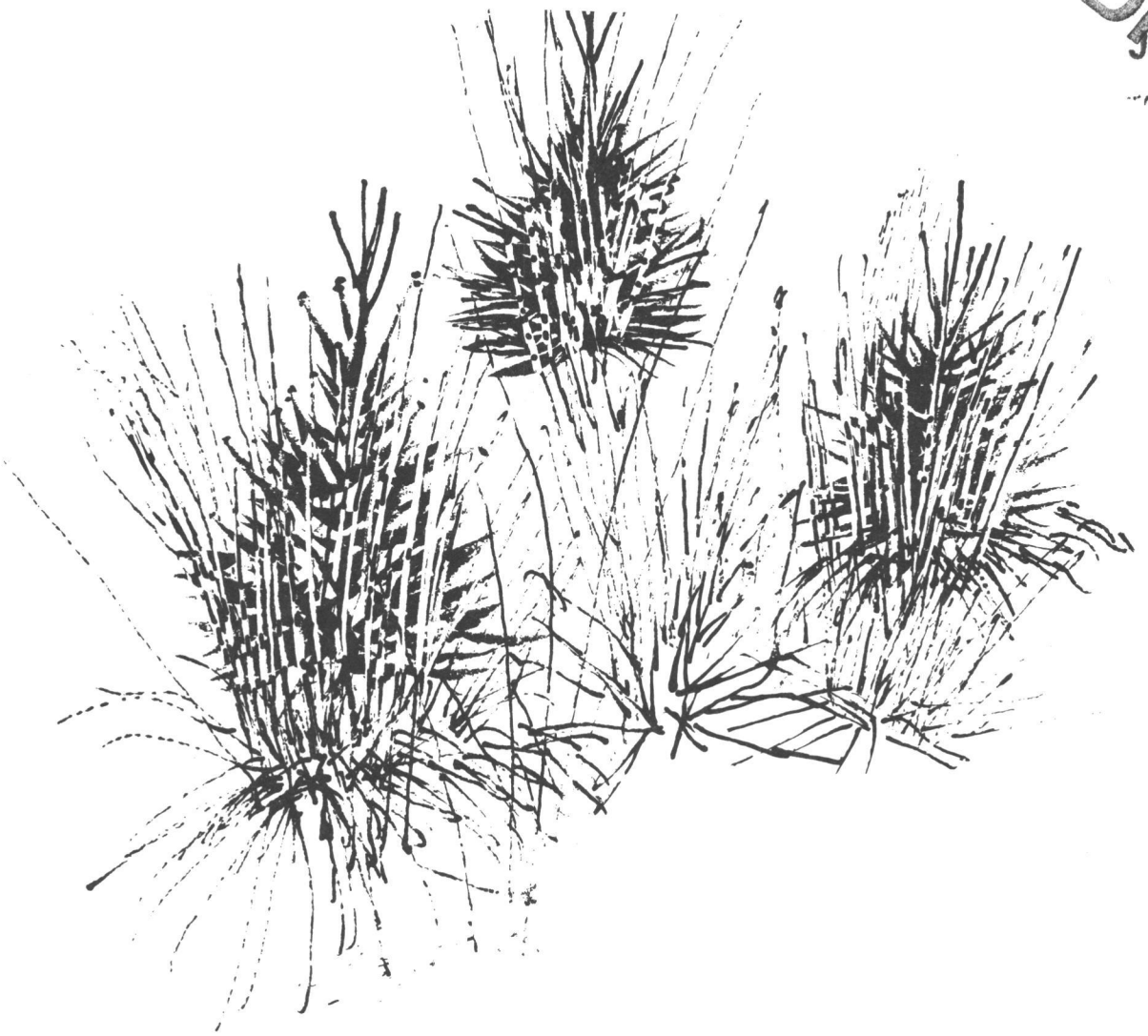

Managing Weeds and Vegetation in Christmas Trees

PNW 219
A Pacific Northwest Extension Publication
Oregon • Idaho • Washington
Revised February 1987

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R.D. William and K.N. Brown

Figure 1.—Adequate weed control practices provide conditions for vigorous growth of quality trees.

