

PLANT MATERIALS TECHNICAL NOTE

Temporary Storage and Handling of Container, Bareroot, and Cutting Stock

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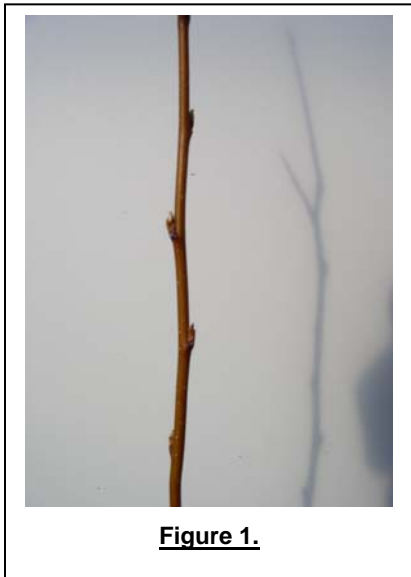
INTRODUCTION: A frequently overlooked cause of tree and shrub mortality in conservation plantings is improper temporary storage and handling of plant materials from the time they are received by the landowner until they are properly installed in the ground. Exposed roots of bareroot stock are particularly sensitive to desiccation and rapid deterioration if improperly stored and handled. Many claims of “poor quality stock” are more likely the result of seedling and cutting deterioration while in the care of the landowner. In this context, **bareroot** plants are defined as seedlings or rooted cuttings grown in the field and shipped without soil surrounding their roots; **containerized or potted** plants are seedlings or rooted cuttings grown for at least one full growing season in a container; **cuttings** are pieces of stem tissue; and **rooted cuttings** are stem tissue that have produced adventitious roots and are now self-supporting plants.

I. COORDINATE PLANTING DATES WITH SEEDLING DELIVERY AND/OR CUTTING HARVEST

DATE: The planting site should be prepared and all equipment, supplies, and labor in-place well in advance of seedling delivery. The interval from seedling delivery to the landowner and planting should be minimized, generally **24 to 72 hours**. Nurseries normally provide shipping date information prior to delivery. If the local Conservation District or Extension Service office is the drop-off point, delivery information is normally available 1 to 2 weeks prior to shipment. The urgency of timely pickup depends on the quality of the storage facilities at the drop-off point. If an environmentally controlled cooler is available, storage for several days to perhaps 2 or more weeks is possible. Optimum storage conditions vary by species, most nursery stock storing well at 33° to 35°F with relative humidity above ~90 to 95 percent. If the drop-off point merely consists of a cool room, garage or shed, pick-up should occur within **24 to 48 hours** of arrival at the drop-off point. If it is likely that conditions at the planting site will not be favorable for planting at the projected date of seedling drop-off, schedule shipping by ground mail directly to the planting site on a date when conditions are more likely to be favorable.

Cuttings used for bio-engineering and other riparian restoration projects may be rooted in a greenhouse and then planted, or, in the case of willow (*Salix* species), cottonwood (*Populus* species), and dogwood (*Cornus* species), inserted directly in the ground prior to adventitious root formation. In the latter case, it is ideal to harvest fully dormant hardwood cuttings in December and January, and then store them in a climate controlled environment until conditions in the spring are suitable for planting and root initiation. It is also possible to harvest cuttings immediately prior to field planting, although obtaining fully dormant cuttings in the spring when field conditions are suitable for planting is frequently difficult (see Forestry Technical Note No. MT-25, *Establishing Willow Cuttings in Riparian Areas*). In either case, the maintenance of cutting viability depends on the quality of environmental control during storage (34° to 38°F with 90 to 95% relative humidity for long-term storage). If refrigeration units are available, fully dormant cuttings taken in late fall to mid-winter can be stored until they are needed in late winter or early spring. At harvest, dip the tops (apical end) of cuttings in latex paint, paraffin, or sealing wax to prevent desiccation and identify the top of the cutting from the bottom (basal). Place cuttings in the cooler in plastic sacks to maintain relative humidity. Inspect for mold and treat with an approved fungicide if needed.

II. IMMEDIATELY INSPECT SEEDLINGS AND CUTTINGS AT THE POINT OF RECEIPT: Whether the seedlings are delivered to a central drop-off point or mailed directly to the planting location, they should be thoroughly inspected upon receipt. Inspect the tops (foliage and stems) for signs of mechanical damage, weather-induced stress, and insect or disease infestation. Seedlings and cuttings should be fully dormant (see FIGURES 1 and 2) with little to no evidence of bud scale separation or green, actively growing tissue.



