## **STEP 3. PREPARE** THE SITE

Streamside restoration sometimes begins with a clean slate—an agricultural field free of established weeds, ready to plant. More often, the site has well-established, invasive perennial weeds, such as Himalayan blackberry, Scotch broom, and reed canarygrass (figure 11), that must be controlled to allow good establishment of native trees and shrubs. This control is generally best done before planting, as part of site preparation.

Good site preparation does not guarantee long-term survival and growth, but it helps. Seedlings get off to a better start, and future maintenance is easier. It is usually much easier and less expensive to control tough weeds before planting than after. You may need to spend two seasons getting your site ready for planting.

Some aggressive site preparation techniques are quite disruptive, can cause unintended damage, and should be used with caution after careful consideration of the situation. Select practices appropriate to the problems and risks at the site, keeping in mind that a minimalist approach to riparian planting often leads to failure.

# **Checklist for Step 3: Prepare the site**

Weed competition is a serious obstacle to successful establishment of riparian plantings; it is usually easier to control competing vegetation before planting than after.

- □ Anticipate future weed problems. Review your site assessment (Step 1, page 2) to identify weeds, barriers to effective planting, access issues, and management limitations.
- □ Allow enough time. It may take two or more seasons to get control of some aggressive weed species.
- □ Choose site preparation methods that kill the root systems of perennial weeds, such as blackberry and Scotch broom. Live roots will resprout.
- □ Consider effectiveness, duration, and cost. Herbicides are often the most effective and least costly method for controlling competing vegetation. Tilling, cutting, mowing, pulling, grubbing, and mulching can also be effective.
- □ Plan ahead to minimize potential new problems. Aggressive site preparation may remove competing weeds but also will expose bare soil, which can lead to new (possibly worse) weeds and the risk of erosion.

#### Seedling survival and growth

Weeds compete with seedlings for moisture and other critical resources. Research has demonstrated that eliminating weeds from a relatively small area around the seedling can dramatically improve seedling survival. Substantial improvements in seedling growth, however, occur only when weeds are nearly completely eliminated. It is easier and cheaper to achieve high seedling survival than rapid seedling growth.

An effective approach to ensure good survival is to create a weed-free area (3 feet by 3 feet or 4 feet by 4 feet) for each seedling before planting and maintain that area for at least 2 years after planting (figure 12). Woodland owners regularly achieve 80% to 90% survival of bare-root seedlings planted in unirrigated, upland soils with this approach.

The weed-free area can be spots, strips, or a broadcast treatment (the entire field) depending on your objectives. Choose the target area and control methods on the basis of site conditions and your preferences, skills, and equipment.



Figure 11. Tall-growing reed canarygrass competes aggressively with transplanted seedlings.

Photo by Brad Withrow-Robinson, © Oregon State University.





Figure 12. Creating a weed-free strip (a) or patch (b) lessens moisture competition for newly planted tree seedlings. Tree shelters protect seedlings from spray and browsing animals.

Photo 12a by Brad Withrow-Robinson, © Oregon State University. Photo 12b by Donna Schmitz, Benton Soil and Water **Conservation District.** 

#### **Competing vegetation**

Table 5 describes site preparation methods for the two types of competing vegetation: herbaceous and woody. The most effective methods kill shoots and roots of target weeds. Removing only the aboveground portion of competing vegetation provides good access and temporarily reduces competition. However, if root systems are not killed or removed, perennial weeds will resprout and compete vigorously with planted seedlings. Future control will be more difficult. There is a clear trade-off between less effective site preparation and an increased need for future maintenance.

Weed control is a means to an end. Your goal is not to kill weeds, but to allow seedlings to survive.

Herbaceous grasses and broadleaf weeds compete vigorously with newly planted trees and shrubs. Their effect is strongest very close to the seedling and in the first few years after planting. Grasses are particularly competitive for several reasons:

- Grasses have a dense, fibrous root system that rapidly absorbs soil moisture.
- Grasses start growing earlier in the season than most woody vegetation and use available soil moisture by early summer. Seedlings need this moisture to survive summer drought.
- Some grasses spread rapidly via underground runners (rhizomes) and can resprout from root fragments.
- Dense herbaceous cover is good habitat for voles (meadow mice), which often kill seedlings by stripping their bark.

Woody vegetation, such as Himalayan blackberry and Scotch broom, competes with seedlings for soil moisture and sunlight. These plants can remain highly competitive much longer than herbaceous plants. Suppressing these aggressive, nonnative, weedy shrubs long enough for trees to establish can be a challenge. A combination of control methods is often required (figure 13).

See Managing Himalayan Blackberry in Western Oregon Riparian Areas, OSU Extension publication EM 8894 (http:// extension.oregonstate.edu/catalog), for more information about controlling blackberry in riparian areas.