Contents

Controlling weedy vegetation that competes with Christmas trees is an essential part of producing quality trees (figure 1). Weeds drastically reduce growth and increase mortality of newly planted trees by competing for light, moisture, and soil nutrients (figure 2). Although established trees tolerate some weed growth, excessive weed competition reduces vigor, needle size, and tree color.

At harvest, weed debris within lower branches will reduce quality or render the tree unmarketable. Employee efficiency and morale are reduced when Canada thistle, wild blackberries, and poison oak infest plantations. Also, bracken fern can increase disease incidence in true firs by serving as an alternate host for white rust.

Weeds provide habitat for wildlife. Deer, for example, browse more in weedy plantations; field mice use weeds for cover; and gophers prefer weedy plants with fleshy roots such as dandelion, false dandelion, Canada thistle, and clovers. Tree damage can be reduced by controlling these preferred food sources or cover for wildlife. Gopher mounds also provide sites for new weed infestations such as tansy ragwort.

In contrast, elimination of all vegetation will increase runoff, cause soil erosion, and increase soil compaction. Trees remain cleaner at harvest when some vegetation covers the soil. Thus, weed control in Christmas trees requires combinations of weed control practices and careful management of the ground cover to maintain tree growth, quality, and ease of harvest while reducing soil erosion and compaction. Successful weed management in Christmas trees involves

Ray D. William, Extension horticultist—weed science, and *Kenneth N. Brown,* Extension agent, Marion County, Oregon State University. The manuscript was reviewed by Extension specialists in Idaho and Washington.

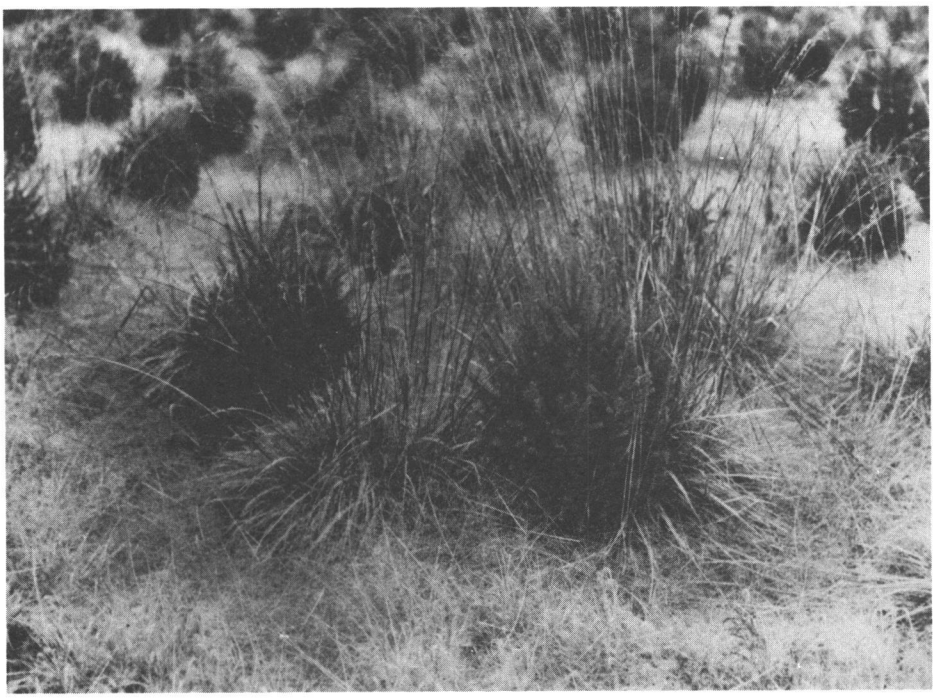

Figure 2.—Weeds reduce tree growth and quality by competing for water, nutrients, and (sometimes) light.

year-round strategies that combine the weed control practices outlined in the following sections.

Weed control practices

Cultivation and tillage

Although cultivation may be possible with square or rectangular planting arrangements, severe weed competition and increased soil erosion are likely to occur during the rainy season. Complete reliance on cultivation often results in increased pruning of tree roots, increased root rots in true firs, compacted soils, and specific weeds that tolerate cultivation (see appendix). In contrast, all weed control programs can be enhanced by spot hoeing or tilling small weed patches that escape or resist other weed control practices.