EXAMPLES OF FULLY DORMANT DECIDUOUS AND CONIFEROUS SPECIES

Seedlings with actively growing tissue (see FIGURES 3, 4, and 5) are highly susceptible to mechanical injury during handling and planting, as well as frost damage. Stems should be firm and smooth without a wrinkled or water-soaked appearance. A small, shallow slice of the stem should reveal a healthy green cambium layer. There should be several fibrous roots originating from the stem with no signs of insects or disease. Saprophytic white molds (fungi) are typically harmless and can be washed off the roots and foliage without incidence. Black mold causes seedling mortality, and needs to be treated with an approved fungicide, or discard contaminated seedlings. After inspection, close and seal the box as you received it.



EXAMPLES OF DECIDUOUS AND CONIFEROUS SPECIES IN EARLY STAGES OF ACTIVE GROWTH

Contact the nursery supplier immediately (even while at the pick-up point) if you have questions or concerns. (Note: Some nurseries recommend not opening sealed boxes until the day of planting,

assuming proper storage conditions and less than 7 days between receipt and planting. This may prove acceptable depending on the nursery, stock quality, and other factors. Use your best judgment!)



FIGURE 6.

III. MINIMIZE PLANT STRESS DURING TRANSPORT TO THE PLANTING SITE:

In the western U.S., farmers and ranchers often travel many miles to a central location to obtain their seedlings. Pickup trucks are often used to transport seedlings and other supplies while the landowner is in town. Seedlings should not be transported in direct sun, even inside a protective box, if increased seedling temperature is possible. Storage boxes should remain closed to prevent seedling desiccation on the trip home. Avoid crushing seedlings by stacking storage boxes too high. If possible, store packaged seedlings inside an air-conditioned cab, out of direct sun, and with the air conditioning “on”. If air temperatures are cool, packaged seedlings may be transported in the back of a pickup with a cap or under a tarp (see FIGURE 6). Transporting

boxed or wrapped seedlings in the back of an open pickup or car trunk is also acceptable if air temperatures in these locations are less than ~45°F, perhaps as much as 60°F for short intervals (<2 hours). Seedlings packaged so that the tops are exposed should only be transported under cover. Wrapping boxes with insulation or blankets helps keep seedlings cool. A cooler(s) with ice in bags is an excellent method of storing seedlings until they reach the planting site. If it is necessary to stop, park the seedlings under shade. These same rules apply when transporting seedlings to the field for planting.

IV. IF NECESSARY, MOISTEN THE ROOTS UPON ARRIVAL AT HOME:

Most bareroot plants have their roots surrounded with sphagnum, peat moss, shredded newspaper, bark, or some other water-holding substrate to maintain moisture. Even dormant stock transpires moisture, although the highest moisture demand begins with active growth. Roots should never have a dry, grayish appearance, or in contrast, be saturated or water-logged. For peat-based packing media, a good rule of thumb is that proper media moisture occurs when a handful of squeezed peat produces 1 to 2 drops of water. There should never be standing water in the bottom of the box or sack. Inspect the bareroot seedlings every 2 to 3 days, and container-grown plants weekly, and lightly moisten all roots as needed. Precise temperature and high humidity control during seedling storage will increase the interval between watering.



FIGURE 7.

V. MINIMIZE TEMPORARY STORAGE:

The sooner seedlings and cuttings are planted in the ground, the better! As a rule of thumb, **seedlings should be placed in the ground within approximately 72 hours of leaving cold storage.** As an example, if seedlings shipped by ground mail to the landowner left refrigeration 48 hours prior to receipt, they should be planted within 24 hours of arrival, if refrigeration is unavailable. If planting is delayed, a household refrigerator is ideal for short-term storage of small lots of seedlings. As noted earlier, ideal nursery stock storage conditions is in a controlled environment (see FIGURE 7) with air temperatures maintained at 33° to 38°F and relative humidity above ~90 to 95 percent. A cool garage, root cellar, or basement also works, although shelf-life and subsequent out-planting success depends on prevailing temperatures and humidity. Even the shaded north side of a building can be used if temperatures remain cool. Keep the seedlings sealed in the original box and only open briefly to inspect and add water. Do

not allow seedlings to freeze. Long-term storage (more than ~7 days) is not advised unless environmental control is provided. Although seedlings may be “lined-out” or “heeled-in” in a shallow trench for long-term storage, this can be a tricky proposition resulting in additional plant stress (see *Windbreaks for Montana - A Landowner’s Guide*). Your best bet is to use good planning to avoid the need for prolonged storage.

