

## Invasive Species Control Plan

Bob Howard



**Location:** 000 Reed Mountain Rd Garberville, CA 95542

**County:** Humboldt

**APN:** 223044010

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The applicant employs following methods to help prevent the introduction and spread of invasive species;

- Cleans outdoor recreation gear
- Not releasing an unwanted pets or fish into the wild
- Identifying the most troublesome invasive species, avoid spreading them, and trying to control them..
- Using only native plants that are appropriate for the region.
- Cleaning all machines before and after use.
- Not disturbing natural areas whenever possible

The sixteen most harmful weeds in Humboldt County include: Scotch broom (*Cytisus scoparius*), Pampas grass (*Cortaderia jubata*), gorse (*Ulex Europaeus*), Himalaya berry (*Rubus discolor*), English ivy (*Hedera helix*), Cape ivy (*Delairea odorata*), European beachgrass (*Ammophila arenaria*), Ice plant (*Carpobrotus edulis*), yellow bush lupine (*Lupinus arboreus*), yellow starthistle (*Centaurea solstitialis*), spotted & diffuse knapweed (*Centaurea maculosa* & *Centaurea diffusa*), bull & Canada thistle (*Cirsium Vulgare* & *Cirsium arvense*), common reed (*Phragmites australis*), Spanish heath (*Erica lusitanica*), and Chilean cordgrass (*Spartina densiflora*).

Please see attached pages for descriptions of species as well as methods of control

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This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center ([wric.ucdavis.edu](http://wric.ucdavis.edu)) or retail through the Western Society of Weed Science ([wsweedsociety.org](http://wsweedsociety.org)) or the California Invasive Species Council ([cal-ipc.org](http://cal-ipc.org)).

*Centaurea diffusa* Lam.

## Diffuse knapweed

**Family:** Asteraceae

**Range:** All western states.

**Habitat:** Plains, rangelands, and forested benchlands, particularly on rugged terrain not well suited for cultivation; often on well drained soils. Needs less moisture than spotted knapweed; can thrive in semi-arid and arid conditions. Seldom persists in shaded places. Not common on cultivated lands or irrigated pasture because it cannot tolerate cultivation or excessive moisture.

**Origin:** Native to southeastern Eurasia.

**Western states listed as Noxious Weed:** Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming

**California Invasive Plant Council (Cal-IPC) Inventory:** Moderate Invasiveness



Diffuse knapweed is a bushy herbaceous taprooted biennial or short-lived perennial that grows to about 3 ft tall. The leaves are alternate and variously covered with short to medium interwoven grayish hairs. The upper leaves are entire and linear; the lower stem leaves are 4 to 8 inches long and deeply pinnate-lobed one to two times. Plants are basal rosettes in fall and winter and bolt to produce erect, highly branched flowering stems in late spring and summer.

The flowerheads consist of spiny or comb-like phyllaries and white or pink to pale purple disk flowers. Unlike squarrose knapweed, the spiny phyllaries (3 mm long) do not reflex downward. The achenes either lack a pappus or have a very short bristly pappus (< 1 mm long). Plants reproduce only by seed. Diffuse knapweed inflorescences detach from the parent plant when stems break off near the ground and tumble along the ground in the wind, dispersing seed to a greater distance than most *Centaurea* species. Data shows that about 20 to 50% of plant inflorescences tumble off site. Diffuse knapweed has been shown to occasionally hybridize with spotted knapweed. It is not known how long seeds remain viable in the soil, but it is assumed that survival would be similar to other *Centaurea* species, 2 to 5 years, with a few seeds surviving longer.

### NON-CHEMICAL CONTROL

**Mechanical**  
(pulling, cutting,  
disking)

Physical and mechanical approaches to diffuse knapweed control include hand pulling, digging, tilling, disking, and cutting or mowing. Physical removal or damage can provide some control depending on the timing and frequency of treatment, the presence of competitive, desirable vegetation, and the level of soil disturbance caused by the treatment.

Hand pulling is practical for scattered diffuse knapweed plants, or for areas where other control methods are not feasible and sufficient labor is available. Repeated hand pulling is necessary during the season and over many years. Successful control has been reported when plants were hand removed 3 times a year (spring, summer, and late summer) over a period of 5 years. Every effort should be made to remove the entire taproot with little soil disturbance. If not possible, then cut the root 2 to 4 inches below the soil surface to remove much of the reproductive crown. Gloves should be worn when hand pulling. The best timing for hand removal is before plants produce viable seed. Hand pulling has not been effective in all areas. On dry soils, it may be difficult to remove the root crown and this can lead to rapid reestablishment.

Mowing typically doesn't kill knapweeds; cut plants generally survive and recover to set seed. Plants mowed at the rosette stage will quickly recover, and mowing too late (after seed set) can disperse seed. However, mowing at the late bud to early bloom stage will reduce seed production. Mowing can also remove dead growth to improve herbicide coverage. A program of cutting only bolted plants, particularly at

the early bloom stage, for several consecutive years can greatly suppress diffuse knapweed.

Cultivation is effective when repeated, but diffuse knapweed typically grows in areas not conducive to tillage.

#### Cultural

Grazing is not an effective eradication method. Diffuse knapweed is not typically considered palatable to livestock. Furthermore, intensive grazing can create ideal seedbeds for further invasion. However, researchers have shown that cattle, sheep and goats will readily graze diffuse knapweed in early spring. Cattle grazing twice in spring decreased seed production by 50%. Sheep typically graze diffuse knapweed from the rosette through bud stage or when it is the only plant available. The timing of grazing may be critical to its success. Although there is no direct evidence, it is likely that the optimal timing would be similar to that of spotted knapweed. For spotted knapweed, early and late-season grazing appear to be the most effective timing with sheep: early season (spring) to reduce flower production, and late season (fall) to reduce density of young plants. In one study, two consecutive years of early and late sheep grazing reduced spotted knapweed but had little effect on the native grass community.

Burning has been shown to give effective control of diffuse knapweed while stimulating grass regrowth. Within 2 years of burning, most diffuse knapweed rosettes were eliminated. A low-severity fire will not kill the below-ground reproductive structures of diffuse knapweed, but a severe fire can kill some of the plant crowns. Burning removes current growth but may enhance seed germination. Dry soil conditions at the time of burning can reduce germination. Burning also can remove dead growth to improve the effect of herbicide applications.

#### Biological

Currently, there is no single biological control agent that effectively controls diffuse knapweed populations. However, numerous biocontrol insects from diffuse knapweed's native range are established in the United States, including flies and weevils which attack seedheads. These include the banded gall fly (*Urophora affinis*), knapweed seedhead fly (*U. quadrifasciata*), knapweed peacock fly (*Chaetorellia acrolophi*), lesser knapweed flower weevil (*Larinus minutus*), and broad-nosed seedhead weevil (*Bangasternus fausti*). *Larinus minutus* in particular is an aggressive and effective biocontrol insect for diffuse and spotted knapweed.

Root-feeding insects may have a more detrimental effect on knapweed populations than seed-feeding ones. Larvae of the diffuse knapweed root beetle (*Sphenoptera jugoslavica*) feed in the roots of diffuse knapweed. Larvae of the moths *Agapeta zoegana* and *Pterolonche inspersa* and the weevil *Cyphocleonus achates* feed in the roots of both diffuse knapweed and spotted knapweed.

The collective stress on the plant caused by these insects sharply reduces seed production and may lead to reduced competitiveness. However, they have not been shown to significantly reduce diffuse knapweed plant densities.

#### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### GROWTH REGULATORS

2,4-D	Rate: 1 to 2 qt product/acre (0.95 to 1.9 lb a.e./acre)
Several names	Timing: Postemergence from rosette to beginning of bolting, or fall rosette. Optimal at early flowering stage.
	Remarks: Control with 2,4-D is only temporary and does not prevent seedling establishment the following year. Generally requires repeat applications. It is not considered as effective as other growth regulator herbicides for season-long control. 2,4-D is broadleaf-selective and has no soil activity. Do not apply ester formulation when outside temperatures exceed 80°F. Amine forms are as effective as ester forms for small rosettes, and amine forms reduce the chance of off-target movement.
Aminocyclopyrachlor + chlorsulfuron	Rate: 4.75 to 8 oz product ( <i>Perspective</i> )/acre
<i>Perspective</i>	Timing: Postemergence and preemergence. Postemergence applications are most effective for plants from the seedling to the mid-rosette stage.
	Remarks: <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do

	<p>not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).</p>
<p>Aminopyralid Milestone</p>	<p><b>Rate:</b> 5 to 7 oz product/acre (1.25 to 1.75 oz a.e./acre)</p> <p><b>Timing:</b> Postemergence and preemergence. Postemergence applications are most effective for plants from the rosette to the bolting stage. Effective control can also be obtained with a fall application to new regrowth.</p> <p><b>Remarks:</b> Aminopyralid is one of the most effective herbicides for the control of diffuse knapweed. It is safe on grasses, although preemergence application at high rates can greatly suppress invasive annual grasses, such as medusahead. Aminopyralid has a longer residual and higher activity than clopyralid. Other members of the Asteraceae and Fabaceae are very sensitive to aminopyralid. For postemergence applications, adding a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary. Other premix formulations of aminopyralid can also be used for diffuse knapweed control. These include <i>Opensight</i> (aminopyralid + metsulfuron; 1.5 to 3.3 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 1.2 to 2.1 pt product/acre), both applied at the rosette to bolting stages.</p>
<p>Clopyralid Transline</p>	<p><b>Rate:</b> 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre). Use higher rate for older plants or dense stands.</p> <p><b>Timing:</b> Preemergence (for seedling control) or postemergence (for seedlings and perennial plant control). Generally optimal to apply in spring, at beginning of bolting up to the bud stage. Can also apply to fall regrowth. Results are best if applied to rapidly growing weeds.</p> <p><b>Remarks:</b> While clopyralid is very safe on grasses, it will injure many members of the Asteraceae, particularly thistles, and can also injure legumes, including clovers. Most other broadleaf species and all grasses are not injured.</p>
<p>Clopyralid + 2,4-D Curtail</p>	<p><b>Rate:</b> 2 to 4 qt Curtail/acre</p> <p><b>Timing:</b> Same as for clopyralid.</p> <p><b>Remarks:</b> Add a non-ionic surfactant.</p>
<p>Dicamba Banvel, Clarity</p>	<p><b>Rate:</b> 1 to 2 pt product/acre (0.5 to 1 lb a.e./acre). Use higher rate for older plants or dense stands.</p> <p><b>Timing:</b> Postemergence from rosette to beginning of bolting, or fall rosette. Optimal at early flowering stage.</p> <p><b>Remarks:</b> Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is not typically used alone to control diffuse knapweed. Dicamba can also be mixed with 2,4-D (1 pt dicamba + 2 pt 2,4-D/acre) or picloram (1 to 2 pt dicamba + 0.5 to 1 pt picloram/acre) for spot treatments.</p> <p>Dicamba is available mixed with diflufenzopyr in a formulation called <i>Overdrive</i>. This has been reported to be effective on diffuse knapweed. Diflufenzopyr is an auxin transport inhibitor which causes dicamba to accumulate in shoot and root meristems, increasing its activity. <i>Overdrive</i> is applied postemergence to rapidly growing plants at 4 to 8 oz product/acre. Higher rates should be used on large annuals and biennials or when treating perennial weeds. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.</p>
<p>Picloram Tordon 22K</p>	<p><b>Rate:</b> 1 to 2 pt product/acre (4 to 8 oz a.e./acre). Use higher rates for older plants or dense stands.</p> <p><b>Timing:</b> Preemergence and postemergence. Postemergence applications are best at rosette to mid-bolting stage (before flowering to prevent current year seed production), or fall rosette stage. Apply when plants are growing rapidly. Under favorable growing conditions, summer application can be effective if higher rates are used.</p> <p><b>Remarks:</b> Picloram is a broadleaf herbicide. It gives a broader spectrum of control than aminopyralid, aminocyclopyrachlor, and clopyralid, and has much longer soil residual activity. Lower rates may require annual spot treatments. Treatment made in bud stage may not prevent seed production in the year of application. Picloram has been shown to provide selective control of diffuse knapweed for 3 to 4 years. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees. Picloram is a restricted use herbicide. It is not</p>

registered for use in California.

Control with lower rates may be improved by tank mixing with dicamba or 2,4-D; picloram and dicamba (0.25 to 0.5 pt/acre + 0.125 to 0.25 pt/acre) and picloram plus 2,4-D (0.5 to 1 pt picloram + 1 to 2 pt 2,4-D/acre). A backpack sprayer or a wiper is highly recommended in small areas to minimize damage to non-target plants.

#### **AROMATIC AMINO ACID INHIBITORS**

Glyphosate

*Roundup, Accord XRT II,*  
and others

**Rate:** Broadcast foliar treatment: 3 qt product (*Roundup ProMax*)/acre (3.375 lb a.e./acre). Spot treatment: 1.5% v/v solution

**Timing:** Postemergence to rapidly growing knapweed when most plants are at bud stage.

**Remarks:** Glyphosate will only provide control during the year of application; it has no soil activity and will not kill seeds or inhibit germination the following season. Glyphosate is nonselective. To achieve selectivity, it can be applied using a wiper or spot treatment to control current year's plants.