Rotary mowing or flailing

Rotary mowing is designed to cut vegetation 2 to 3 inches above the soil surface. Mowing reduces soil moisture and nutrient losses by reducing growth and height of vegetation for brief intervals between mowings.

In contrast, flailing cuts vegetation at or near the soil surface. Frequent flailing, especially in late spring, can reduce competition for soil moisture and nutrients by reducing weed growth during the dry summer period.

Plantations must be planted in straight rows with adequate space for passage of equipment if continuous mowing is planned, especially as market size approaches. Often, tree rows can be planted 6 to 12 inches wider than normal to accommodate equipment passage. Tractors should be equipped with fenders to avoid limb breakage or injury. Control weeds growing around the base of trees by hoeing or treating with a selective herbicide.

Herbicidal weed control

Herbicides provide effective and economic methods of managing weeds when used as part of a year-round weed control program in Christmas tree plantations. Herbicides require correct handling to minimize risk. Application at exactly the correct rate and at the right time is essential for selective weed control with minimal chance of tree injury. Consistent results can be obtained by reading the label—always verify that Christmas trees *are listed* on the label—and consulting other information about proper application and timing of each herbicide. Also, learn to identify weed species and select appropriate control methods for each weed infesting your plantation.

Note: This publication does not recommend herbicides for specific situations. These recommendations change from time to time. For the latest information, see your county Extension agent or consult the latest edition of the *Pacific Northwest Weed Control Handbook* ("For further reading," page 8).

Types and action of herbicides. Herbicides registered for use in Christmas trees are applied to soil during the rainy season or to actively growing vegetation during the summer. Some soil-applied herbicides kill germinating seedlings, while others control both seedlings and newly established weeds. These herbicides require uniform application over the soil surface followed by adequate rainfall for incorporation and activation. Most herbicides applied to the soil control susceptible weeds throughout one season; but they require either yearly applications, often at reduced rates after adequate control has been achieved, or applications every other year.

Consult the product label for information about soil types and herbicide rates. On light-textured sandy or rocky soils containing little organic matter, reduce rates of soil-applied herbicides to minmize chance of tree injury. During application, spray less herbicide by driving slightly faster or make separate applications over coarse-textured or rocky areas.

Foliar-active herbicides control actively growing vegetation. Selectivity in Christmas trees often can be achieved by directing the spray towards the weeds and avoiding contact with tree foliage. Conifers tend to be more resistant after active tree growth ceases in midsummer. Complete coverage of weed foliage is necessary for contact herbicides like paraquat, whereas translocated herbicides like glyphosate (Roundup) require only partial coverage. Often, surfactants are formulated with these herbicides or can be added to the spray mixture to increase contact and movement into the plant.

Know your weeds. Accurate weed identification is essential to select the most effective herbicides for use in a year-round weed management program. Obtain identification pamphlets from

your pesticide dealer or purchase local references such as *Gilkey's Weeds of the Pacific Northwest* and *A Guide to Selected Weeds of Oregon* ("For further reading," page 8). Identify and map the location of principal weed infestations throughout your tree planting. Then, design or improve your weed control program using your experience and the information provided in the appendix.

Application and equipment. Herbicides must be applied accurately and with proper equipment as described on the product label. Lightweight, portable, and relatively inexpensive backpack sprayers are adequate for spraying herbicides in small plantations and for spot treatments on large plantations. Backpack sprayers with a pressure gauge or internal pressure control can be calibrated to provide uniform application.

Cover the space between trees with either a single flood-jet nozzle or a two-nozzle boom, or mount a flood-jet nozzle toward the top of the spray tank for two-row applications directed behind the applicator.

Usually, 20 to 40 gallons of water per acre are applied, although many herbicides can be applied in 5 to 10 gallons water per acre with a flood-jet nozzle.

Managers of larger plantations generally depend on tractor-mounted sprayers or aerial application of herbicides. Ground sprayers equipped with a low-pressure piston pump and mechanical agitation will provide efficient and reliable application. Adjustable spray booms can be designed for multirow, directed, or topical applications with 20 to 40 gallons water per acre when trees are small.