As noted earlier, the maintenance of cutting viability depends on the quality of environmental control during storage (34° to 38°F with 90 to 95% relative humidity for long-term storage). If refrigeration units are available, fully dormant cuttings taken in late fall to mid-winter can be stored until they are needed in late winter or early spring. Again, apply latex paint, paraffin, or sealing wax to cut tops to prevent desiccation and identify the top of the cutting from the bottom. Place cuttings in the cooler in plastic sacks to maintain relative humidity. Inspect for mold and treat with an approved fungicide if needed.

VI. SWEATING SEEDLINGS: Certain species such as bur oak (*Quercus macrocarpa*) and hackberry (*Celtis occidentalis*) have a tendency to remain dormant, especially when soils are wet and cool. Trees and shrubs that remain dormant for most or all of the first growing season will probably die before the next growing season. In order to overcome bud dormancy, a technique called “sweating” is used to initiate bud break.

Sweating trees is a simple process that can be accomplished using the packing materials shipped with the trees and duct tape. One to two weeks before planting, remove the seedlings from the cooler. Line the cardboard shipping boxes with a large plastic bag. Place broken (opened) bundles of trees loosely in the plastic-lined box and wet thoroughly. Fold and tape the plastic together to create an airtight seal. Store the wrapped trees at room temperature, away from direct sunlight, for 1 to 2 weeks, checking periodically to ensure they do not dry out. Condensation should form on the inside of the plastic within hours, indicating a tight seal and that the sweating process is working.

When properly sweated, the buds of these species will have swollen and, in some cases, broken open. Use extra precautions when planting sweated stock, especially if leaves are beginning to emerge, because they are very sensitive to desiccation during handling and immediately after planting.

VII. REMOVE FROM COLD STORAGE ONLY AS MANY SEEDLINGS OR CUTTINGS AS CAN BE PLANTED IN A GIVEN TIME FRAME: If planting is planned for the cool morning hours, remove only enough plant material from cold storage to meet the anticipated need for that time period. Always keep roots covered with a moist substrate (moist burlap or towel) or media (soil:water slurry, polyacrylamide slurry, moistened peat moss, excelsior fiber, or kraft paper) until they are placed in the ground. Never cover roots with any dry substrate or material including peat moss, soil, etc. Bareroot seedling mortality can occur in literally seconds, and conifer seedlings are particularly sensitive. If conifer roots dry enough to assume a dry, gray color instead of their normal shiny, wet appearance, they have probably suffered serious damage. Bareroot conifers are especially sensitive to root desiccation and should only be handled and planted by experienced planters. If seedlings are to be hand planted, transport them in a bucket or container filled with moist media and always stored in the shade. Seedlings should be stored in buckets or trays in a similar fashion when using mechanical transplanters. If seedlings are shipped in plastic (polyethylene film) sacks or lined boxes, be sure to avoid over heating inside the sacks during transport and planting.

Although soaking roots in standing water prior to planting is acceptable for short intervals, do not leave bareroot conifer roots submerged in water for more than 1 hour. Soaking bareroot deciduous trees and shrubs for up to 4 hours may enhance the survival of some species. Do not leave roots in standing water overnight. Containerized stock should be kept consistently moist with periodic watering. Pre-treat stored unrooted cuttings prior to planting by soaking in water for 24 to 48 hours.

VIII. HANDLE BAREROOT SEEDLINGS AND ROOTED CUTTINGS WITH CAUTION: Young seedlings have delicate roots and buds that are easily damaged during handling. Never pull a seedling by the top (foliage and stems) to separate it from a bundle or from packing material. Avoid damaging buds during planting or installation of seedling protectors. Carefully open bundles, untie if necessary, and then cautiously remove individual seedlings. Remove all ties, labels, and containers prior to planting to prevent girdling damage.