#### **BRANCHED-CHAIN AMINO ACID INHIBITORS**

Imazapyr

*Arsenal, Habitat, Stalker,*  
*Chopper, Polaris*

3 to 4 pt product/acre has been shown to give some level of control.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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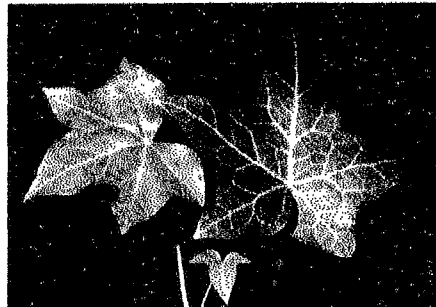
*Hedera helix* L.; English ivy

*Hedera canariensis* Willd.; Algerian ivy

(= *H. helix* L. ssp. *canariensis* (Willd.) Cout.)

*Hedera hibernica* (G. Kirchn.) Bean; Irish or Atlantic ivy

## English, Algerian and Atlantic ivy



**Family:** Araliaceae

**Range:** Many western states, including Washington, Oregon, California, Idaho, Arizona, and Utah.

**Habitat:** Riparian corridors, moist woodlands, forest margins, coastal habitats, and disturbed sites such as cleared forests, urban waste places, and old homesteads. Requires some moisture year-round. Tolerates deep shade, but thrives where plants receive some summer shade and direct winter sun.

**Origin:** Native to Europe and introduced to the United States as an ornamental. English ivy is still a common landscape ornamental of which there are numerous cultivars.

**Impacts:** Under favorable conditions, plants spread invasively and can develop a dense cover that outcompetes other vegetation in natural areas. Infestations around old homesteads have been present for many years and serve as nursery sites for further spread. It has escaped from cultivation in many places, especially near the coast and along riparian corridors. English ivy grows over the natural vegetation in an area, including trees, and eventually kills most resident plants by shading them out with its dense canopy of foliage. It thrives in deciduous trees, which allow plants to receive more light and to continue upward growth during winter months. Trees covered with ivy are more susceptible to wind damage from the extra weight. English ivy berries and leaves can be toxic to humans and cattle when ingested in quantity, and the sap can cause contact dermatitis in sensitive individuals, which includes about 10% of the population.

**Western states listed as Noxious Weed:** *H. helix*, Oregon, Washington; *H. canariensis* and *H. hibernica*, Washington

**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness

English ivy and other closely related *Hedera* species are fast growing, perennial, evergreen vines that vigorously climb other vegetation and on structures. Plants have two growth forms. The juvenile form has viny stems to about 12 inches long with leaves that are usually three-lobed. The adult reproductive form has erect shrubby stems with ovate to diamond-shaped leaves. Juvenile stems are vine-like, growing both on the ground and vertically into canopies. Juvenile stems develop adventitious roots along the ground and aerial root-like structures that enable stems to cling to objects such as trees and buildings. Juvenile leaves are palmately three to five lobed and vary in size, up to 12 inches long. Adult reproductive stems are erect, shrubby, lack aerial roots, and are non-climbing. Adult leaves are ovate to diamond-shaped and up to 6 inches long. Leaves of both forms have smooth upper surfaces, often slightly glossy, and usually dark green. Leaf stalks and lower leaf surfaces are sometimes glabrous but usually covered with grayish star-shaped hairs.

Unlike most plants in the region that flower in spring or summer, ivy flowers in fall. The shrubby adult form develops flowers in racemes or panicles of simple umbels. The juvenile stage may last for 10 years or more before reproducing by seed. Fruits are berrylike, dark blue to black, about 4 to 8 mm wide. Fruits mature in spring with an individual plant producing tens of thousands of fruit each year. Fruits are consumed and dispersed primarily by birds. English ivy also reproduces vegetatively from juvenile stems. Stem fragments of juvenile and adult plants left in contact with moist soil can regenerate into a new plant. Plants can live 100 years or more.

**NON-CHEMICAL CONTROL****Mechanical**  
(pulling, cutting,  
disking)

When the plant carpets the forest floor, individual stems can be readily pulled off the ground; however, it is essential to remove all runners. If off-site removal is not possible, all plant parts must be placed off the ground in such a way that they can dry out. Repeated removal efforts over multiple years may allow desirable vegetation to colonize the area. Because ivy can resprout and establish from stem fragments, mowing or cutting is not recommended. Small or young ivy plants can be pulled off supporting structures or trees, and roots dug out. The roots of young plants can be easily dug out, particularly when the soil is moist, from the ground around the base of infested trees. Older individuals generally do not resprout. Gloves should be worn as many people are sensitive to the dermatitis-causing agents in the plant.

Cutting ivy off before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. Cut ivy at ground level with power or manual saws, and then pry the vines from the tree or structure. Once the vines are cut they will eventually die and fall from the tree, usually after the first extended hot and dry period. Occasionally vines will be embedded in the trunk of the tree, which makes control by both hand and chemicals very difficult.

**Cultural**

Grazing and burning are not considered effective control options. The leaves and fruit can be toxic to livestock. Deer have been shown to feed on ivy in its native range.

Although prescribed burning is not an effective control option, the use of a blowtorch can be successful. To be successful, plants and resprouts must be repeatedly burned until the plant's resources are exhausted.

**Biological**

Because *Hedera* species are still widely used as ground covers and ornamentals, there is no biological control program established for their management.

**CHEMICAL CONTROL**

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

**GROWTH REGULATORS****Picloram****Tordon 22K**

**Rate:** Broadcast foliar treatment: 3 to 4 pt product/acre (0.75 to 1 lb a.e./acre) plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves

**Timing:** Postemergence foliar treatments are best when plants are growing rapidly at or beyond early to full bloom stage.

**Remarks:** High levels of picloram can give long-term soil activity for broadleaves. Picloram has proved successful in Australia. Picloram is a restricted use herbicide. It is not registered for use in California. Do not apply near trees, or damage may occur through root uptake.

**Triclopyr****Garlon 3A, Garlon 4  
Ultra, Pathfinder II**

**Rate:** Spot treatment: 2 to 5% v/v solution of *Garlon 4 Ultra* and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of *Garlon 4 Ultra* plus a 20% v/v basal oil concentrate in water. Basal cut stump treatment: 20% v/v *Garlon 4 Ultra* in water. Cut stump treatment: undiluted *Garlon 3A* or 33% *Garlon 3A* in water. Stem injection treatment: drill and fill the stem of large mature plants that are climbing up other trees with 100% *Garlon 3A* or 4 *Ultra*. Basal bark treatment: 20% v/v *Garlon 4 Ultra* in 20% v/v basal oil and water, or *Pathfinder II* as a ready-to-use formulation.

**Timing:** Postemergence when plants are growing rapidly. Cut stump and basal bark treatments can be applied anytime as long as the ground is not frozen.

**Remarks:** Triclopyr is a selective herbicide for broadleaf species. In areas where desirable grasses are growing under or around ivy, triclopyr can be used without non-target damage. For cut stump treatments, cut stems horizontally at or near ground level. Apply herbicide solution immediately after the stump is cut. Suckering from the roots typically occurs after cutting, but the treatment should control most resprouts. Basal bark treatment: spray the lower trunk, including the root collar, to a height of 12 to 15 inches from the ground; the spray should thoroughly wet the lower stem but not to the point of runoff. When making bark treatments, be careful not to get the spray solution on the bark of desirable trees. Plants should not be cut for at least one month after basal bark treatments. Spraying triclopyr immediately after the removal of most leaves and young shoots with a string trimmer has also proved successful.

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate

*Roundup, Accord XRT II,*  
and others

**Rate:** Spot treatment: 2 to 4% v/v solution of *Roundup ProMax* (or other trade name with similar concentration of glyphosate) in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of *Roundup* (or other trade name) in water. Cut stump treatment: 25% v/v *Roundup* (or other trade name) in water.

**Timing:** Postemergence when plants are growing rapidly. Foliar treatments should be made in late summer or early fall. For cut stump treatment, application in late summer, early fall or dormant season provides best control. Treatment should occur immediately after cutting.

**Remarks:** Glyphosate is a nonselective systemic herbicide with no soil activity. It gives good control with some resprouts. Plants should not be cut for at least 4 months after foliar treatments. Cut stump applications are made as described for triclopyr. Glyphosate has also proved successful in Australia.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

Imazapyr

*Arsenal, Habitat, Stalker,*  
*Chopper, Polaris*

**Rate:** Spot treatment: 1 to 2% v/v solution of *Stalker* plus 0.25 to 0.5% surfactant v/v in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water. Cut stump treatment: 20% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water or 20% *Habitat* v/v in 80% water carrier. Basal bark treatment: 20% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water.

**Timing:** Postemergence when plants are growing rapidly. Best when used in late summer to early fall.

**Remarks:** Imazapyr is a soil residual herbicide and may result in bare ground around plants for some time after treatment. Cut stump and basal bark applications are made as described for triclopyr. Plants should not be cut for at least 4 months after basal bark treatment. Another ALS inhibitor, metsulfuron, has proved successful in Australia.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.



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*Phragmites australis* (Cav.) Trin. ex Steud.

## Common reed

**Family:** Poaceae

**Range:** A western biotype is native throughout the western United States and adjacent Canada. A Gulf Coast biotype is found from Florida across to southern California, although it is not known if this biotype is native or introduced from Mexico and Central America. A non-native biotype has been found throughout the contiguous U.S. and adjacent Canada.

**Habitat:** Wetlands, riparian areas, shores of lakes and ponds.

**Origin:** The non-native biotype was introduced from Europe, apparently via ships' ballast. There are also native biotypes of *Phragmites australis*.

**Impacts:** Forms dense stands in wetlands and reduces native plant biodiversity.

**Western states listed as Noxious Weed:** Oregon, Washington



Common reed is a rhizomatous perennial grass to 15 ft tall, usually found growing in water or along the shores of streams, ponds, and lakes. The leaves are typical for a grass, but large: up to 1.5 inches wide and 8 to 16 inches long. The ligule (at the junction of the leaf blade and the stem) is tipped by a fringe of hairs, while the blades and sheaths are smooth. Leaf sheaths of the introduced biotype adhere tightly to the stem into winter, while in the native biotype the sheaths fall away as the leaves die in the autumn. Stems ("culms") are sturdy, up to 0.5 inch thick at the base, and slightly ridged or rough to the touch under the leaf sheath.

The inflorescence is 6 to 16 inches long, tawny brown or purplish, and feathery in appearance. The glumes (bracts below the flowering spikelet) are shorter than the lemmas (bracts at the base of individual florets) and are hairless. Plants reproduce by seeds, rhizomes, and stem fragments. The florets often have many hairs, allowing seed to blow with the wind or in the airstreams of vehicles, or to float in the water. The seeds are short-lived (likely < 2 years) under field conditions, and a persistent seedbank does not accumulate. Common reed rhizomes form a dense network under the colony; each rhizome can grow 10 ft or more in a single growing season.

There are several biotypes of common reed, some native and some introduced. The following table offers a good comparison between the native biotype and the major European biotype. The authors of the table caution that these characters may not distinguish the Gulf Coast type of common reed, which has been introduced into portions of southern California and Arizona in the west.

### SUMMARY OF MORPHOLOGICAL CHARACTERS THAT DISTINGUISH NATIVE AND INTRODUCED PHRAGMITES AUSTRALIS IN THE UNITED STATES.

Character	Native	Introduced
Ligule length	> 1.0 mm	< 1.0 mm
Lower glume length	3.0 to 6.5 mm Most > 4.0 mm	2.5 to 5.0 mm Most < 4.0 mm
Upper glume length	5.5 to 11.0 mm Most > 6.0 mm	4.5 to 7.5 mm Most < 6.0 mm
Adherence of dead leaf sheaths	Loose, drop off easily	Tight, remain on dead stems
Growth form (stem density)	Typically in mixed communities. Stem density may be low to high, dead stems less	Often grows as a monoculture. Stem density is high, dead stems often persist to

	likely to persist to the next growing season.	the next growing season.
Culm texture	Smooth, shiny	Dull or flat color, slightly ridged
Culm color	May be dark red at nodes and internodes, where exposed to UV. May be green as well.	Typically green, occasionally with some red color at the lower nodes
Spots on culms	May be present	Not present; mildew may be present
Leaf color	Lighter, yellow green to dark green	Typically darker green, but may be lighter in saline areas

From: *Phragmites Field Guide: Distinguishing Native and Exotic Forms of Common Reed (Phragmites australis) in the United States*, by Jill Swearingen and Kristin Saltonstall (2010). (<http://www.nps.gov/plants/allen/fact/pdf/phau1-powerpoint.pdf>)

#### NON-CHEMICAL CONTROL

<b>Mechanical</b> (pulling, cutting, disking)	<p>Digging and removal of common reed is usually not feasible, given its dense root and rhizome system and its tendency to grow on rocky or rough ground or in standing water. If attempted, remove as much root and rhizome as possible, as broken root and rhizome sections will resprout from fragments. Hand pulling is not an effective strategy, as it rarely is possible to remove roots and rhizomes without breaking and fragmenting these tissues.</p> <p>Mowing is difficult in wetland sites, and unless applied repeatedly, mowing will not generally control this perennial species. Timely mowing can prevent seed production, however.</p> <p>Mulching with plastic or fabric sheets has not been shown to be effective, given that shoots from rhizomes are sharp-tipped as they emerge from the soil.</p>
<b>Cultural</b>	<p>Dredging and draining of water where common reed is found may reduce the vigor of common reed colonies. However, draining and dredging are not appropriate for use on most wetland preserves where the weed is often found in abundance.</p> <p>Prescribed burning is sometimes used for controlling this species, primarily by removing old growth of common reed and allowing seeds of other species to germinate and perhaps establish. Burning is sometimes used to remove old growth in preparation for herbicide application.</p>
<b>Biological</b>	<p>There are currently no biological control agents to aid in the control of common reed. Literature and field surveys in the northeastern United States and eastern Canada indicate that at least 26 native herbivores attack common reed in North America. There have been no deliberate releases made of European insects known to feed on the introduced biotype, but at least 21 species have been accidentally introduced to North America.</p>

#### CHEMICAL CONTROL

The following specific use information is based on published papers or reports by researchers and land managers. Other trade names may be available, and other compounds may also be labeled for this weed. Directions for use may vary between brands; see label before use. Most herbicide applications will require multiple applications to fully control common reed. Because it usually is found growing in or near standing water, only aquatic herbicide formulations are recommended for use. Additionally, most states require specific aquatic endorsements for applicators of aquatic herbicides. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate	<b>Rate:</b> Broadcast treatment: 4 to 6 pt product ( <i>Rodeo</i> or <i>Aquamaster</i> )/acre (2 to 3 lb a.e./acre). Spot treatment: 0.75% v/v solution. Wiper treatment: 33 to 50% of concentrated product.
<i>Rodeo</i> , <i>Aquamaster</i>	<b>Timing:</b> Postemergence to plants in full bloom in late summer or autumn.
	<b>Remarks:</b> Use up to 1% non-ionic surfactant approved for aquatic use to improve herbicide uptake. Removal of old stalks and foliage by mowing or burning in spring may be necessary for the herbicide application to adequately cover the foliage and for the treatment to be effective. Glyphosate overspray will injure or kill other plants that it contacts. Wiper application can also be used to apply glyphosate to common reed. Glyphosate can be combined with imazapyr for more effective control under some circumstances.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

Imazapyr	<b>Rate:</b> 4 to 6 pt product/acre (1 to 1.5 lb a.e./acre)
Habitat	<b>Timing:</b> Postemergence to plants fully leafed out in summer.