Otherwise, aerial applications with 5 to 10 gallons water per acre are frequently applied because tree height and row spacings do not limit aerial spraying. However, the necessity of uniform application, tall obstacles such as trees or power lines, and possible herbicide drift onto harvest roads or adjoining property limit the flexibility and use of aerial equipment in some situations.

Controlled droplet applicators (CDA) are spinning disks that emit uniform spray droplets of liquid herbicides using small volumes of water. A small hand-held device is available, but it should be used to apply herbicides only where adequate tree tolerance has been demonstrated. Tree injury has resulted because instructions require the applicator to empty the spinning disk of liquid by raising it above the reservoir before stopping the motor.

If you use this method, start and stop the spinning disk in safe places away from trees. Recent development of larger CDA units mounted on spray booms may be more applicable to Christmas tree plantations.

Because glyphosate (Roundup) translocates readily in plants, a variety of wick or roller applicators have been developed for applying concentrated solutions on target weeds. Most applicators are constructed from PVC pipe but contain special nylon rope that wicks the herbicide from the pipe. Several types of applicators are available locally from farm supply stores. A 33% solution of glyphosate is applied to *both* sides of susceptible vegetation. Weeds must be taller than new trees or located between rows because selectivity depends on avoiding contact with the tree.

Sprayer calibration. Proper calibration of equipment is essential for accurate and uniform application of herbicides. Determine a comfortable ground speed and measure the time required to cover a certain distance by walking, driving, or flying over the area to be sprayed. Fill the sprayer and measure the amount of spray collected during the same time from all nozzles. Determine the area sprayed from one or all nozzles and convert to the part of an acre. Here's an example:

Ground speed: 33 seconds per 100 feet
Spray collected (in 33 seconds): 32 fluid ounces or 2 pints
Area sprayed (5 feet wide by 100 feet): 500 square feet or 0.0115 acre

Using these figures, 21.7 gallons would be applied per acre. A 5-gallon backpack sprayer would cover 0.23 acre (10,000 square feet), or 4.3 tankfuls would be required to spray an acre. A 100-gallon sprayer would cover 4.6 acres. (See the box on page 5, "How to calculate the correct herbicide rate.")

Herbicide formulations and calculations. Herbicides are formulated as soluble powders, wettable powders, flowables, dispersible granules, miscible liquids, or emulsifiable concentrates. Both flowable and wettable powder formulations contain finely ground clay particles that form suspensions, not solutions. Therefore, continuous agitation with mechanical agitators is required during application. Strainers both within the line and at nozzles should have openings 50-mesh or larger to permit passage of the suspension through the spraying system.

Because wettable powder formulations are abrasive, recalibrate sprayers frequently to assess delivery rates, and change nozzles frequently, depending on use and wear.

Recommended rates listed on herbicide labels are stated in pounds or gallons product per acre. Because several products with different amounts of active ingredient may be available, guidelines in Extension publications are listed in pounds active ingredient (ai) or acid equivalent (ae) to apply per acre.

When tank-mixing herbicides, always add the chemicals to a partially filled spray tank in the following order:

1. compatibility agents (if needed),
2. wettable powders or dispersible granules,
3. flowables,
4. emulsifiable concentrates,
5. oils, and
6. surfactants.

Avoid excessive foaming by filling the tank before adding surfactants.

Use pesticides safely!

- **Wear** protective clothing and safety devices as recommended on the label. **Bathe or shower** after each use.
- **Read** the pesticide label—even if you've used the pesticide before. **Follow closely** the instructions on the label (and any other directions you have).
- **Be cautious** when you apply pesticides. **Know** your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.

How to calculate the correct herbicide rate

Dry formulations

Note: for this calculation, use the *decimal form* of the percent active ingredient (.8 for 80%, etc.).

$$\frac{\text{Pounds active ingredient per acre}}{\text{Percent active ingredient}} = \text{pounds product per acre}$$

Example: $\frac{2 \text{ lb}}{.8} = 2.5$ lb product per acre

Liquid formulations

$$\frac{\text{Pounds active ingredient per acre}}{\text{Concentration in pounds active ingredient per gallon}} = \text{gallons product per acre}$$

Example: $\frac{2 \text{ lb}}{4 \text{ lb per gal}} = 0.5$ gal product per acre

Areas smaller than 1 acre

Area sprayed with backpack × pounds product per acre = amount product per area sprayed

