

Table 6. Care and handling of bare-root seedlings.

Stage	Recommended practices
Long-term storage (more than 3 days)	<ul style="list-style-type: none"> • Store in a cooler at 33°F to 36°F. • Use packaging that prevents moisture loss. Most nurseries store and ship seedlings in waxed bags or boxes that “breathe” but prevent water loss.
Transport from nursery	<ul style="list-style-type: none"> • Use a refrigerated or insulated truck or reflective tarp (white exterior, silver-foil interior) over seedlings in an open-bed truck. • Do not expose seedling containers to direct sunlight. • Avoid using dark-colored tarps, which build up heat. • Travel during cool times of day if possible.
Short-term storage (a few hours to 3 days)	<ul style="list-style-type: none"> • Store below 42°F (ideal temperature range is 34°F to 36°F).
Transport to planting site	<ul style="list-style-type: none"> • Use proper packaging for seedlings and a reflective tarp. • Do not transport in the open; keep covered. • Do not stack bags more than two high. • When arriving at the site, store seedlings in shade. • Do not take more seedlings than can be planted in 1 day.
At planting site	<ul style="list-style-type: none"> • The greatest risk of damage from moisture loss, temperature, and physical handling is at this stage. • Handle seedling boxes or bags gently; do not throw or drop. • Reseal partially empty bags. • Avoid rubbing or tearing roots when taking seedlings out of the storage bag and putting them in the planting bag. Do not cram too many in the bag. • Seedlings may be dipped in water (for 1 minute at most) before placing in a planting bag, but do not store in water or the roots will die. • Do not leave seedlings unprotected on the ground, and make sure roots stay moist.

Checklist for Step 5: Take care of the planting

Maintenance after planting often makes the difference between success and failure.

- Control competing vegetation for 2 years or more after planting to ensure good survival. Controlling invasive weeds and other competing vegetation leaves more soil moisture and other resources for seedlings.
- Minimize animal damage problems—from livestock or wildlife—by using seedling protective devices, fencing, or repellents as needed. Try to anticipate problems during your initial site assessment (Step 1, page 2), but monitor and respond to problems if they occur.
- Irrigation can help improve seedling survival and growth, particularly for water-loving species on droughty soils. Consider the labor and expense involved, and select species that can survive on the site over the long term without irrigation.
- Visit the site periodically to monitor seedling survival and growth and determine maintenance needs. The first season after planting is the most critical, but maintenance may be needed for several years before seedlings are free to grow.

STEP 5. TAKE CARE OF THE PLANTING

Maintenance weed control

The task at this stage is to maintain the weed control achieved before planting. Without continued control, weeds will quickly return and affect seedling survival and growth. This is a common source of failure in riparian plantings.

Once the planted species begin to shade a significant portion of the ground, weed control becomes much easier. The time required to reach this stage varies. With effective weed control, conifer plantings on unirrigated,

upland sites in western Oregon commonly reach this point (called “free to grow”) in 4 to 6 years. There is less research or experience for riparian plantings to guide us, so plan for ongoing weed control in your planting for at least that long.

An added challenge in postplanting vegetation control is the need to mow, trim, or spray around vulnerable seedlings. If site preparation was effective, the main concern will be annual grasses and broadleaf weeds. Try to maintain the same control targets established before planting (e.g., a 3-foot by 3-foot or 4-foot by 4-foot patch or a 3- to 4-foot-wide strip).

Mowing is popular in young plantings. With available tools ranging from tractor-mounted mowers to handheld weed trimmers, mowing can keep woody weeds under control across a range of terrains and planting sizes. Mowing alone is not a good way to control herbaceous plants and gives only modest relief from moisture competition.

Mulches are effective for suppressing weeds around planted seedlings and retaining moisture into the summer. Various mulch materials are available.

Weed mats are made of woven synthetics, paper, or other materials (figure 19). They are placed over bare ground and fastened with landscape pins or rocks and soil. Commercial products include Vispore, Pak, and Brush Blanket. Longevity varies from one to several seasons. Mats come in various sizes; the recommended minimum is a 3-foot square. Mats are effective against grass and forbs but not resprouting woody vegetation. Mats have several disadvantages; they are relatively expensive (\$0.75 or more per mat) and labor intensive to install, provide shelter for rodents, and can move if the area floods.

Organic materials used for mulching include straw and wood chips. Newspapers, cardboard, and other low-cost alternatives can be used as mats. These materials are inexpensive and readily available (figure 20), but they



Figure 19. Mulch mats under ponderosa pine seedlings on a dry site in southwest Oregon.

Photo by Applegate Partnership and Watershed Council.

can be a source of weed seed, are not as effective as weed mats for suppressing weeds, and may decompose too quickly or be swept away by floods.