**Remarks:** Use up to 1% non-ionic surfactant approved for aquatic use to improve herbicide uptake. Removal of old stalks and foliage by mowing or burning in spring may be necessary for the herbicide application to adequately cover the foliage and for the treatment to be effective. Imazapyr overspray will injure or kill other plants that it contacts. Imazapyr can be combined with glyphosate for more effective control under some circumstances.

**ECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

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*Lupinus* spp.

## Lupines

**Family:** Fabaceae

**Range:** Several species present in all western states.

**Habitat:** Lupines are adapted to dry, relatively infertile soils. They often require ecological disturbance to persist and are common in pasture, rangeland, recent burns, sand dunes, forests, sagebrush communities, and grasslands.

**Origin:** Nearly all species are native plants in the western United States.

**Impacts:** Native lupines are a desirable component in natural communities. Lupines and their ability to fix nitrogen play an important role in colonization of sites following disturbance, and in most cases, lupine control is unnecessary. Lupine control is generally limited to small pastures or rangeland with the major goal of preventing livestock poisoning. Many lupine species contain poisonous alkaloids throughout the growing season that can potentially poison livestock and/or cause birth defects (crooked calf syndrome). Lupine control is also justified to prevent unwanted changes in native plant communities. Yellow bush lupine (*L. arboreus* Sims) has expanded its range in California and can negatively impact coastal dune communities by changing vegetation structure and soil nitrogen levels.



Lupine species are mostly herbaceous perennials, but some can be annuals. They range in size from small plants shorter than 1 ft to large shrubs taller than 8 ft. The leaves are palmate-compound with 5 to 28 leaflets. Roots typically are associated with nitrogen-fixing bacteria.

The flowers are produced in dense or open whorls, racemes or on an erect spike. Each flower is 0.5 to 1 inch long, with a typical pea-flower shape. Flowers can range in color from white to yellow to purple. Due to the flower shape, several species are known as bluebonnets or Quaker bonnets. The fruit is an exploding pod containing several seeds. Seeds are generally dispersed close to the parent plant. Viability of seeds is considered to be similar to most other legumes, i.e., seeds probably survive in the soil for several years.

### NON-CHEMICAL CONTROL

<b>Mechanical</b> (pulling, cutting, disking)	Hand pulling, tillage, and digging are effective for controlling established plants, but the disturbance from these methods can promote new recruitment. The root system should be severed below the thickened crown. Larger species can be removed with a weed wrench.
	Most lupine species will quickly regrow following mowing. Mowing is not effective unless done frequently enough to prevent seed production and reduce vigor of established plants.
<b>Cultural</b>	Grazing is not an effective control method. Some lupine species can be intermittently grazed without problems, but livestock producers should determine the toxicity of the lupine species before grazing. Avoid grazing during times of year that livestock are susceptible to poisoning or birth defects. Populations often increase in heavily grazed systems.
	Like many other legumes, lupines usually respond positively to fire. Germination of seeds and resprouting of established plants is common post-fire for many lupine species. Several species typically occur in habitats subject to fairly frequent fire.
	Promoting competitive vegetation can slow spread and help prevent establishment.
<b>Biological</b>	Several native insects such as beetles, butterflies, and moths feed on lupine species. No introduced biological controls are known or are likely to occur with this group of natives.

### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

### GROWTH REGULATORS

- 2,4-D** **Rate:** 1 to 2 qt product/acre (0.95 to 1.9 lb a.e./acre)
- Several names** **Timing:** Postemergence to rapidly growing plants before flowering. In grazed areas, allow enough time for complete burndown before grazing.
- Remarks:** 2,4-D is broadleaf-selective and safe on most grasses. 2,4-D has minimal soil activity. Often tank-mixed with chlorsulfuron or dicamba. Do not apply ester formulation when outside temperatures exceed 80°F.
- Dicamba** **Rate:** 0.5 to 2 pt product/acre (0.25 to 1 lb a.e./acre). Use higher rates for large established plants.
- Banvel, Clarity** **Timing:** Postemergence to rapidly growing plants before flowering.
- Remarks:** Dicamba is a broadleaf-selective herbicide. Dicamba is often mixed with 2,4-D (0.5 to 1 pt dicamba + 2 pt 2,4-D/acre).

### AROMATIC AMINO ACID INHIBITORS

- Glyphosate** **Rate:** 1 to 2 qt product (*Roundup ProMax*)/acre (1.1 to 2.25 lb a.e./acre). Spot treatment: 1.5% v/v solution.
- Roundup, Accord XRT II, and others** **Timing:** Postemergence to rapidly growing plants before flowering. In grazed areas, allow enough time for complete burndown before grazing.
- Remarks:** Glyphosate will not kill seeds or inhibit germination the following season. Glyphosate has no soil activity and is nonselective. It can create bare ground conditions that are susceptible to weed recruitment. In areas with desirable vegetation, use spot treatment. Glyphosate is a good control option if reseeding is planned shortly after application, as it will not injure seedlings emerging after application. Add a surfactant when using a formulation where it is not already included (e.g., *Rodeo, Aquamaster*).

### BRANCHED-CHAIN AMINO ACID INHIBITORS

- Chlorsulfuron** **Rate:** 1 to 2.6 oz product/acre (0.75 to 1.95 oz a.i./acre)
- Telar** **Timing:** Postemergence to rapidly growing plants before flowering. In grazed areas, allow enough time for complete burndown before grazing.
- Remarks:** Always use a surfactant. Chlorsulfuron can be tank-mixed with 2,4-D for quicker burndown. Included with aminocyclopyrachlor in *Perspective*.
- Metsulfuron** **Rate:** 1 to 2 oz product/acre (0.6 to 1.2 oz a.i./acre)
- Escort** **Timing:** Postemergence to rapidly growing plants before flowering. In grazed areas, allow enough time for complete burndown before grazing.
- Remarks:** Similar activity compared to chlorsulfuron. Always use a surfactant. Metsulfuron can be tank-mixed with 2,4-D for quicker burndown. Other premix formulations of metsulfuron can be used at similar application timing. These include *Cimarron Max* (metsulfuron + dicamba + 2,4-D) and *Cimarron X-tra* (metsulfuron + chlorsulfuron). Metsulfuron is not registered for use in California.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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*Delairea odorata* Lem.

## Cape-ivy

**Family:** Asteraceae

**Range:** Mainly along the coast of California and Oregon. Also invasive in Hawaii.

**Habitat:** Riparian corridors, seasonal wetlands, coastal habitats, coastal bluffs and scrub, moist canyons, coastal grassland, oak woodlands, and disturbed sites such as roadsides, urban waste places, or other areas. Requires some moisture year-round. Grows in deep shade or under cloudy conditions and does not tolerate full sunlight. Tolerates serpentine soils, and established plants can survive drought conditions.

**Origin:** Native to the moist mountain forests of South Africa and introduced to the United States in the late 1800s as a houseplant. Also considered an invasive weed problem in Australia.

**Impacts:** Under favorable conditions, plants spread invasively and can develop a dense cover that outcompetes other vegetation in natural areas. Vines grow over trees and shrubs and can form dense mats that smother underlying vegetation. Such problematic infestations also reduce native species richness and seedling recruitment in the community. Cape-ivy contains pyrrolizidine alkaloids (liver toxins) and can be toxic to animals when ingested; fish can be killed when plant materials are soaking in waterways.

**Western states listed as Noxious Weed:** California

**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



Cape-ivy is a fleshy perennial vine, with stems to about 30 ft long. The leaves are glossy green, glabrous, alternate, broadly deltate to "ivy-shaped", 1 to 4 inches long, 1.5 inches wide with 5 to 9 lobes. The foliage is evergreen in mild climates and the leaves and stems are deciduous elsewhere.

The flowers are yellow, grouped on terminal and axillary corymbs, with disk flowers approximately 5 mm long arranged in clusters. The fruits are achenes about 2 to 3 mm long, often with a pappus or a crown of hairs. Plants reproduce primarily vegetatively, from fragments of rhizomes, stolons, and stems. A stem fragment as small as one inch, if it has a node, can generate a new plant. Even small fragments of dying stems can resprout, although the regeneration rate is reduced by about one-third. While most seeds produced are not viable, some viable seeds develop in sites throughout California and Oregon. When viable seed are produced, they can disperse long distances by wind.

### NON-CHEMICAL CONTROL

#### Mechanical

(pulling, cutting, disking)

Manual removal of plants, including roots and rhizomes, before viable seed develops can help control infestations in areas where plants are accessible. Removing all plant material from the site will help prevent rerooting of rhizomes, stolons, or stem fragments. Follow-up removal of resprouts is essential. In some large patches, all stems can be cut at ground level and Cape-ivy rolled up like a rug. Although the below-ground reproductive tissues will resprout, this strategy makes it possible to detect and spot-treat new sprouts while avoiding contact with desirable vegetation.

Because Cape-ivy can resprout and establish from stem fragments, mowing is not recommended.

Cutting off Cape-ivy before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. All plant parts should be bagged and properly disposed of.

- Cultural** Grazing and burning are not considered effective control options. The leaves and stems can be toxic to livestock.
- Biological** To date, no biological control agents have been released. However, extensive research by USDA-ARS has been ongoing since 1998. Several species of insects are being examined as potential controls, including a gall-forming fly (*Parafreutreta regalis*), a leaf-mining moth (*Acropelia* spp.), a defoliating moth (*Diota rostrata*), and a stem-boring moth (*Digitivalva delaireae*). The two most promising, the stem-boring moth and the gall-forming fly, are going through the final stages of testing.

#### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### GROWTH REGULATORS

- Clopyralid** **Rate:** Spot treatment: 0.5% v/v solution plus 0.25 v/v surfactant to thoroughly wet all leaves.
- Transline** **Timing:** Postemergence when plants are growing rapidly.  
**Remarks:** Clopyralid is a selective herbicide for broadleaf species. This compound has been shown to be successful in controlling Cape-ivy in Australia.
- Triclopyr** **Rate:** Spot treatment: 0.5 to 1% v/v solution of *Garlon 4 Ultra* and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves.
- Garlon 4 Ultra,**  
**Pathfinder II** **Timing:** Postemergence when plants are growing rapidly.  
**Remarks:** Triclopyr is a selective herbicide for broadleaf species. In areas where desirable grasses are growing under or around Cape-ivy, triclopyr can be used without non-target damage.

#### AROMATIC AMINO ACID INHIBITORS

- Glyphosate** **Rate:** Spot treatment: 1 to 2% v/v solution of *Roundup ProMax* (or other trade name with similar concentration of glyphosate) in water, or 1% *Roundup* (or other trade name) plus 0.5% *Garlon 4 Ultra* v/v plus silicon surfactant in water to thoroughly wet all leaves. Wiper treatment: 33 to 50% of concentrated product.
- Roundup, Accord**  
**XRT II, and others** **Timing:** Postemergence when plants are growing rapidly. Best results when treated in late summer or early fall.  
**Remarks:** Glyphosate is a nonselective systemic herbicide. It gives good control with some resprouts. In many situations, it may be more appropriate to use a wiper application to achieve selectivity. Glyphosate can be combined with triclopyr for more effective control. Use a surfactant when applying this combination.

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*Cytisus scoparius* L.

## Scotch broom

**Family:** Fabaceae

**Range:** The entire Atlantic and Pacific coasts from Alaska to British Columbia to California, and from Nova Scotia through Georgia. Also Idaho, Montana and Utah, as well as one Hawaiian island.

**Habitat:** Grasslands, shrublands, oak woodlands, forest margins, coastal habitats, riparian corridors; disturbed sites such as roadsides, pasture, gravelly floodplains, burned areas, cleared forests. Typically in mountain regions and cool coastal areas with dry summers. Grows best on sandy, high phosphorus soils with acidic to neutral pH; can tolerate high boron concentrations. Rarely grows on limestone soils.