Example (dry): 0.23 acre × 2.5 lb product = 0.58 lb product per 5 gal

Example (liquid): 0.23 acre × 0.5 gal product = 0.115 gal or 18.4 fluid ounces or approximately 1 pint per 5 gal

Choosing alternatives and managing weed vegetation

Site preparation and new plantings

Choose fields with proper slope, drainage, and manageable weed infestations by either avoiding fields severely infested with perennial species or controlling these species before planting. Perennial weed or brush control requires destruction of the entire plant, including underground roots and stems. Herbicides such as glyphosate or dalapon that translocate throughout the plant provide the most satisfactory control of these species. Choose the correct herbicide based on knowledge of the weed infestation.

Begin site preparation the fall before by broadcasting a general purpose, translocated herbicide such as glyphosate to control most vegetation and reduce wildlife habitats. Avoid plowing or excessive soil disturbance to minimize erosion and muddy conditions at planting. In recently cultivated fields, winter cover crops such as wheat, annual ryegrass, or improved perennial turfgrasses can be planted by mid-September to reduce soil erosion and improve planting conditions in spring.

Managing weedy vegetation in new plantings requires careful planning with nearly complete weed control around each tree, to ensure survival and vigorous tree growth while providing a protective soil cover between rows that will minimize soil erosion.

Design your initial weed control program to:

1. eliminate weed competition during spring and early summer, yet allow for either planting or annual reestablishment of a protective ground cover to reduce erosion;
2. minimize soil compaction and development of the hardpans caused by repeated tillage;
3. reduce chances of mechanical, chemical, or wildlife injury to newly planted trees; and
4. avoid stimulation of resistant weed species or establishment of preferred food sources and cover for wildlife.

Know your weeds. When you're ready to design a year-round weed management program, consult the appendix and the latest edition of the *Pacific Northwest Weed Control Handbook* ("For further reading," page 8).

Normally, a soil-applied herbicide such as atrazine or simazine is applied soon after planting, to reduce the chance of weed competition and injury from wildlife until the trees are established. Adjust the rates, depending on soil type and organic matter content.

On sites prone to soil erosion, an increasing number of growers are considering new dwarf or improved turfgrass or ground cover species that require minimal management (figure 3). Examples include "living mulches" that respond to drought, low fertility, or sublethal rates of new postemergence herbicides. These technologies and cultural practices offer additional management options that save resources, minimize production costs, and improve long-term productivity while maintaining tree vigor and quality.

Current research and Extension efforts are causing frequent changes and revision of these management options.

Soil-applied herbicides should be applied after planting new trees, either broadcast or within the row, to control all competing vegetation. Often, a small tractor is equipped with a spray tank and boom, with nozzles spaced over the row or directed toward the tree base, to form an 18- to 24-inch band along the tree row.

Established plantings

After trees are established, shift your weed management practices away from cultivation, to avoid root pruning and to increase soil stabilization—resulting in less erosion, soil compaction, and mud at harvest. Persistent soil-applied herbicides can either be broadcast or applied in bands within the tree row. Normally, late fall or early spring applications are most effective because

Figure 3.—Where sites are prone to soil erosion, some growers have adapted technologies from orchardists. They are managing sod cover crops between tree rows. They use herbicides to control vegetation within tree rows. The new dwarf or intermediate sods require less maintenance if drought or low fertility occurs, or if growers apply sublethal rates of postemergence herbicides.

the herbicide is incorporated and activated in the soil with rainfall.

Certain foliar-active herbicides may be applied to actively growing weeds before budbreak of the trees in the spring or after terminal buds mature in summer. Directed sprays or hand-held wipers can be used throughout the year.

Herbicide combinations, applied either separately or as tank-mixes, are most effective when you identify each weed species and select appropriate combinations and application dates.

Managed soil covers such as grass sods, annual species, or small, noncompetitive weeds, can be mowed or flailed between tree rows. Mowing will often favor the growth of turfgrasses over that of weeds. A narrow strip representing ⅓ to ½ the area must be maintained weed-free to minimize competition and reduced crop growth.