Herbicides can be an effective and efficient way to control weeds after planting, but seedlings are also susceptible to commonly used herbicides (e.g., glyphosate). Avoid damage by directing spray at weeds and shielding seedlings to prevent contact with leaves or green bark. Glyphosate and other foliar-active herbicides have no soil activity; they kill what is already growing but don't prevent establishment of new weeds. Two or more treatments may be needed each season to control emerging weeds. Many formulations of glyphosate are available. Check the label to see if a product allows your intended use.

Animal damage control

Animal damage is another common cause of plant mortality in riparian plantings. Hardwood species are particularly attractive to many animals. Carefully assess the need for protection, taking into account the food and shelter available in the area for various animal species. Physical methods of damage prevention (e.g., fences, cages, and tubes) are useful, but they are also expensive and require periodic inspection and maintenance. Using large



Figure 20. Organic material such as bark or wood chips is often used as an inexpensive form of mulch and weed protection.

Photo by Applegate Partnership and Watershed Council.

planting stock and controlling weeds to promote rapid seedling growth will help minimize many animal damage problems.

Beaver and nutria can cause extensive damage to young seedlings. Removing these animals may be an option; however, the site will likely be repopulated from adjacent areas. Plantings quickly grow beyond nutria but may remain attractive to beaver for many years.

Protection methods include individual tree protectors (e.g., 2- or 4-inch wire mesh cages), chicken wire or sheet metal loosely wrapped around larger tree trunks, and fencing between the planting and stream.

Depending on your situation, you may be able to meet your objectives using a species not preferred by beaver, such as ninebark. Consult with local experts. Small, isolated plantings that are the only woody plants in the neighborhood are more attractive and more vulnerable and will likely require more protection than large plantings adjacent to other areas of woody vegetation.

Deer typically browse young seedlings early in the growing season, when new shoots are tender. Deer will browse up to about 3.5 or 4 feet. If deer are a problem, you need to protect trees'

leaders until they grow past this height. If you fence an area, the fence must be at least 8 feet high to keep out deer.

Tree shelters (figure 21) and plastic mesh tubing, supported with a bamboo or wooden stake, are effective but expensive and labor intensive to install (\$3 to \$6 per tree installed). Big-game repellants (e.g., Deer-Away and BGR) must be applied every 2 weeks in spring and early summer to be effective against lighter browsing. Bud caps, flexible netting, and other materials are less expensive than tree shelters and sometimes prevent browsing.

Mice and voles can be very damaging to young plantings. They can thrive under a tall, dense cover of grassy weeds. When vole populations surge, they will eat the bark on seedlings of all species, girdling and killing trees up to



Figure 21. Tree shelters protect seedlings from several forms of animal damage but are labor intensive and expensive to install.

Photo by Donna Schmitz, Benton Soil and Water Conservation District.

1 to 2 inches in diameter. Most damage occurs during winter. The most effective control is to eliminate cover by mowing grasses short and eliminating grassy weeds near seedlings. The standard 3-foot by 3-foot or 4-foot by 4-foot area used to reduce weed competition works well for preventing vole damage, too. Tree shelters and aluminum foil (wrapped around the base of seedlings) can also protect seedlings.

Livestock (e.g., cows, horses, sheep, goats, and llamas) find young seedlings palatable and can heavily damage unprotected seedlings. The best way to keep livestock out of planted areas is standard woven wire or electric fencing.

Irrigation

Although all plants can benefit to some degree from irrigation, it is usually not essential. Selecting appropriate species and planting stock, using proper handling and planting techniques, and effectively controlling weeds will help ensure success in the absence of supplemental water.

Irrigation can help seedlings survive summer drought and improve seedling vigor and growth. Hardwoods are more susceptible to drought than conifers. Irrigation will be a temporary practice, so you must select species that will survive without irrigation after they are established.

Carefully evaluate the need for irrigation. If your planting is on farmland with water rights and irrigation

equipment, irrigation may be feasible and effective. On other sites, irrigation can be time consuming and expensive.

Irrigation is most appropriate under the following conditions:

- During the first one or two growing seasons, to help seedlings establish
- On very coarse soils (e.g., sandy or gravelly) with minimal water-holding capacity
- When planting water-loving species (e.g., alder, willow, and cottonwood)
- When water rights are available

Irrigation methods include sprinklers, drip systems, and hand watering. Select a method on the basis of cost and available equipment, labor, and water. If you don't have a water right to irrigate, you may have to carry water in from off site. Contact the Oregon Water Resources Department (<http://www.wrd.state.or.us/>) for more information.

For maximum benefit, begin watering by early summer, before plants develop high levels of moisture stress. Plan to water every 10 to 14 days, tapering off as summer progresses. Drying down at the end of the growing season helps induce dormancy and increase winter hardiness, so avoid frequent irrigation in late summer.

Tree seedlings may not expand their root area much in the first growing season. They depend on nearby soil for moisture. Monitor this area. Water deeply and slowly to thoroughly wet the rooting zone.