**Origin:** Central and southern Europe and North Africa. Introduced to the U.S. in the 1850s as an ornamental and for erosion control.

**Impacts:** Grows rapidly, forming dense stands that most wildlife find impenetrable and unpalatable. Dense stems limit regeneration of most other plant species, and the accumulation of woody biomass creates a dangerous fire hazard. Broom can fix nitrogen, which increases soil fertility and gives a competitive advantage to other non-native weeds.

**Western states listed as Noxious Weed:** California, Idaho, Montana, Oregon, Washington  
**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



Scotch broom is a fast-growing deciduous shrub, 5 to 10 ft tall, with yellow, pea-like flowers. Stems are 5-angled or ridged, often star-shaped in cross-section. New twigs are green, erect and covered with wavy hairs, becoming smooth and woody with age. The leaves at branch bases have three leaflets alternately arranged. Upper leaves are simple, without petioles. Leaflets are < 1/3 inch long, widest at the tip and often pointed.

Plants begin flowering from 18 months to 3 years of age. The bright yellow, occasionally maroon, flowers are single or in pairs in leaf axils. Reproduction is by seed. Seeds are in small, flattened pods 0.75 to 2 inches long. Pods are dark brown or black when mature; contain 5 to 9 seeds, and have hairs along the margin. When mature, pods eject the seeds several feet from the plant. Seeds can remain viable in the soil for up to 30 years. Large soil seedbanks often accumulate making long term control difficult. Shrubs may live for up to 30 years.

### NON-CHEMICAL CONTROL

#### Mechanical (pulling, cutting, disking)

Seedlings and small shrubs can be hand pulled. For larger established shrubs, a weed wrench or other woody weed extractor can be used. Extract the entire root or resprouting will occur. Best results are achieved when soil is moist. Disturbing the soil can stimulate the seedbank.

Cutting broom off before it flowers will reduce seed production and will deplete the plant's energy reserves. Resprouting is common after treatment, but can be reduced by cutting broom at the beginning of the dry season. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. Cut shrubs at ground level with power or manual saws.

Heavy equipment can be used to control broom in areas where soil disturbance and nonselective species removal are not important considerations. Stumps remaining following such treatment will require herbicide application to prevent regrowth.

#### Cultural

Grazing is not considered an effective control option. Broom flowers and seeds contain quinolizidine alkaloids and can be toxic to humans and livestock. Foliage may be mildly toxic and is unpalatable to most livestock, except goats. Goats confined to a small area can help control resprouts after a cutting or burn



treatment.

Burning alone is not effective. Although burning can remove debris, it also removes competing vegetation, releases nutrients into the soil, and stimulates germination of broom seed in the soil. It is important to employ a control strategy following a burn, otherwise the broom population may become worse. Follow-up treatments could include herbicide application, repeat burnings, and/or revegetation with desirable species.

#### Biological

Insects introduced as biological control agents include the Scotch broom seed beetle (*Bruchidius villosus*), the Scotch broom seed weevil (*Apion fuscirostre*), and the Scotch broom twig miner moth (*Leucophaea spartifoliella*). The latter two species are specific to Scotch broom, while the seed beetle also attacks Portuguese broom, Spanish broom, and French broom.

#### CHEMICAL CONTROL

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#### GROWTH REGULATORS

Picloram	<b>Rate:</b> Broadcast foliar treatment: 2 qt product/acre (non-cropland) or 1 qt product per acre (rangeland) plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves.
Tordon 22K	<b>Timing:</b> Foliar treatments are best when plants are growing rapidly at or beyond early to full bloom stage.
	<b>Remarks:</b> Picloram has long soil residual activity that will control germinating broadleaf plants. Picloram is a restricted use herbicide. It is not registered for use in California.
Triclopyr	<b>Rate:</b> Broadcast treatment: 2 to 3 qt <i>Garlon 4 Ultra</i> /acre (1 to 1.5 qt a.e./acre) or 3 to 4 qt <i>Garlon 3A</i> /acre (1.125 to 1.5 qt a.e./acre). Spot treatment: 0.75 to 1.5% v/v solution of <i>Garlon 4 Ultra</i> , or 1 to 1.5% <i>Garlon 3A</i> and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of <i>Garlon 4 Ultra</i> plus a 20% v/v ethylated crop oil in water.
<i>Garlon 3A, Garlon 4 Ultra, Pathfinder II</i>	Basal cut stump treatment: 20% v/v <i>Garlon 4 Ultra</i> in water. Cut stump: <i>Garlon 3A</i> , undiluted or 50% in water. Basal bark treatment: 20% v/v <i>Garlon 4 Ultra</i> in 20% v/v ethylated crop oil and water, or <i>Pathfinder II</i> (ready-to-use formulation).
Aminopyralid + triclopyr	<b>Timing:</b> Postemergence when plants are growing rapidly. Cut stump, basal cut stump, and basal bark treatments can be applied anytime as long as the ground is not frozen.
<i>Capstone</i>	<b>Remarks:</b> Selective herbicide for broadleaf species, will not injure grasses growing nearby. For cut stump treatment, cut stem horizontally at or near ground level and immediately apply herbicide solution. Roots may sucker after cutting, but the treatment should control most resprouts. For basal cut stump treatment, leave a higher stump and treat the cut surface and all the remaining bark. For basal bark treatment, spray the lower trunk, including the root collar, to a height of 12 to 15 inches; the spray should thoroughly wet the lower stem but not to the point of runoff. Plants should not be cut for at least one month after basal bark treatment. Triclopyr is also used in a premix with aminopyralid ( <i>Capstone</i> ) at 6 to 8 pt product/acre.
Triclopyr + 2,4-D	<b>Rate:</b> Spot treatment: 0.5 to 1.5% v/v solution of <i>Crossbow</i> and water to thoroughly wet all leaves.
<i>Crossbow</i>	<b>Timing:</b> Postemergence when plants are growing rapidly.
	<b>Remarks:</b> <i>Crossbow</i> in water forms an emulsion (not a solution).

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate	<b>Rate:</b> Spot treatment: 1.5 to 2% v/v solution of <i>Roundup ProMax</i> (or other trade name with similar concentration of glyphosate) in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of <i>Roundup</i> (or other trade name) in water. Cut stump treatment: 25% v/v <i>Roundup</i> (or other trade name) in water; 50% can reduce resprouting but may exceed label rate if stands are dense.
<i>Roundup, Accord XRT II, and others</i>	<b>Timing:</b> Foliar treatments should be made in late summer or early fall. For cut stump treatment, apply in late summer, early fall or dormant season; treat immediately after cutting.
	<b>Remarks:</b> Nonselective systemic herbicide that may kill partially-sprayed plants off target. It gives good control with some resprouts. Plants should not be cut for at least 4 months after foliar treatments. Cut

stump applications are made as described for triclopyr.

**BRANCHED-CHAIN AMINO ACID INHIBITORS**

Imazapyr

*Arsenal, Habitat,  
Stalker, Chopper,  
Polaris*

**Rate:** Spot treatment: 1 to 2% v/v solution of *Stalker* plus 0.25 to 0.5% surfactant v/v in water to thoroughly wet all leaves. Low volume/thinline treatment: 10% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water. Cut stump treatment: 20% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water or 20% *Habitat* v/v in 80% water carrier. Basal bark treatment: 20% v/v solution of *Stalker* plus a 20% v/v ethylated crop oil in water.

**Timing:** Postemergence when plants are growing rapidly. Best when used in late summer to early fall.

**Remarks:** Soil residual herbicide; may result in bare ground around plants for some time after treatment. Cut stump and basal bark applications are as described for triclopyr. Plants should not be cut for at least 4 months after basal bark treatment.

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*Cortaderia selloana* (Schultes) Asch. & Graebner;  
pampasgrass

*Cortaderia jubata* (Lemoine) Stapf; jubatagrass

## Pampasgrass and jubatagrass

**Family:** Poaceae

**Range:** Jubatagrass is found along coastal areas of California and Oregon. Pampasgrass is primarily in coastal areas of California and Oregon, but can also be found inland in both states and Utah.

**Habitat:** Disturbed areas, dunes, bluffs, roadsides, road-cuts, logged forests. Many coastal shrub and grasslands (including serpentine soils) and adjacent inland areas moderated by fog or other maritime influences. Pampasgrass is also found in undisturbed coastal shrubland and marshes, inland riparian areas and other interior sites where sufficient moisture is available (may tolerate standing water for prolonged periods).

**Origin:** Jubatagrass is native to equitable mid-elevation regions of the Andes Mountains in Ecuador, Peru, Bolivia, and northern Argentina, where the climate is similar to that of coastal California. Pampasgrass is native from the mid-elevation Andes slopes of northeastern Chile and northwestern Argentina to the low elevation subtropical grasslands and riparian areas of northern Argentina, Uruguay, and southern Brazil. Jubatagrass and pampasgrass were introduced as landscape ornamentals and for erosion control, but have since escaped cultivation and become noxious weeds in some areas of California, especially along the coast.

**Impacts:** Mature plants of both species are highly competitive with native vegetation and forestry tree seedlings. Jubatagrass produces abundant apomictic seed, and is currently more widespread than pampasgrass in California. Yet pampasgrass may be the more invasive species since it tolerates a wider range of climate variation. Both species are noxious weeds in Australia, Tasmania, and New Zealand.

**Western states listed as Noxious Weed:** *Cortaderia jubata*, California

**California Invasive Plant Council (Cal-IPC) Inventory:** Both species are High Invasiveness

*Cortaderia* species are large, densely tufted perennial grasses with long basal leaves and tall, showy, plume-like inflorescences. The leaves have sharply serrated margins that can easily cut the skin. Pampasgrass tussocks typically grow much larger than those of jubatagrass, and have a more erect, fountain-like appearance. The dense fibrous roots grow from shallow short lateral rhizomes. Ligules consist of a dense ring of hairs mostly 2 to 3 mm long.

Both species produce plumes that are 1 to 3 ft long, although jubatagrass often has a more purplish tinge compared to pampasgrass. Despite the similarity in appearance, the reproductive strategy of pampasgrass and jubatagrass are very different. In jubatagrass, all plants are female and develop seed without fertilization (apomixis). In pampasgrass, plants are functionally male or female. Male plumes are sometimes purplish-tinted.

Unlike jubatagrass, pampasgrass develops seed only when male and female plants are within pollination range of one another. Historically, the plumes on female plants were considered more attractive and were exclusively propagated by division within the nursery trade for ornamental purposes. In more recent years, some nursery stock has been propagated by seed, and both sexes have been widely planted as landscape ornamentals. Weedy populations spread quickly near these ornamental plantings.

*Cortaderia selloana*



*Cortaderia jubata*

Plants of both species reproduce only by seed. Each seed-bearing plume can produce up to 100,000 seeds. The seeds are very light and can disperse long distances with wind (to about 20 miles). Human activity can also disperse plants long distances. Because the seeds are so small, they do not survive long in the soil seedbank. Germination occurs in fall after the first rains, continuing through spring. Seeds typically survive for less than 6 months under field conditions, and a persistent seedbank does not accumulate.

#### NON-CHEMICAL CONTROL

<b>Mechanical</b> (pulling, cutting, disking)	Hand-pulling seedlings can help prevent the spread of either species. For removing established clumps, pulaskis, mattocks, or shovels are the safest and most effective tools. To prevent resprouting, it is important to remove the entire crown and top section of the roots. Detached plants left lying on the soil surface may take root and reestablish under moist soil conditions. Some land managers recommend turning the removed clumps upside down so the roots dry out in the air. A large chainsaw or weedeater can expose the base of the plant, allow better access for removal of the crown, and make disposal of the detached plant more manageable. Plumes can also be cut off to avoid seed dispersal. However, plants that have had plumes removed may develop more plumes during the flowering season. Mechanical removal by heavy equipment, including excavators and backhoes, can be very effective and selective. However, these methods are labor- and cost-intensive, and feasibility depends upon site accessibility, size of the infestation, funding, and availability of volunteer support.
<b>Cultural</b>	Heavily mulching bare sites or planting desirable vegetation may prevent or reduce seedling establishment. Burning or grazing are not typically considered effective control strategies for <i>Cortaderia</i> in North America, but cattle have been shown to provide effective control for pampasgrass in commercial forests of New Zealand. Any soil disturbance that creates bare ground, including natural disturbance (fire or landslides) and human-caused disturbance, promotes invasion by jubatagrass or pampasgrass.
<b>Biological</b>	There are no biological control agents available for either of the <i>Cortaderia</i> species.

#### CHEMICAL CONTROL

The following specific use information is based on publications and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### LIPID SYNTHESIS INHIBITORS

Fluazifop	<b>Rate:</b> Spot treatment: 2 to 4% v/v solution (0.5 to 1% a.i.). Low volume treatment: 4% v/v solution of product.
Fusilade	<b>Timing:</b> Postemergence. Best in late summer or fall, after flowering when translocation of herbicide to base of tillers and rhizomes is at its peak. <b>Remarks:</b> Control of jubatagrass with fluazifop was inconsistent. It has no soil residual activity. Other grass herbicides were not as effective.