Certain weeds resist repeated use of the same weed control practice. Many perennial weeds, for example, tolerate cultivation, but low-growing prostrate weeds resist mowing. Some weed species resist a specific herbicide, either naturally or through survival of resistant types. Rotating weed control practices, including individual herbicides and spot treating with a hoe or herbicide, will eliminate resistant survivors and reduce severe infestations of tolerant weeds that require additional control.

Restoration of abandoned plantations

Severe weed competition in abandoned plantations often causes extremely slow tree growth with short, yellow needles. True firs normally suffer most from severe competition, Douglas-fir less, and pines least. With restoration and elimination of weed competition, tree color will improve dramatically, and substantially larger buds and longer terminals will develop after release.

To release tree growth in abandoned plantings, broadcast a maximum selective rate of one or a combination of herbicides. When you choose the treatment, note carefully both the weeds you'll control and the restrictions about soil type or timing of each herbicide application. After eliminating weed growth, reduce your rates and rotate the herbicides. You can mow again to supplement and maintain a year-round weed management program.

Year-round vegetation management

Production of quality Christmas trees requires design and maintenance of year-round vegetation management, before planting and throughout the life of the plantation. Year-round management involves integrating a variety of control practices. Consider the following points as you develop a year-round strategy:

Prevention involves avoiding weed problems by planting clean stock and cleaning field equipment when you move to sites that lack specific weeds. Eradicate new weed infestations before they become established throughout the plantation. Avoid weed shifts by rotating weed control practices that have the same (or similar) action on the weed.

Identify and map all weed infestations throughout the plantation. Consult various weed identification sources, including books and local consultants. You can make a map by noting the weeds present in a single 2 × 3 foot frame that you randomly place throughout the plantation. Repeat according to the number of acres in the field. Keep records for comparison several years later, when weeds may have shifted.

List controls based on your experience, herbicide labels, local experts, and published information. Learn the strengths and weaknesses, proper timing, and unique properties of each control method before integrating it into a year-round strategy.

Prioritize your weeds. One priority would include highly competitive or troublesome weeds (such as perennials), poisonous plants, and weeds that attract vertebrate pests. Another would

Appendix

Weed susceptibility chart for Christmas trees[a]