# **Mechanical control**

Mowing is commonly used to clear herbaceous plant debris and woody species, such as blackberry, before planting. However, mowing alone is not an effective way to control perennial weeds, which simply regrow after cutting. In some cases, multiple annual mowings over several years can substantially reduce blackberry cover and vigor. Tractor-mounted mowers are preferred where access and slopes permit, although soil compaction might be a concern. Soil compaction has been shown to reduce seedling growth in upland forests. Where machinery use is not feasible, use machetes, loppers, or brush cutters. A chainsaw with a hedge-trimmer attachment is also effective.



Figure 13. Example of Himalayan blackberry control in a riparian terrace next to a farm field: (a) just prior to mowing with a rotary mower, (b) in the middle of the first growing season, and (c) after 4 years of growth. Site preparation included two mowings followed by a fall application of glyphosate. Postplanting treatments included spot spraying with glyphosate and hand weeding.

Photos by Max Bennett, © Oregon State University.

Table 5. Site preparation methods.			
Method	Effectiveness and duration <sup>1</sup>	Cost/acre per application <sup>2</sup>	Comments
Grasses and herbaceous vegetation			
Herbicides: applied with vehicle and boom spray or hose, or with backpack or hand sprayer	High 1—2 years	\$60—\$200	Can apply to strips or planting spots. Minimum area is 3 feet by 3 feet, centered on seedling. Dead plant material temporarily protects soil and delays weed reinvasion from seed.
Mechanical: tilling	High 2–4 months	\$100-\$200	Weeds sprouting from seed rapidly reinvade exposed soil.
Mechanical: mowing	Low 1–4 weeks	\$50—\$150	Mowing does not stop moisture competition but may reduce rodent problems. Must be repeated often.
Manual: scalping, hoeing	Medium 3–6 weeks	\$120-\$360	Minimum area is 3 feet by 3 feet, centered on seedling. Weeds sprouting from seed rapidly reinvade exposed soil.
Mulch (mats or other)	Medium 1—2 years	\$150—\$400 for mats	Mats must be well secured and flat on ground. Minimum area is 3 feet by 3 feet, centered on seedling. Mulch mats can harbor rodents and might wash away in high water.
Woody shrubs			
Herbicides: applied with vehicle and boom spray or hose, or with backpack or hand sprayer	High 1—3 years	\$60-\$250	Complete spray coverage is most effective. Dead plant material temporarily protects soil and delays weed reinvasion from seed.
Herbicides: cut-stem or basal- bark treatment	High 1—3 years	\$50–\$120	Apply water-soluble formulations to cut stem surfaces. Apply oil-soluble formulations to penetrate bark. Standing dead material provides dead shade. Debris and leaf litter cover soil.
Mechanical: grubbing roots, raking	High 1—2 years	\$600—\$1,000	Weeds sprouting from seed rapidly reinvade exposed soil.
Mechanical: mowing	Low 1–4 weeks	\$100-\$300	Doesn't kill roots, which rapidly resprout. Must be repeated often.
Manual: slashing	Low 1–6 weeks	\$400—\$600	Doesn't kill roots, which rapidly resprout. Must be repeated often.
Manual: grubbing roots	High 1—2 years	\$1,000-\$3,000	Weeds sprouting from seed rapidly reinvade exposed soil.

<sup>1</sup> Effectiveness at reducing competition for site resources; duration is the period that competition is significantly reduced.

<sup>2</sup> Site preparation costs for each practice are highly variable and depend on site-specific situations. Costs listed here reflect a typical range of site conditions, but actual costs might be higher. Lower costs are associated with larger areas, easier ground, and forestry or agricultural contractor rates. Higher costs are associated with smaller projects, difficult conditions, and landscape contractor rates.

Hand scalping (i.e., scraping the vegetation down to bare mineral soil with a shovel or planting hoe) is a simple method for removing grasses and herbaceous weeds at planting (figure 14). For this method to be effective, you need to clear a 3- to 4-foot-wide area and remove many of the roots. This is labor intensive and provides only temporary relief from competition. Hand scalping usually needs to be repeated at least once during the first growing season and also the following year. Using mulch mats or other mulch materials after hand scalping can help prevent weed reemergence (Step 5, page 18).

**Mechanical scalping** with a brushblade-equipped tractor or other specialized equipment can be an effective means of removing brush if roots are also removed. This intensive and disruptive method is not suitable for many restoration situations because it can lead to soil compaction, erosion, and weed invasion.

**Manual pulling** is extremely labor intensive but can be effective if done thoroughly (i.e., remove all roots and rhizomes of blackberry). Like tillage and mechanical scalping, pulling can also leave lots of disturbed soil, increasing the risk of erosion and weed invasion.