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate	<b>Rate:</b> Broadcast treatment: 2 to 3.3 qt product ( <i>Roundup ProMax</i> )/acre (2.25 to 3.7 lb a.e./acre). High-volume spray-to-wet spot treatment: 2% v/v solution of product. Low-volume treatment: 8 to 10% v/v solution of product. Wiper treatment: 33 to 50% of concentrated product.
<i>Roundup, Accord</i> <i>XRT II</i> , and others	<b>Timing:</b> Postemergence. Best in late summer or fall, after flowering when translocation of herbicide to base of tillers and rhizomes is at its peak. <b>Remarks:</b> Glyphosate provides the most consistent jubatagrass control with all plant sizes in both fall and early summer. Low volume treatment at 8% and wiper applications at 33% gave the best and most consistent control.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

Imazapyr	<b>Rate:</b> 2 to 4% v/v solution of product for spot treatment (0.45 to 0.9% a.e. solution)
<i>Arsenal, Habitat,</i> <i>Polaris</i>	<b>Timing:</b> Postemergence. Best in late summer or fall, after flowering when translocation of herbicide to base of tillers and rhizomes is at its peak. <b>Remarks:</b> Results were inconsistent from site to site and year to year. Imazapyr is a slow-acting systemic herbicide and may take a year or two to achieve effective control on <i>Cortaderia</i> .

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

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*Cirsium vulgare* (Savi) Ten.

## Bull thistle

**Family:** Asteraceae

**Range:** Found in every state in the U.S.

**Habitat:** Disturbed areas including rangeland, pastures, forest clearcuts, roadsides and waste areas. Also occurs in foothills, dry meadows and riparian areas.

**Origin:** Native to Europe.

**Impact:** Bull thistle is not palatable to livestock and reduces the forage potential of infested pasture and rangeland. Once established, it can outcompete native plants. Although common, bull thistle is generally not considered as problematic as musk or Scotch thistle.

**Western states listed as Noxious Weed:** California, Colorado, New Mexico, Oregon, Washington

**California Invasive Plant Council (Cal-IPC) Inventory:** Moderate Invasiveness



Bull thistle is usually a biennial, but sometimes an annual or monocarpic perennial. It can grow up to 7 ft in height, but 2 to 6 ft is more common. Rosettes up to 3 ft in diameter form the first year. Leaves are 3 to 12 inches long, deeply lobed with coarse prickly hairs on the top and woolly hairs underneath. Leaves have sharp spines along the midrib and at the tip of the lobes, with the tip resembling a spear. Plants can have spreading branches, and sometimes a single stem. Stem have spiny wings that run down the length of the stem. Bull thistle requires vernalization before bolting.

Plants produce solitary (or sometimes clustered) pink-magenta flowerheads at the end of each stem. They are 1.5 to 2 inches wide and 1 to 2 inches long. Large spiny bracts surround the seedheads. Bull thistle reproduces and spreads entirely from seeds. Under favorable conditions, plants can produce 100 to 300 seeds per flowerhead or more, with 1 to more than 400 flowerheads per plant. Seeds have a feathery pappus that detaches at maturity, so seeds usually do not travel great distances by wind. Most seeds fall within a few feet of the parent plant. Seeds germinate in fall or spring depending on soil moisture. Most seeds either germinate or die within the first year, but seeds buried to about 6 inches or deeper may survive for up to 3 years or more.

### NON-CHEMICAL CONTROL

#### Mechanical (pulling, cutting, disking)

Tillage, hoeing, and hand pulling are effective as long as they are done before flowering to prevent seed production. Any mechanical or physical control measure that severs the root below the soil surface is very effective. The plant must be cut off below the soil surface and no leaves should remain attached, or the plant will recover.

Mowing is only effective when done either immediately before flowering or when plants are just starting to flower. Mowing too early only delays flowering, while mowing too late may allow production of viable seed. Because there can be a wide variation in the maturity of plants, a single mowing is generally insufficient because some seed will still be produced. Repeated mowing throughout the growing season is a more successful approach.

#### Cultural

The ability of thistles to invade pastures can be changed by grazing management, primarily by changing the competitiveness of the desirable pasture species. Sheep, goats, and horses, but not cattle, will eat young plants and can have a significant effect on thistles in the early stages of an infestation. Goats tend to avoid bull thistle foliage but eat the flowerheads, which can completely prevent seed dispersal from mature plants. Light grazing by sheep may selectively reduce competition from neighboring plants, increasing

seedling survival, growth, flowering and seed production in bull thistle.

It is unclear whether fire will completely kill bull thistle. Only mature thistle plants may readily combust and their seed may already be dispersed. Fire can create conditions that favor the establishment of bull thistle, so colonization after a fire may be enhanced. Burning can be used to remove above-ground material once it dries in late summer to fall. This can facilitate subsequent herbicide applications. Burning may also encourage the seedbank to flush, providing an opportunity for seedling control.

#### Biological

The bull thistle gall fly (*Urophora stylata*) was released as a biocontrol agent in the Pacific Northwest, as was the thistle head weevil, *Rhinocyllus conicus*. *Urophora* is not established in California yet and has little impact elsewhere. *R. conicus* is widely established in the western United States and attacks many thistle species, including some native species. A weevil, *Trichosiromus horridus*, was introduced to the U.S. in 1974 to control musk thistle and other thistles. Reports of its effectiveness vary.

#### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### GROWTH REGULATORS

##### 2,4-D

**Rate:** 1.6 to 2.1 qt product/acre (1.5 to 2 lb a.e./acre)

##### Several names

**Timing:** Postemergence at rosette stage. Treat seedling rosettes in fall.

**Remarks:** 2,4-D is broadleaf-selective and has no soil activity. It may require repeat applications. 2,4-D is generally not the most effective treatment, but is widely used because of low cost. Use a surfactant. When using the ester formulation do not apply when outside temperatures exceed 80°F.

##### Aminocyclopyrachlor + chlorsulfuron

**Rate:** 4.75 to 8 oz product (*Perspective*)/acre

##### *Perspective*

**Timing:** Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the bolting stage.

**Remarks:** *Perspective* provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).

##### Aminopyralid *Milestone*

**Rate:** 3 to 5 oz product/acre (0.75 to 1.25 oz a.e./acre)

**Timing:** Postemergence in spring to early summer when the target plants are in the rosette to bolting stage, or in fall to seedlings.

**Remarks:** Aminopyralid is a broadleaf herbicide similar to picloram, but more selective and generally safe on grasses. Its soil residual activity will kill emerging seedlings. Aminopyralid has a longer soil residual and higher activity than clopyralid. Aminopyralid can also be used in a premix with 2,4-D (*Forefront HL*) at 1.2 to 1.5 pt product/acre for bull thistle control.

##### Clopyralid *Transline*

**Rate:** 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre)

**Timing:** Postemergence in spring up to the bud stage. Can also apply to fall regrowth. Results are best if applied to rapidly growing weeds.

**Remarks:** Clopyralid is a broadleaf herbicide like picloram, but more selective. It is very safe on grasses.

##### Dicamba *Banvel, Clarity*

**Rate:** 1 to 2 pt product/acre (0.5 to 1 lb a.e./acre)

**Timing:** Postemergence to rosettes in spring. Fall applications help control seedling rosettes.

**Remarks:** Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is also effective when tank-mixed with 2,4-D (0.75 lb a.e./acre of dicamba + 0.25 lb a.e./acre of 2,4-D). Avoid drift to sensitive crops. Do not apply when outside temperatures exceed 80°F.

Dicamba is available mixed with diflufenzopyr in a formulation called *Overdrive*. This has been reported to be effective on bull thistle. Diflufenzopyr is an auxin transport inhibitor which causes

dicamba to accumulate in shoot and root meristems, increasing its activity. *Overdrive* is applied postemergence at 4 to 8 oz product/acre on rapidly growing plants. Higher rates should be used on large annuals and biennials. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.

Picloram

**Rate:** 0.5 to 0.75 pt product/acre (2 to 3 oz a.e./acre)

Tordon 22K

**Timing:** Postemergence during active growth before bud stage.

**Remarks:** Picloram is one of the most effective herbicides for bull thistle control. Most broadleaf plants are susceptible, but relatively safe on established grasses. It is also effective when mixed with dicamba or 2,4-D. Picloram has long soil residual activity and has been reported by some to injure young or germinating grasses. Picloram can also be used in a premix with 2,4-D (*Grazon P+D*) to give control of bull thistle. Picloram products are federally restricted use pesticides. Picloram and its formulations are not registered for use in California.

Triclopyr

**Rate:** 0.33 to 1.5 gallons *Garlon 3A*/acre or 0.25 to 1 gallons *Garlon 4 Ultra*/acre (1 to 4.5 lb a.e./acre)

*Garlon 3A, Garlon 4**Ultra*

**Timing:** Postemergence to rapidly growing weeds, up to bud stage.

**Remarks:** Triclopyr is broadleaf-selective and safe on most grasses. It is most effective on smaller plants. *Garlon 4 Ultra* is formulated as a low volatile ester. However, in warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage. Recommended rates are based on those reported for perennial thistles. Triclopyr can also be used in a premix with 2,4-D (*Crossbow*) or clopyralid (*Transline*).

**BRANCHED-CHAIN AMINO ACID INHIBITORS**

Chlorsulfuron

**Rate:** 1 oz product/acre (0.75 oz a.i./acre)

Telar

**Timing:** Postemergence to young rapidly growing weeds.

**Remarks:** Chlorsulfuron provides residual control 1 year after treatment. It has mixed selectivity, but is generally safe on grasses. Always use a surfactant. 2,4-D at 1 to 2 pt product/acre can be tank-mixed with chlorsulfuron for quicker burndown.

Imazapyr

**Rate:** Broadcast treatment: 4 to 6 pt product/acre (1 to 1.5 lb a.e./acre). Spot treatment: 1% v/v solution

*Arsenal, Habitat, Stalker, Chopper, Polaris*

**Timing:** Postemergence at flowering.

**Remarks:** Imazapyr is best used as a spot treatment. It is a nonselective herbicide. It also has long soil residual activity and can leave more bare ground than other treatments, even a year after application. Recommended rates are based on those reported for perennial thistles.

Metsulfuron

**Rate:** 1.5 to 2 oz product/acre (0.9 to 1.2 oz a.i./acre)

Escort

**Timing:** Postemergence to young, rapidly growing weeds in spring before flowering, or in fall to new rosettes.

**Remarks:** Metsulfuron has mixed selectivity, but is generally safe on grasses. Use a surfactant. It can be tank-mixed with 2,4-D or aminopyralid. *Opensight* is a premix of aminopyralid and metsulfuron; use at 1 to 2.5 oz product/acre. Metsulfuron has some soil residual activity. Recommended rates are based on those reported for perennial thistles. Metsulfuron and its formulations are not registered for use in California.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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*Cirsium arvense* (L.) Scop.

## Canada thistle

**Family:** Asteraceae

**Range:** Found throughout much of the United States, including all western states.

**Habitat:** Open, disturbed sites such as roadsides, gardens, pastures, hillsides, rangeland, stream banks, forest openings, and sometimes cropland such as alfalfa or grains. Prefers moist soils but will tolerate a wide range of soil types.

**Origin:** Native to southeastern Europe and the eastern Mediterranean area.

**Impact:** Competes aggressively with native plant species. It causes extensive yield loss in crops by competing for nutrients, light and water. It may also have an allelopathic effect. The productivity of pastures is significantly reduced because livestock avoid grazing Canada thistle and surrounding plants due to the spiny nature of the mature foliage. Canada thistle can also be economically damaging to ranchers by causing an increase in infections due to abrasions. Canada thistle is a host species for several agricultural insect and disease pests such as the sod-web worm, bean aphid, stalk borer, and cucumber mosaic virus.

**Western states listed as a noxious weed:** Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming  
**California Invasive Plant Council (Cal-IPC) Inventory:** Moderate Invasiveness



Canada thistle is an erect perennial that grows up to 3 to 5 ft tall and forms patches or clumps that are usually of a single sex. Stems ordinarily die back over winter and new shoots are formed in spring from old stem bases or root buds when the soil moisture permits. Canada thistle has an extensive creeping root system that can reach depths of 6 to 15 ft making eradication difficult. The spiny lobed leaves are 6 to 8 inches long and 1 to 1.5 inches wide. The leaves are alternate, oblong or lance-shaped and the base leaves stalkless and clasping.

Plants are dioecious (separate male and female plants) and flower heads are white to purple, borne in clusters of 1 to 5 per branch. The purplish involucre is glabrous or has white wooly hairs. Plants develop from seed and from vegetative shoots that generate from adventitious root buds. Canada thistle can produce between 1,000 and 5,000 seeds per stem. Most seeds fall near the parent plants or disperse short distances with wind. Birds and small mammals can consume and disperse some seeds. The seeds have been known to survive in the soil for up to 20 years and longevity is favored by deep burial.

### NON-CHEMICAL CONTROL

#### Mechanical (pulling, cutting, disking)

Mowing can be used to reduce the nutrient storage in the roots and suppress flower formation. However, for mowing to be effective it must be repeated at least every 3 to 4 weeks over several growing seasons or coupled with other control practices.

Tillage or cultivation can actually increase Canada thistle because it breaks the root system into fragments, spreading the roots through the soil and stimulating development of new plants. Small root pieces have enough stored reserves to develop new plants. Small roots can survive at least 100 days without nutrient replenishment from photosynthesis. For cultivation to be effective it must be repeated at 21 day intervals throughout the growing season.

#### Cultural

Neither grazing nor prescribed burning have been shown to be effective for the management of Canada thistle.