Weeds	Management method													
	Cultivation	Mowing	Atrazine	Simazine	Hexazinone (Velpar L)	Pronamide (Kerb)	Oryzalin (Surflan)	Dalapon (Dowpon)	2,4-D (Esteron)	Glyphosate (Roundup)	Paraquat	Asulam (Asulox)	Fluazifop (Fusilade)	Sethoxydim (Poast)
Broadleaf weeds														
Ann. sowthistle	S*	S	S	S	S	R	R	R	S	S	S+		R	R
Prickly lettuce	S*	S	S	S	S	R	R	R	M		S+		R	R
Hawksbeard	S*	M+				R		R					R	R
Pigweed	S*	S	S	S	S	R	S*	R	M	S	S		R	R
Lambsquarter	S*	S	S	S	S	M	S*	R	S	S	M		R	R
Mustards	S*	S	S	S	S	S	R	R	S	S	S		R	R
Knotweed	M*	R	S	M*	S	M	M*	R	R	R	R		R	R
Filaree	M*	R			S	R		R	S				R	R
Clovers	M*	R	R	R	S	R	R	R	M	R	R	R	R	R
Vetch	M*	M+	M*	M*		R	R	R	M	M	M+		R	R
Curly dock	M*	R	R	R	M	R	R	R	M		M+	M	R	R
Plantain	S*	R	S*	S*		R	R	R	S		M+	R	R	R
Queen Ann's lace	S*	M+				R	R	R	M		S+		R	R
Tansy ragwort	M*	R				R	R	R	S	R	S+	M	R	R
Bull thistle	M*	M	S*	S*		R	M*	R	S	S	S+	R	R	R
Per. sowthistle	R	R+				R	R	R	M		S+	R	R	R
Canada thistle	R	R+	M*	R		R	R	R	M	S	S+	R	R	R
Dandelion	R	R+	R	R	S	R	R	R	S	S	S+	R	R	R
False dandelion	R	R	R	R	S	R	R	R	M	S	S+	M	R	R
Field bindweed	R	R	R	R		R	R	R	M	M	S+		R	R
Grass weeds														
Ann. bluegrass	S*	R	S	S	S	S	S*	S	R	S	S	S	R	R
Ann. ryegrass	S*	M	S*	S*	S	S	S*	S	R	S	S+	R	M	S
Barnyardgrass	S*	M	S*	S*	S	S	S*	S	R	S	S+		S	M
Bromegrasses	S*	M	S	S	S	S	S*	S	R	S	S+		S	S
Tall fescues	S*	M	R	R	S	S	M*	M	R	S	M+	R	M	M-S
Bentgrass	R	R+	S			S	R	M	R	S	M+		S	S
Orchardgrass	R	R+	R	R	M	S	R	M	R		S+	M	S	S
Quackgrass	R	R+	M	R	S	M	R	M	R	M	S+	R	M	R
Per. ryegrass	R	R+	R	R	M	S	R	M	R	S	S+	R	M-R	S
Velvetgrass	R	R+	R	R	S	S	R	R	R		R		M-R	M
Woody species														
Blackberries,														
trailing	R	R+	R	R	M	R	R	R	R	R	R	R	R	R
evergreen	R	R+	R	R	R	R	R	R	R	M	R	R	R	R
Himalaya	R	R+	R	R	R	R	R	R	R	S	R	R	R	R
Alder	R	R+	R	R	R	R	R	R	S	M	R	R	R	R
Cherry	R	R+	R	R	R	R	R	R	M	S	R	R	R	R
Cottonwood	R	R+	R	R		R	R	R	M-R		R	R	R	R
Maple	R	R+	R	R	R	R	R	R	R	M	R	R	R	R
Vine maple	R	R+	R	R	R	R	R	R	R	M	R	R	R	R
Oak	R	R+	R	R	R	R	R	R	S	S	R	R	R	R
Willow	R	R+	R	R	R	R	R	R	M		R	R	R	R
Salal	R	R+	R	R	R	R	R	R	R	R	R	R	R	R
Poison oak	R	R+	R	R	R	R	R	R	R	M	R	R	R	R
Other weeds														
Bracken fern	R+	R+	R	R	M	R	R	R	R	S	R	S	R	R
Horsetail rush	R+	R+	R	R		R	R	R	M+	R	R	M	R	R

[a]Key to symbols:

S Susceptible to herbicide or easily controlled with cultivation and mowing.

M Moderate control or suppression of weed competition can be expected under normal conditions.

R Weeds resist treatments or competition is not significantly reduced.

* Seedlings controlled only (biennial stages resistant).

\+ Vegetative control only.

include moderately competitive weeds or ground covers—these may require suppression during active growth stages. Again, you might choose low-growing or winter annuals to provide protection from soil erosion. Your priorities should change as the trees mature or as you begin a new planting cycle.

Design and implement a year-round weed management strategy that not only employs a wide array of weed suppression or control practices but also provides long-term stability and resource conservation. Rotate and combine weed management practices that have different actions on the weed. Include the hoe or spot spray, if need be, to avoid or delay weed shifts and spread of infestations.

Evaluate the results of your weed management program by periodically mapping weed infestations, preferably once each year (midsummer to late summer). Based on your yearly evaluation, modify your weed management practices before weed populations shift and become established throughout the plantation.

For further reading

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Newton, M., and F. B. Knight, *Handbook of Weed and Insect Control Chemicals for Forest Resource Managers,* 1981. Order from Timber Press, P.O. Box 92, Forest Grove, OR 97116. Single copy $16.95 paper or $24.95 cloth.

Pacific Northwest Weed Control Handbook, a Pacific Northwest Extension publication (latest edition; published annually). Single copy $15.00 plus $2.25 postage and handling. Order from Agricultural Communications, Publications Orders, Oregon State University, Corvallis, OR 97331-2119 *or* Bulletin Department, Cooperative Extension Service, Cooper Publication Bldg., Washington State University, Pullman, WA 99164-5912.

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Published and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914, by the Oregon State University Extension Service, O.E. Smith, director; Washington State University Cooperative Extension, J.C. Engibous, interim director; the University of Idaho Cooperative Extension Service, H.R. Guenthner, director; and the U.S. Department of Agriculture cooperating.