include: past nursery experience, prelift chilling requirement, and measurements of root-growth potential and cold hardiness. If a lifting date is not known for a specific conifer, it is usually best to delay lifting in the fall, or lift earlier in the spring.

From the field to the cooler…. Prestorage Handling. Once lifted, conifer seedlings are moved to a work area and graded, bundled, and packaged for storage. Seedling condition can deteriorate during this time as a result of desiccation, molding, metabolic activity, or developmental processes (bud flushing).

Controlling plant water loss and reducing temperature will help maintain quality. Roots are very susceptible to desiccation from solar heating (direct sunlight), dry air, and wind. Lifted nursery stock should be immediately placed in field containers and transported to a covered work area.

If field containers are not refrigerated, bareroot stock should be handled, packed, and stored within a few hours. Seedlings in large field containers will heat up more rapidly than will those in smaller containers.

Always keep lifted stock out of
direct sunlight and keep plants cool.

Field containers should be covered with a moisture-holding material to help prevent water loss. Damp burlap is often used as a cover; it must be kept damp. Lifted plants may be sprayed with water to help prevent desiccation, but once placed into storage excessive moisture may result in molding.

Packaging for storage: Seedlings are packed in containers or bags for handling ease, inventory accounting, and especially for protection from desiccation. Moisture loss over the course of cold storage appears to be greater in the roots than the tops. Freezer stored stock must be protected from desiccation.

A polyethylene moisture barrier is often used for this purpose. A multiwall kraft/polyethylene bag or cardboard carton with a polyethylene liner is commonly used. Adding water to packing material can help retard moisture loss (some nurseries pack in moist sphagnum moss or cedar shavings), but wet foliage could enhance the development of mold.

The simplest way to reduce moisture loss is to use a vapor barrier in packaging.

If seedlings must be stored in open containers, protect them by maintaining a high relative humidity of 98% or greater. Containers should be stacked within the refrigeration unit to allow good air circulation and uniform cooling.

Mold control: Molding is a major cause of bareroot seedling loss during storage and can reduce outplanting survival rates. There are several fungi that cause molding, and all are common to nursery soils. Inoculum (fungal spores, etc.) may be present in soil adhering to roots and foliage, and in packaging materials. Mold development is favored by warm temperatures (above 32 degrees F) and by presence of free water on foliage.

Treating seedlings with fungicides prior to lifting might be beneficial, but drench applications after lifting are questionable.

Storage mold is reduced by preventing seedling prestorage injury from frost, fertilizer burn, and mechanical damage. In addition, storage duration should be minimized with stored stock being checked frequently. Freezer storage helps suppress molding but the hazard returns during the thawing process.

Storage temperature: Bareroot conifers may be either "cold stored" or "freezer stored". One of the major benefits of freezer storage is that molding is controlled by this lower temperature. Otherwise, cold storage will often provide similar results to that of freezer storage. Cold storage is recommended for short-term storage (1 to 3 months); freezer storage is used for long term storage (4-6 months).

In cold storage, the air temperature surrounding the seedlings (the "in-bag" air temperature) should be 32.9 to 35.6 degrees F (0.5 to 2 degrees C), while in freezer storage the temperature should be 28.4 to 30.2 degrees F (-1 to -2 degrees C). Because the temperature within the storage containers can be warmer than the ambient air temperature of the refrigeration unit and will depend upon air circulation, container size, and seedling density, a long, narrow probe is used to check the temperature within containers.

Freezer-stored seedlings must be thawed before they are planted. Several researchers report that while the stock is either being frozen or thawed, the ambient air temperature should not be more than 1.8 to 3.6 degrees F above or below freezing, respectively. Others allow thawing to occur in an ambient air temperature of 50 to 59 degrees F (10 to 15 degrees C).

Storage duration: Bareroot conifer stock has been successfully stored for 2 to 8 months, even longer, when the critical post-production factors are met. *Bareroot plants listed as being successfully freezer-stored include: Douglas-fir, noble fir, white fir, balsam fir, Pacific silver, fir, Shasta red fir, grand fir, Fraser, fir, western red cedar, western hemlock; Sitka spruce, Englemann spruce, Norway spruce, ponderosa pine, lodgepole pine, Scotch pine, western white pine, eastern white pine, western larch, giant sequoia.*

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