#### Biological

Three insects have been released as biocontrol agents. None of these species have had a significant impact



	to bud stage Canada thistle.
Dicamba	<b>Rate:</b> 4 pt product/acre (2 lb a.e./acre)
Banvel	<b>Timing:</b> Postemergence to rosettes. Fall applications are also effective.
	<b>Remarks:</b> Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is not typically used alone to control Canada thistle because it is not as effective as other herbicides such as aminopyralid, clopyralid or aminocyclopyrachlor.
	Dicamba is available mixed with diflufenzopyr in a formulation called <i>Overdrive</i> . This has been reported to be effective on Canada thistle. Diflufenzopyr is an auxin transport inhibitor which causes dicamba to accumulate in shoot and root meristems, increasing its activity. <i>Overdrive</i> is applied postemergence at 4 to 8 oz product/acre to rapidly growing plants. Higher rates should be used when treating perennial weeds. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.
Picloram	<b>Rate:</b> 2 pt product/acre (8 oz a.e./acre).
Tordon 22K	<b>Timing:</b> Best when applied postemergence to rapidly growing thistle after most leaves emerge but before bud stage. Fall applications are also effective.
	<b>Remarks:</b> Picloram gives a broader spectrum of control than aminopyralid, aminocyclopyrachlor, and clopyralid, and has much longer soil residual activity. Most broadleaf plants are susceptible. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees. <i>Tordon 22K</i> is a federally restricted use pesticide. Picloram is not registered for use in California.

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate	<b>Rate:</b> Broadcast foliar treatment: 2 qt product ( <i>Roundup ProMax</i> )/acre (2.25 lb a.e./acre). Spot treatment: 2% v/v solution
<i>Roundup</i> , <i>Accord XRT II</i> , and others	<b>Timing:</b> Postemergence to rapidly growing thistles when most plants are past the bud stage. Fall applications must be before the first killing frost.
	<b>Remarks:</b> Do not tank-mix other herbicides with glyphosate for thistle control. More than 1 year of treatment may be necessary for complete control. Glyphosate will only provide control during the year of application; it has no soil activity and will not kill seeds or inhibit germination the following season. Glyphosate is nonselective. To achieve selectivity, it can be applied using a wiper or spot treatment to control current year's plants.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

Chlorsulfuron	<b>Rate:</b> 1 to 1.33 oz product/acre (0.75 to 1 oz a.i./acre)
Telar	<b>Timing:</b> Postemergence from bolting to bloom stages. Can also apply in fall.
	<b>Remarks:</b> Chlorsulfuron has mixed selectivity on both broadleaf and grass species but is generally safe on most grasses. It has fairly long soil residual activity. The herbicide solution requires constant agitation during application.
Imazapyr	The herbicide label indicates that 4 to 6 pt product/acre gives some level of control, but imazapyr is not usually the herbicide of choice for the control of Canada thistle.
<i>Arsenal</i> , <i>Habitat</i> , <i>Stalker</i> , <i>Chopper</i> , <i>Polaris</i>	
Sulfometuron	<b>Rate:</b> 6 to 8 oz product/acre (4.5 to 6 oz a.i./acre)
<i>Oust</i> and others	<b>Timing:</b> Apply preemergence or early postemergence before or during the rainy season when weeds are germinating or actively growing.
	<b>Remarks:</b> Sulfometuron has mixed selectivity. It can cause minor damage to some native perennial grasses and has a fairly long soil residual. Higher rates may increase control but will also give more bare ground. Requires 20 inches of annual rainfall or more for effective preemergence control.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

on Canada thistle.

The larvae of the Canada thistle stem weevil (*Ceutorhynchus litura*) bore into the main leaf vein and then into the crown. It is considered the most effective of the current biocontrol agents, reducing plant vigor. When present in high enough densities it can kill the plant. Larvae of the bud weevil (*Larinus planus*) feed on the bud and can reduce the potential for sexual reproduction. Larvae of the thistle stem gall fly (*Urophora cardui*) bore into the apical meristem of shoots and form a gall. They can reduce plant vigor and can prevent flower formation depending upon the location of the gall.

A pathogenic rust (*Puccinia punctiformis*) infects Canada thistle (mix sap from infected plant with water and spray uninfected plants to infect them), but it too has not had a significant effect on its control.

## CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

## GROWTH REGULATORS

2,4-D	<b>Rate:</b> 2 qt product/acre (1.9 lb a.e./acre)
Several names	<b>Timing:</b> Postemergence in spring at the pre-bud to early bud stage.
	<b>Remarks:</b> Control with 2,4-D alone is only temporary; therefore, it is commonly mixed with other growth regulator herbicides. Research from Colorado showed control from a spring 2,4-D application followed by fall application with different herbicides. 2,4-D is broadleaf-selective and has no soil activity. Do not apply ester formulation when outside temperatures exceed 80°F.
Aminocyclopyrachlor + chlorsulfuron	<b>Rate:</b> 4.75 to 8 oz product ( <i>Perspective</i> )/acre
<i>Perspective</i>	<b>Timing:</b> Postemergent to plants before they produce seed.
	<b>Remarks:</b> <i>Perspective</i> provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. May need retreatment for 1 to 2 additional years. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).
Aminopyralid	<b>Rate:</b> 5 to 7 oz product/acre (1.25 to 1.75 oz a.e./acre)
<i>Milestone</i>	<b>Timing:</b> Postemergence in spring after all plants have fully emerged (some may be budding) until the oldest plants are in full flower stage. Use the higher rate when applying to flowering plants. Applications are also effective in fall before a killing frost. Use higher rates for older/dense stands or for longer residual control.
	<b>Remarks:</b> May need retreatment for 1 to 2 additional years. Aminopyralid is one of the most effective herbicides for the control of Canada thistle. It is safe on grasses, although preemergence application at high rates can greatly suppress invasive annual grasses, such as medusahead. Aminopyralid has a longer residual and higher activity than clopyralid. Other members of the Asteraceae and Fabaceae are very sensitive to aminopyralid.
	Other premix formulations of aminopyralid can also be used for Canada thistle control. These include <i>Opensight</i> (aminopyralid + metsulfuron; 2.5 to 3 oz product/acre) and <i>Forefront HL</i> (aminopyralid + 2,4-D; 1.5 to 2.1 pt product/acre), both applied at the rosette to bolting stages. The formulation with metsulfuron is not registered for use in California.
Clopyralid	<b>Rate:</b> 0.67 to 1.33 pt product/acre (4 to 8 oz a.e./acre)
<i>Transline</i>	<b>Timing:</b> Postemergence before the bud stage when most of the basal leaves have emerged. Fall applications are also effective.
	<b>Remarks:</b> One or more treatments per season may be needed for 1 to 3 consecutive years for complete control. Allow at least 20 days after application before disturbing treated areas. While clopyralid is very safe on grasses, it will injure many members of the Asteraceae, particularly thistles, and can also injure legumes, including clovers. Most other broadleaf species and all grasses are not injured. Also applied in a premix with triclopyr ( <i>Redeem</i> , 2.5 to 4 pt product/acre) to rosette

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center ([wric.ucdavis.edu](http://wric.ucdavis.edu)) or retail through the Western Society of Weed Science ([wsweedscience.org](http://wsweedscience.org)) or the California Invasive Species Council ([cal-ipc.org](http://cal-ipc.org)).

*Centaurea solstitialis* L.

## Yellow starthistle

**Family:** Asteraceae

**Range:** Most contiguous states, except a few southern and northeastern states.

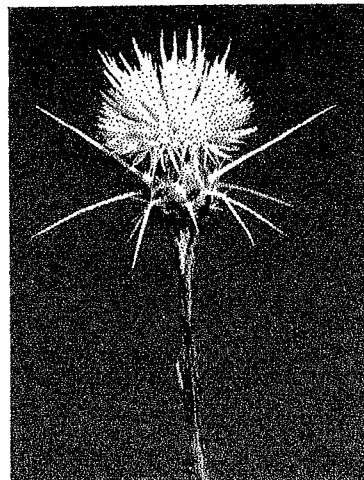
**Habitat:** Open disturbed sites, open hillsides, grassland, rangeland, open woodlands, fields, pastures, roadsides, waste places. May also inhabit cultivated fields. Does not tolerate low light areas or shading.

**Origin:** Southern Europe. Accidentally introduced as a seed contaminant in alfalfa. It has spread rapidly since its introduction into California in the mid-1800s.

**Impacts:** Plants are highly competitive and typically develop dense, impenetrable stands that displace desirable vegetation in natural areas, rangelands, roadsides and other places. Yellow starthistle is considered one of the most serious rangeland weeds in the western U.S. Yellow starthistle is sometimes problematic in grain fields, where the seeds can contaminate the grain harvest and lower its quality and value. Yellow starthistle contains an unidentified compound that causes nigropallidal encephalomalacia or chewing disease in horses.

**Western states listed as Noxious Weed:** Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington

**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



Yellow starthistle is a simple to bushy winter annual, occasionally biennial, with spiny yellow-flowered heads and stiff wiry stems to 6 ft tall. Plants form a basal rosette of leaves until mid-spring. Stem leaves are alternate and mature foliage is grayish- to bluish-green, densely covered with fine white cottony hairs. Its leaf bases form wings along the stems. Rosette leaves typically wither by flowering time. The taproot can extend deep into the soil (> 6 ft) allowing plants to utilize deep soil moisture not available to other annual species, particularly grasses.

The flowerheads are solitary on stem tips, and consist of numerous yellow disk flowers. The phyllaries are densely to sparsely covered with cottony hairs or with patches of hairs at the bases of the spines. The central spine of the main phyllaries is 10 to 25 mm long, stiff, yellowish to straw-colored throughout. Yellow starthistle reproduces only by seed and develops two types of achenes. The outer ring of achenes is a dull dark brown, often speckled with tan, lacking pappus bristles, and often remaining in heads. The inner achenes are glossy, gray or tan to mottled cream-colored and tan, with slender white pappus bristles 2 to 5 mm long. Most seeds fall near the parent plant. Some seed is viable 8 days after flower initiation. Large flushes of seeds typically germinate after the first fall rains, but smaller germination flushes can occur during winter and early spring. Seeds can survive for up to about 10 years in the field under certain environmental conditions, but it appears that few seeds survive beyond 4 years.

### NON-CHEMICAL CONTROL

**Mechanical**  
(pulling, cutting,  
disking)

Hand removal, mowing, or cultivation, when used to prevent seed production over 2 to 3 years or more (the soil life of the seeds), can reduce or eliminate an infestation.

Manual removal of yellow starthistle is most effective with small patches or in maintenance programs where plants are sporadically located in the grassland system. This usually occurs with a new infestation or in the third year or later in a long-term management program. These methods can also be important in steep or uneven terrain where other mechanical tools (e.g., mowing) are impossible to use. To ensure that

plants do not recover it is important to detach all above-ground stem material. Leaving even a 2-inch piece of the stem can result in recovery if leaves and buds are still attached to the base of the plant. The best timing for manual removal is after plants have bolted but before they produce viable seed (i.e. early flowering). At this time, plants are easy to recognize, and some or most of the lower leaves have senesced. If hand removal is conducted after plants begin to produce seeds, it may be necessary to put pulled plants in bags and remove them from the site. Hand removal is particularly easy in areas with competing vegetation. Under this condition, yellow starthistle will develop a more erect slender stem with few basal leaves. These plants are relatively brittle and easy to remove. In addition, they usually lack leaves at the base and, consequently, rarely recover even when a portion of the stem is left intact. Hand removal options for yellow starthistle typically include hand pulling, hoeing, or string trimming. Systematic surveys and repeated removal should be conducted every 2 to 4 weeks throughout the growing season.

Mowing is most effective when 2 to 5% of the total population of seedheads is in bloom. Mowing too early can result in higher seed production. Plants should be cut below the height of the lowest branches. It will require multiple years of continuous mowing to successfully manage yellow starthistle. Mowing is best used in an integrated approach. Since it is a late season management tool, it is best employed in the later years of a long-term management program or in a lightly infested area. Mowing is not feasible in many locations due to rocks and steep terrain. Mowing is not always successful and can decrease the reproductive efforts of insect biocontrol agents, injure late growing native forb species, and reduce fall and winter forage for wildlife and livestock.

The success of mowing depends on proper timing and the growth form of the plant. Mowing too early (before seedheads reach spiny stage) or too late (after seed set) will usually increase the yellow starthistle problem. Mowing too early in the season can remove competitive grass cover and promote vigorous yellow starthistle regrowth. If done too late, mowing scatters yellow starthistle seed. Best results were obtained by mowing once at the early flowering stage, and again 4 to 6 weeks later to cut regrowth during the floral bud stage. A dense spring canopy of desirable vegetation optimizes yellow starthistle control. Yellow starthistle plants with an erect, high-branching growth form are effectively controlled by a single mowing at the early flowering stage, while sprawling low-branching plants cannot be controlled even with repeated mowing. Despite its limitations, mowing conducted at the early flowering stage, before viable seed production, can be very effective for yellow starthistle control.

Anecdotal information also indicates that mowing the standing skeletons in fall, before the first rains, can form a mulch that blocks light and suppresses subsequent germination of yellow starthistle. A flail mower is considered best. The yellow starthistle litter layer may be less suppressive to grass germination, as it is not as light dependent as yellow starthistle.

Tillage is effective, and is occasionally used on roadsides. It is also often used in agricultural lands, which is probably why yellow starthistle is not a significant cropland weed. In wildlands and rangelands, tillage is usually not appropriate because it can damage important desirable species, increase erosion, alter soil structure, and expose the soil for rapid reinfestation if subsequent rainfall occurs. Any tillage operation that severs the roots below the soil surface can effectively control yellow starthistle. Early summer tillage, before viable seeds are set, and repeated tillage following rainfall/germination events will rapidly deplete the yellow starthistle seed bank, but may also have the same effect on the seed bank of desirable species.

#### Cultural

High-intensity short-duration grazing by sheep, goats, or cattle should be implemented during the period when yellow starthistle plants have bolted to just before they produce spiny heads. Cattle and sheep avoid yellow starthistle once the buds produce spines, whereas goats continue to browse plants even in the flowering stage. For this reason, goats have become a more popular method for controlling yellow starthistle in relatively small infestations.