IX. PLANT WHEN WEATHER CONDITIONS FAVOR SEEDLING SURVIVAL: Environmental conditions at field planting time can have a major impact on seedling and cutting viability after planting. Planting conditions are best on cool, cloudy, humid days with little or no wind. When possible, schedule planting

on days when the weather forecast favors seedling survival. Do not plant on hot, dry, windy days. Refer to FIGURE 8, Climatic Stress Chart, to identify suitable conditions for planting. Cease planting when air temperatures and relative humidity in the field fall above the curved line representing current sustained

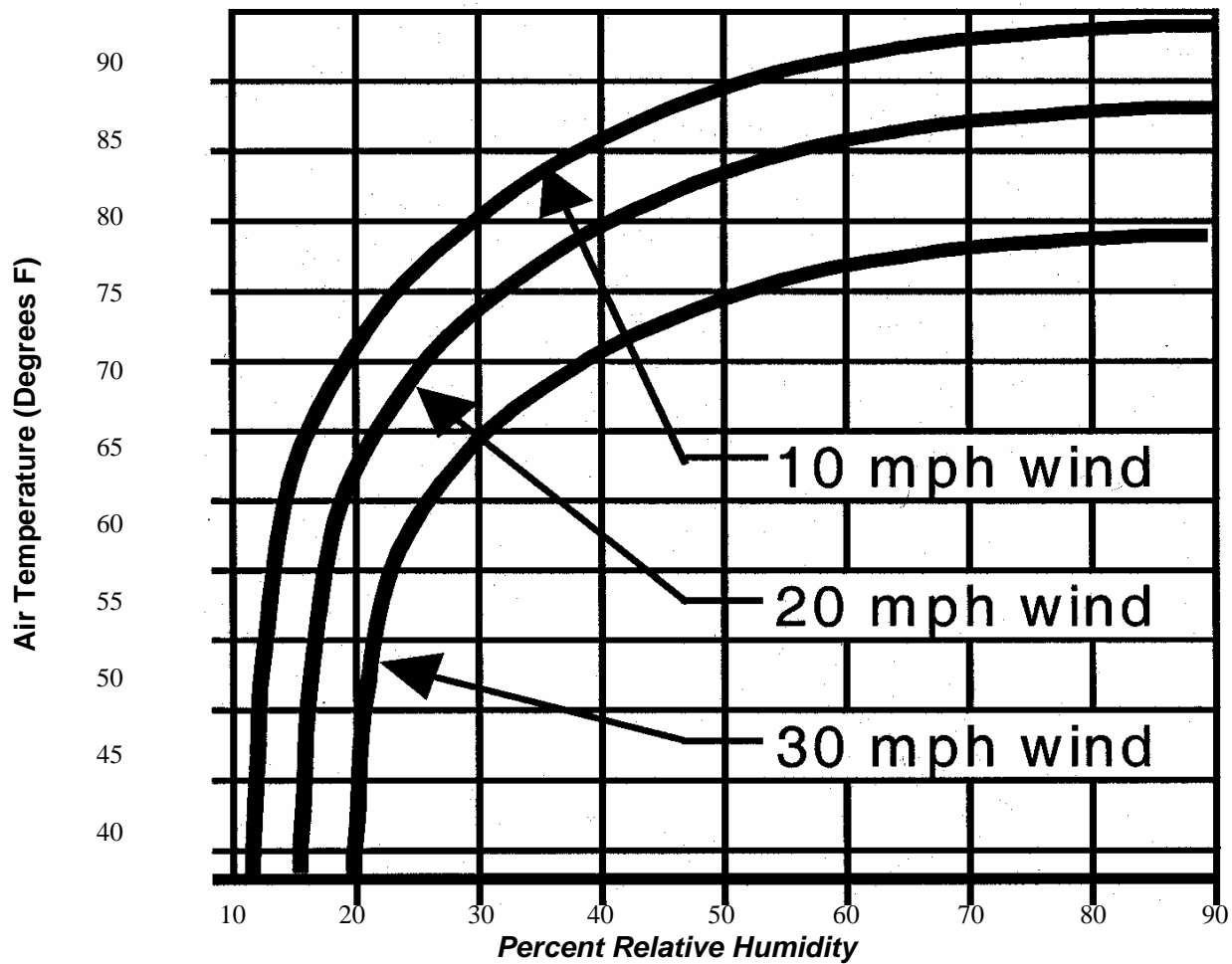


FIGURE 8.

wind speeds at the site, or when sustained wind speed exceeds 30 miles per hour. As conditions approach those indicated by the appropriate wind speed line, use extra care to prevent seedling desiccation. Site conditions falling below the appropriate wind speed line are generally considered good for tree and shrub planting. Do not plant when the soil is frozen or excessively dry, and do not handle stock when temperatures are at or below freezing. To monitor changing and projected weather conditions, visit the appropriate state weather site at <http://weather.noaa.gov>

These few steps can make the difference between a fully successful planting and a complete failure. When in doubt, call your local NRCS, Conservation District, Extension Service office, or state or private nursery.

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