**Grazing** is not an effective means of site preparation but may be suitable in some cases once seedlings are well established.

**Tillage** (including plowing, harrowing, and rototilling) can clear ground and break up sod, allowing easy planting and a clean start. But unless it's done repeatedly during the season before planting, tillage alone is generally not very effective against perennial weeds because of their ability to resprout from root fragments.

Tillage can also create several unintended consequences. It leaves the ground open and vulnerable to erosion and recolonization by other weeds. A freshly tilled field can be a sticky mess at planting. Rototilling strips (3 to 4 feet wide) can minimize some of these drawbacks.

Subsoiling, or ripping, is a special form of tillage that may be justified in cases of serious soil compaction, such as on pastures used for winter grazing. Combine tillage with mulch mats or other methods to maintain the target weed-free area after planting.

### **Chemical control**

Herbicides are an effective, and versatile, method for controlling perennial weeds before planting. They can be applied with power-driven spray equipment or backpack sprayers to provide control across a range of terrains without soil disturbance. Use herbicides according to your needs; create weed-free patches or strips to ensure good survival, or use a broadcast application to clear the entire site. Timing is critical, and herbicide effectiveness depends on the chemical used and species targeted.

#### Timing

If applied when weeds are actively growing, herbicides containing glyphosate will kill common perennial grasses (e.g., reed canarygrass, bentgrass, and tall fescue), annual grasses, and other herbaceous vegetation. Application rates will vary depending on the weeds present. Glyphosate is a foliar-active herbicide, so it will not control weeds that emerge from seeds after treatment. Additional methods will be needed to maintain weed control in the first few seasons after planting; these could include mulch, reapplications of glyphosate, or soil-active herbicides.

For blackberry and other woody species, herbicide application is most effective when plants have not been recently cut or mowed before spraying. When this is not practical, mow early in the season, and allow shoots to regrow before spraying.

#### **Formulations**

Several formulations of both glyphosate and triclopyr can control blackberry, Scotch broom, and other woody species. Chemical formulation and timing greatly affect effectiveness on target weeds and sensitivity of nontarget plants. These chemicals will damage or kill the hardwood trees and shrubs commonly included in riparian plantings, which is why controlling weeds during site preparation, before planting, is so important. Use extreme care when spraying, especially near riparian areas.

Consult the Pacific Northwest Weed Management Handbook (http:// pnwhandbooks.org/weed), the Oregon Department of Forestry, your local soil and water conservation district, and your local Extension office for more information about formulation and timing of herbicide applications. Also see "Important information about using herbicides" (page 15).

## **Minimizing erosion**

"Light touch" site preparation may reduce the risk of erosion but provide poor control of competing vegetation. More aggressive site preparation may provide excellent weed control but expose bare soil. This is a particular concern on or near stream banks that are washed by storm flows.

Strategies for minimizing erosion:

- Prior to site preparation on stream banks and terraces, plant and establish willow cuttings near the channel to dissipate stream energy.
- Remove competing vegetation only in small patches along a stream rather than in a continuous section.
- Use erosion-control cloth and other bioengineering approaches (figure 15).
- Use herbicides, and retain dead material to protect soil.
- Establish cover crops, or maintain untreated strips of vegetation.



Figure 14. Scalping provides only a temporary "leg up" on weed competition.

Photo by Paul Oester, © Oregon State University.



Figure 15. Erosion-control matting was used on this section of Thompson Creek in Jackson County, Oregon, after a steep, eroding bank was graded back to a more desirable angle, exposing bare soil. The site was revegetated with willow cuttings (visible as stakes in the fabric) and grass.

Photo by Applegate Partnership and Watershed Council.

#### Important information about using herbicides

- Use a herbicide registered for your intended use.
- Read the herbicide label, and follow the instructions. The label is the law!
- When appropriate, use formulations that are labeled for aquatic use. Consider the toxicity of both the herbicide *and* the surfactant.
- Mix herbicides well away from riparian areas.
- Wear protective clothing and safety devices as the manufacturer's label instructs.
- Avoid spraying on windy or hot days (above 75°F) to minimize herbicide spray drift and risk of volatilization (turning into a vapor). The risk varies with the herbicide.
- For herbaceous vegetation, spot-spraying or wipeon techniques are often a suitable alternative to broadcast applications.
- For woody vegetation, injection or cut-surface treatments can be appropriate.

The Oregon Department of Agriculture regulates herbicide use. The Oregon Department of Forestry regulates applications on forestland, including forested riparian buffers. Land in other land-use categories may have different regulations. Contact the appropriate agencies for current information about restrictions on herbicide use near streams.

See the *Pacific Northwest Weed Management Handbook* (*http://pnwhandbooks.org/weed*) and other resources listed under "For more information" (page 27), for more details on herbicide application and regulation.