Grazing the weed during the bolting stage can provide palatable high protein forage (8 to 14%). This can be particularly useful in late spring and early summer when other annual species have senesced. Grazing alone will not provide long-term management or eradication of yellow starthistle, but can be a valuable tool in an integrated management program. This prescription must be continued for at least 3 years in a severe infestation to reduce the yellow starthistle seed bank.

Prescribed burns can provide control if conducted at the proper timing. Burning should be timed to coincide with the very early yellow starthistle flowering stage. At this time yellow starthistle has yet to produce viable seed, whereas seeds of most desirable species have dispersed and grasses have dried to provide adequate fuel. Fire has little if any impact on seeds in the soil. Burning at other times may enhance yellow starthistle survival by removing the thatch and encouraging seed germination in fall.

The ability to use repeated burning depends on climatic and environmental conditions. In areas where

resources are ample and total plant biomass is abundant, 2 or 3 consecutive years of burning may be practical. However, in other situations, fuel loads may not be sufficient to allow multiple year burns. Consequently, prescribed burning may be more appropriate as part of an integrated approach.

Air quality issues can be significant when burns are conducted adjacent to urban areas. A major risk of prescribed burning is the potential of fire escapes. This risk is greatest when burns are conducted during the summer months. In some areas, burning can lead to rapid invasion by other undesirable species with wind-dispersed seeds, particularly members of the sunflower family.

In addition to summer burning, yellow starthistle seedlings have been controlled using winter or early spring flaming. This technique is somewhat nonselective, and control of yellow starthistle is inconsistent. When spring drought follows a flaming treatment, control of yellow starthistle can be excellent. In contrast, a wet spring can lead to complete failure and increased yellow starthistle infestation, particularly since competing species may be dramatically suppressed.

#### Biological

Six insects have become established for the control of yellow starthistle in the western United States. These include three species of weevils (seed-head weevil [*Bangasternus orientalis*], flower weevil [*Larinus curtus*], and the hairy weevil [*Eustenopus villosus*]), and three species of flies (seed-head fly [*Urophora sirunaseva*], peacock fly [*Chaetorellia australis*], and the false peacock fly [*Chaetorellia succinea*]). All six insects attack the flower heads of yellow starthistle and produce larvae that develop and feed within the seedhead. Of these, only four have become well established. Of these, only two, *Eustenopus villosus* and *Chaetorellia succinea*, have any significant impact on reproduction. The combination of these two insects reduces seed production by 43 to 76%. Although this level of suppression is not sufficient to provide long-term yellow starthistle management, the use of biological control agents can be an important component of an integrated management approach. A more successful biological control program will likely require the introduction of plant pathogens or other insects which attack roots, stems, or foliage.

A new potential biological control agent is a root-feeding weevil, *Ceratopion basicorne*, that has shown promise under greenhouse conditions. It has yet to be approved, but is expected to be released in the next couple of years.

The most widely studied pathogen for yellow starthistle control is the Mediterranean rust fungus *Puccinia jaceae*. It can attack the leaves and stem of yellow starthistle, causing enough stress to reduce flowerhead and seed production. Although it has been released it does not seem to have much impact on yellow starthistle populations.

#### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### GROWTH REGULATORS

##### 2,4-D

##### Several names

**Rate:** 1 to 1.5 pt product/acre (0.48 to 0.72 lb a.e./acre) for small rosettes, 2 to 4 pt product/acre (0.95 to 1.9 lb a.e./acre) for larger plants up to bolting

**Timing:** Postemergence from rosette to beginning of bolting, but before flowering.

**Remarks:** 2,4-D controls larger plants well, but is not considered as effective as other growth regulator herbicides for season-long control. It is broadleaf-selective and may injure other non-target species, particularly crop plants. 2,4-D has no soil activity. Do not apply ester formulation when outside temperatures exceed 80°F. Amine forms are as effective as ester forms for small rosettes, and amine forms reduce the chance of off-target movement from volatility.

##### Aminocyclopyrachlor + chlorsulfuron

##### Perspective

**Rate:** 3 to 5 oz product (*Perspective*)/acre

**Timing:** Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage.

**Remarks:** Aminocyclopyrachlor gives control of yellow starthistle similar to aminopyralid. *Perspective* provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for

**Aminopyralid**  
**Milestone**

use in California and some counties of Colorado (San Luis Valley).

**Rate:** 3 to 5 oz product/acre (0.75 to 1.25 oz a.e./acre). Use higher rates when weeds are larger.

**Timing:** Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage. Earlier applications (i.e., in fall) may not provide full-season control, and later applications (bolting to early spiny stage) will require higher rates.

**Remarks:** Aminopyralid is one of the most effective herbicides for the control of yellow starthistle. It is safe on grasses, although preemergence application at high rates can greatly suppress invasive annual grasses, such as medusahead. Aminopyralid has a longer residual and higher activity than clopyralid. Other members of the Asteraceae and Fabaceae are very sensitive to aminopyralid. For postemergence applications, a non-ionic surfactant (0.25 to 0.5% v/v spray solution) enhances control under adverse environmental conditions; however, this is not normally necessary.

Other premix formulations of aminopyralid can also be used for yellow starthistle control. These include *Opensight* (aminopyralid + metsulfuron; 1.5 to 2 oz product/acre) and *Forefront HL* (aminopyralid + 2,4-D; 2 to 2.6 pt product/acre), both applied at the rosette to bolting stages.

**Clopyralid**  
**Transline**

**Rate:** 0.25 to 0.67 pt product/acre (1.5 to 4 oz a.e./acre). Seedlings and rosettes can be treated at the lower rate, but bolted plants should be treated at higher rates.

**Timing:** Postemergence and preemergence. For postemergence application, apply to plants from seedling to mid-bolting stage. However, since clopyralid has a shorter soil residual compared to aminopyralid, optimal timing is at the later rosette stages, but before bolting. Earlier applications (i.e., in fall) may not provide full-season control, and later applications (bolting to early spiny stage) will require higher rates and may not give sufficient control.

**Remarks:** Clopyralid gives excellent control of yellow starthistle. While it is very safe on grasses, it will injure many members of the Asteraceae, particularly thistles, and can also injure legumes, including clovers. Most other broadleaf species and all grasses are not injured.

When clopyralid is used to control seedlings a surfactant is not necessary. However, when treating older plants or plants exposed to moderate levels of drought stress, surfactants can enhance the activity of the herbicide.

**Clopyralid + 2,4-D**  
**Curtail**

**Rate:** 2 to 4 qt *Curtail*/acre

**Timing:** Same as for clopyralid.

**Remarks:** Add a non-ionic surfactant.

**Dicamba**  
**Banvel, Clarity**

**Rate:** 0.5 pt product/acre (0.25 lb a.e./acre) for seedlings, 1 to 1.5 pt product/acre (0.5 to 0.75 lb a.e./acre) for larger plants up to bolting.

**Timing:** Postemergence to plants from rosette to beginning of bolting.

**Remarks:** Dicamba is a broadleaf-selective herbicide often combined with other active ingredients. It is not typically used alone to control yellow starthistle.

Dicamba is available mixed with diflufenzopyr in a formulation called *Overdrive*. This has been reported to be effective on yellow starthistle. Diflufenzopyr is an auxin transport inhibitor which causes dicamba to accumulate in shoot and root meristems, increasing its activity. *Overdrive* is applied postemergence at 4 to 8 oz product/acre to rapidly growing plants. Higher rates should be used on large annuals. Add a non-ionic surfactant to the treatment solution at 0.25% v/v or a methylated seed oil at 1% v/v solution.

**Picloram**  
**Tordon 22K**

**Rate:** 1 to 1.5 pt product/acre (4 to 6 oz a.e./acre)

**Timing:** Postemergence and preemergence. Postemergence applications should be made to plants from rosette to bud formation stage. Apply when there is adequate soil moisture and weeds are growing rapidly.

**Remarks:** Picloram acts much like aminopyralid, aminocyclopyrachlor, and clopyralid, but gives a broader spectrum of control and has much longer soil residual activity. It can provide about 2 to 3 years of control. Most broadleaf plants are susceptible. Although well-developed grasses are not usually injured by labeled use rates, some applicators have noted that young grass seedlings with fewer than four leaves may be killed. Do not apply near trees. *Tordon 22K* is a federally restricted use pesticide. Picloram is not registered for use in California.

**Triclopyr**  
*Garlon 3A, Garlon 4 Ultra*  
**Rate:** 1 pt *Garlon 4 Ultra* or 1.33 pt *Garlon 3A*/acre (0.5 lb a.e./acre) for seedlings, up to 3 pt *Garlon 4 Ultra* or 4 pt *Garlon 3A*/acre (1.5 lb a.e./acre) for larger plants.  
**Timing:** Postemergence from seedling to bolting stage.  
**Remarks:** Triclopyr has little to no residual activity. It is broadleaf-selective and typically does not harm grasses. *Garlon 4 Ultra* is formulated as a low volatile ester. However, in warm temperatures, spraying onto hard surfaces such as rocks or pavement can increase the risk of volatilization and off-target damage.

#### AROMATIC AMINO ACID INHIBITORS

**Glyphosate**  
*Roundup, Accord XRT II, and others*  
**Rate:** Broadcast foliar treatment: 1.33 to 2.67 qt product (*Roundup ProMax*)/acre (1.5 to 3 lb a.e./acre). Spot treatment: 1% to 2% v/v solution  
**Timing:** Postemergence to plants from bolting to beginning of flowering.  
**Remarks:** Glyphosate is the most effective herbicide for late season control. Good coverage, clean water, and rapidly growing yellow starthistle plants are all essential for adequate control. It has no soil activity and is nonselective. To achieve selectivity, it can be applied using a wiper or spot treatment to control current year's plants.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

**Chlorsulfuron**  
*Telar*  
**Rate:** 1.33 to 2.6 oz product/acre (1 to 1.95 oz a.i./acre)  
**Timing:** Preemergence activity only. Chlorsulfuron does not have postemergence activity on yellow starthistle and must be used in combination with 2,4-D, dicamba, or triclopyr to provide effective control.  
**Remarks:** Chlorsulfuron has mixed selectivity on both broadleaf and grass species but is generally safe on grasses. It has fairly long soil residual activity. Herbicide solution requires constant agitation during application.

**Imazapyr**  
*Arsenal, Habitat, Stalker, Chopper, Polaris*  
 Not often used for yellow starthistle control but has been shown to be somewhat effective at 3 to 4 pt product/acre. It has preemergence and some postemergence activity, and a long soil residual.

**Sulfometuron**  
*Oust and others*  
 Not often used for yellow starthistle control but has been shown to be somewhat effective at 1 to 2 oz product/acre. It has preemergence activity only, and a long soil residual.

#### PHOTOSYNTHETIC INHIBITORS

**Hexazinone**  
*Velpar L*  
 Not often used for yellow starthistle control but has been shown to be somewhat effective at 1 to 2.5 gal product/acre. It has preemergence activity only, and a long soil residual. High rates of hexazinone can create bare ground, so only use high rates in spot treatments.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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*Rubus armeniacus* Focke

## Himalaya blackberry

**Family:** Rosaceae

**Range:** Common throughout the western United States, except in Wyoming, North and South Dakota.

**Habitat:** Disturbed, open, moist sites such as canals, ditch banks, fencerows, roadsides, open fields, and riparian zones, in a variety of plant communities. It can also tolerate periodic flooding with brackish water.

**Origin:** A cultivar introduced from Eurasia, originating from Armenia, quickly spread throughout Europe and the rest of the world.

**Impact:** Himalaya blackberry is a highly competitive plant with a growth form that allows it to quickly crowd out native species. Its thickets have dense canopies allowing little light penetration and reducing the growth of understory plants. In riparian areas it can prevent access to water sources for livestock and wildlife.

**Western states listed as Noxious Weed:** California, Oregon  
**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



Himalaya blackberry is an evergreen erect shrub that grows up to 10 ft tall and is climbing, mounded, or trailing. The aboveground canes are usually biennial while the roots are perennial. The roots are found in the top 20 inches of the soil but may grow down to a depth of 7 ft in loose soil. The roots can sprout new shoots from root buds, and in good conditions root fragments may sprout a new plant. The stems are green to purplish-red, woody, strongly angled, and are protected against predation by straight or curved prickles with a thick base. The leaves are pinnately compound with 3 to 5 leaflets that are dark green with a white underside covered with dense short hairs. The leaflets are broadest above the middle, toothed and sometimes shallowly lobed.

The flowers of Himalaya blackberry are white to pinkish and numerous in non-glandular panicles. They are self-fertile with 5 petals, and numerous stamens and pistils. The fruit are edible and an aggregate of drupelets that adhere to a fleshy receptacle. The mature berries are ovoid to oblong, black, 0.75 inch long, glossy, and glabrous or slightly pubescent. They typically ripen later in the season than the native berries. Seeds are dispersed primarily by birds. In addition to seeds, plants reproduce by root sprouts and stem tip rooting. Seeds likely only survive a few years in the soil.

### NON-CHEMICAL CONTROL

#### Mechanical (pulling, cutting, disking)

Hand pulling can be an effective control method for small populations. To successfully control populations with mechanical removal, it is important to remove the canes, roots and the root crowns to prevent resprouting. A Pulaski, mattock or similar device can be used to remove plants. Bulldozing may cause resprouting and can spread the weed by fragmenting roots and stems.

Cutting and removing only the aboveground biomass will result in the stimulated growth of root sprouts. The root sprouts must be controlled and repeated cutting of the above-ground biomass during flowering time will exhaust the root stores.

Tillage can be effective if the canes are raked and removed from the site. However, this will cause significant soil disturbance and is unsuitable in riparian areas.

#### Cultural

Goats will readily consume Himalaya blackberry and could help to control new populations. It is a common



method of management in Australia and New Zealand. Their consumption is indiscriminate and could result in the loss of other desirable species. This is particularly true in riparian areas.

Burning is only effective if the root sprouts are controlled by other methods, such as chemicals, when they resprout after the burn.

#### Biological

Blackberry leaf rust fungus (*Phragmidium violaceum*) was discovered in 2005 on the coast of Oregon and has since spread through most of the counties. It appears to have been accidentally introduced. It partially to fully defoliates Himalaya blackberry and evergreen blackberry (*Rubus laciniatus*) and also reduces tip rooting. The fungus is native to Europe, the Middle East and Africa and has been used for years to control native blackberry plants in Australia and New Zealand. It is not an approved biocontrol agent yet and has not shown sustained control of Himalaya blackberry over a wide region.

#### CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference. Excellent control information, both chemical and non-chemical, can be obtained

at <http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7434.html#MANAGEMENT> and <http://extension.oregonstate.edu/catalog/pdf/em/em8894.pdf>.

#### GROWTH REGULATORS

Dicamba	<b>Rate:</b> 1 to 2 pt product/acre (0.5 to 1 lb a.e./acre)
Banvel, Clarity	<b>Timing:</b> Postemergence, to weed regrowth in the late summer or fall following a mowing or tillage treatment.  <b>Remarks:</b> Dicamba provides only suppression of growth. It is a broadleaf-selective herbicide often combined with other active ingredients, particularly 2,4-D. Tank mix combinations with glyphosate are also more effective. It may injure grasses at higher rates. Do not apply when outside temperatures exceed 80°F. Do not exceed 64 oz product/acre per year.
Fluroxypyr	<b>Rate:</b> 22 oz product/acre (7.7 oz a.e./acre)
Vista XRT	<b>Timing:</b> Postemergence when target plants are growing rapidly.  <b>Remarks:</b> Reduced control occurs if plants are under stressed growth conditions.
Triclopyr	<b>Rate:</b> Broadcast foliar treatment: 4 pt product ( <i>Garlon 4 Ultra</i> )/acre (2 lb a.e./acre). Spot treatment: 0.75 to 1% <i>Garlon 4 Ultra</i> or 1% <i>Garlon 3A</i> ; thoroughly cover the foliage. Basal bark treatment: 20% <i>Garlon 4 Ultra</i> mixed with basal oil or seed oil; <i>Pathfinder II</i> is a ready-to-use triclopyr/oil mix. Dormant stem and leaf treatment: 1% v/v solution of <i>Garlon 4 Ultra</i> with 2 to 3% v/v crop oil concentrate or seed oil. For <i>Capstone</i> use 8 to 9 pt product/acre.
<i>Garlon 3A, Garlon 4 Ultra, Pathfinder II</i>	<b>Timing:</b> Postemergence in mid-summer or early fall after flowering and start of fruit set. Basal bark applications can be made almost any time of the year, even after leaves have senesced (aged, dried, and fallen from plant). In areas where people frequently harvest the fruit of wild blackberries, a mid-fall basal bark treatment might be desirable to avoid human contact with the chemical. For dormant stem and leaf treatment apply to dormant leaves and stems in late fall and winter in a 3% crop oil concentrate mixture. Spray the plant until it is thoroughly wet but not to the point of runoff. Like basal bark treatments, the timing of this technique prevents human contact with the herbicide during berry-picking season.  <b>Remarks:</b> Foliage or stems (dormant stem application) must be thoroughly wet. Triclopyr is broadleaf-selective and safe on most grasses. It is most effective on smaller plants and has little or no residual activity. For basal bark treatment, thoroughly cover a 12 to 15-in basal section of the stem with spray but not to the point of runoff. <i>Garlon 3A</i> and other amine formulations are registered for aquatic use. Ester formulations (e.g., <i>Garlon 4 Ultra</i> ) may volatilize if applied in warm temperatures. Application in some counties and grape-growing areas may be restricted. Sometimes aminopyralid + triclopyr ( <i>Capstone</i> ) or glyphosate and triclopyr (1% solution each) are used to achieve better control.
Aminopyralid + triclopyr ( <i>Capstone</i> )	

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate	<b>Rate:</b> Broadcast foliar treatment: 2 to 3 qt product ( <i>Roundup ProMax</i> )/acre (2.25 to 3.4 lb a.e./acre). Spot treatment: 0.5 to 1.5% v/v solution.
<i>Roundup, Accord XRT II</i> , and others	<b>Timing:</b> Postemergence in late summer to early fall when canes are growing rapidly, have reached full

succulent foliage will not entirely be killed by fire, even if enough fuel was available to carry a burn. Grazing is also not a recommended control option, particularly on sensitive dunes.

#### Biological

There are currently no biological controls for *Carpobrotus edulis* or any other species of iceplant. The iceplant scale insects, *Pulvinariella mesembryanthemi* and *P. delottoi*, have a small impact on some individuals, but would likely not be useful as a control tool.

#### CHEMICAL CONTROL

The following specific use information is based on reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### GROWTH REGULATORS

Aminocyclopyrachlor +  
chlorsulfuron  
*Perspective*

**Rate:** 4.75 to 8 oz product (*Perspective*)/acre

**Timing:** Postemergence and preemergence. Postemergence applications are most effective when applied to plants from the seedling to the mid-rosette stage.

**Remarks:** *Perspective* provides broad-spectrum control of many broadleaf species. Although generally safe to grasses, it may suppress or injure certain annual and perennial grass species. Do not treat in the root zone of desirable trees and shrubs. Do not apply more than 11 oz product/acre per year. At this high rate, cool-season grasses will be damaged, including bluebunch wheatgrass. Not yet labeled for grazing lands. Add an adjuvant to the spray solution. This product is not approved for use in California and some counties of Colorado (San Luis Valley).

#### AROMATIC AMINO ACID INHIBITORS

Glyphosate  
*Roundup, Accord XRT II,*  
and others

**Rate:** Broadcast foliar treatment: 1.3 qt product (*Roundup ProMax*)/acre (1.46 lb a.e./acre). Spot treatment: 1.5 to 2% v/v solution

**Timing:** Because of the succulent nature of the plants, it is best to apply the herbicide at a time when the plant is rapidly growing.

**Remarks:** Glyphosate is the only chemical option registered in California that has been shown to effectively kill *Carpobrotus edulis* or other iceplant species. The addition of 1% surfactant can increase the effectiveness of the herbicide. Since glyphosate is nonselective, it may be more appropriate to use a shielded sprayer or even a wiper application technique at 50% concentrate of the herbicide.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

This WEED REPORT does not constitute a formal recommendation. When using herbicides always read the label, and when in doubt consult your farm advisor or county agent.

This WEED REPORT is an excerpt from the book *Weed Control in Natural Areas in the Western United States* and is available wholesale through the UC Weed Research & Information Center ([wrlc.ucdavis.edu](http://wrlc.ucdavis.edu)) or retail through the Western Society of Weed Science ([wsweedscience.org](http://wsweedscience.org)) or the California Invasive Species Council ([cal-ipc.org](http://cal-ipc.org)).

*Ammophila arenaria* (L.) Link.

## European beachgrass

**Family:** Poaceae

**Range:** Coasts of central to northern California and the Pacific Northwest; coasts of the central eastern states.

**Habitat:** Coastal dune systems. Populations may extend inland for half a mile or more.

**Origin:** Native to northern Europe. Originally planted along the Pacific coast from the late 1800s to the mid-1900s for sand stabilization, European beachgrass has since invaded nearly every major dune system in California.

**Impacts:** Populations trap blowing sand, building dunes into steep slopes which do not support native coastal vegetation. Dense stands also outcompete other species and provide poor habitat for wildlife.

**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



European beachgrass is a clumping perennial grass to 4 ft tall, with coarse, tough foliage and long thick rhizomes. Its stems and leaves are erect and rigid. It produces long, hard, scaly rhizomes both horizontal and vertical, mostly within the top 8 inches of sand. When the population traps sand, the rhizomes are buried deeper. This further stimulates rhizome growth and shoot production, which further increases sand deposition. Plants that are not continually accumulating sand may senesce and decompose slowly, or can persist as large, living, stable clumps for decades.

European beachgrass reproduces both from rhizomes and seed. Dormant rhizome fragments survive long periods of submersion in ocean water and disperse with ocean currents. It flowers in summer, producing dense, cylindrical panicles 6 to 12 inches long. Seed viability and seedling establishment are typically low and seedlings are rarely encountered.

### NON-CHEMICAL CONTROL

**Mechanical** (pulling, cutting, disking) Plants can be removed manually with a two-year program. Begin removal in March, as plants emerge from dormancy. Rhizomes must be dug to a depth of 8 inches, and removal must be repeated as resprouts emerge — as many as 8 removals during the first season and again during the second season. This method is expensive but allows conservation of relict native species. Removing young plants before they become well established can prevent spread and more expensive control programs.

In suitable circumstances, heavy equipment can be used for initial removal, to be followed by manual removal. Deep ripping to 3 ft has been found to be an effective first step.

**Cultural** Burning does not control beachgrass but by removing the tops may allow easier access for mechanical removal or herbicide application. One study reports effective control using a fall burn to remove beachgrass tops, followed by treating resprouts with glyphosate in the following season.

**Biological** There are no biological control agents available for the management of European beachgrass.

### CHEMICAL CONTROL

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

#### AROMATIC AMINO ACID INHIBITORS

**Glyphosate** Rate: 8% to 10% v/v solution (*Roundup ProMax*) as a spot treatment, 33% to 50% v/v solution as a wiper

*Roundup, Accord  
XRT II, Rodeo, and  
others*

solution

**Timing:** Postemergence to non-dormant plants during active growth.

**Remarks:** Glyphosate is a nonselective herbicide. It has no soil activity. With *Rodeo*, use a non-ionic surfactant (0.5% to 1.5% in spot treatments, 1% to 2.5% in wiper treatments). Effectiveness may be increased by addition of ammonium sulfate. Standing dead biomass may still have to be removed to allow revegetation. This treatment is only marginally effective and most land managers find better control when glyphosate is tank mixed with imazapyr.

#### BRANCHED-CHAIN AMINO ACID INHIBITORS

Imazapyr

**Rate:** 2 to 3 pt product/acre (0.5 to 0.75 lb a.e./acre)

*Habitat, Arsenal,  
Stalker, Chopper,  
Polaris*

**Timing:** Best when applied pre- or postemergence in fall or spring to non-dormant plants. Applications in fall may be most effective. Some areas allow application only from September to February due to the presence of snowy plovers, an endangered species.

**Remarks:** Imazapyr is a nonselective herbicide. It also has a relatively long soil residual activity and may have longer-term effects on the plant community.

Imazapyr +  
glyphosate +

**Rate:** 2% *Roundup ProMax* or other trade name with similar amount of active ingredient + 1% *Habitat* v/v solution for spot treatment.

*Habitat, Arsenal, or  
Polaris + Roundup  
and others*

**Timing:** Postemergence in fall or spring to non-dormant plants. Applications in fall may be most effective.

**Remarks:** This combination appears to have improved efficacy and fewer negative effects compared to imazapyr alone. This tank mix is often used because the quicker response to glyphosate indicates that the application was successful. Success of treatment is enhanced with multiple applications per year.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al. 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California. 544 pp.

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*Ulex europaeus* L.

## Gorse

**Family:** Fabaceae

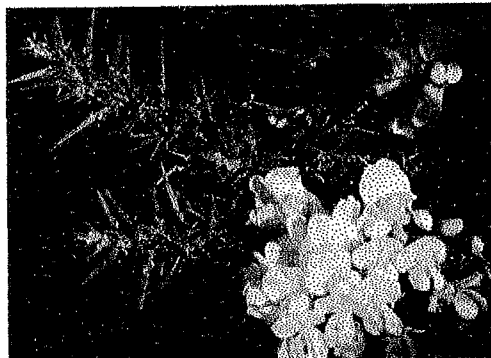
**Range:** Although gorse occurs along the Atlantic coast from Virginia to Massachusetts, it is most prevalent along the Pacific coast from California to British Columbia and is also found at high elevation on two Hawaiian Islands.

**Habitat:** Grasslands, shrublands, forest margins, coastal habitats and disturbed sites such as roadsides, pasture lands, gravelly floodplains, burned areas, and cleared forests. Grows well on shady slopes with high soil moisture and good drainage. Frost-damaged plants can resprout from the crown. Does not survive severely cold winters or arid climates. It grows best on acidic soil and tolerates many soil types, including serpentine, but seldom grows in high calcium soils.

**Origin:** Native to western Europe and introduced as an ornamental or hedge shrub.

**Impacts:** Gorse often forms dense, impenetrable thickets that exclude desirable vegetation and increase fire risk. Mature plants contain about 2 to 4% flammable oils. Gorse can fix nitrogen, enabling the plant to colonize and dominate areas with poor soil. The plant also produces abundant leaf litter that can acidify the upper soil layers. Soil is often bare between individual plants, increasing erosion on steep slopes where gorse has replaced grasses or forbs. Plants are spiny and mostly unpalatable when mature, thus reducing pasture quality.

**Western states listed as Noxious Weed:** California, Oregon, Washington  
**California Invasive Plant Council (Cal-IPC) Inventory:** High Invasiveness



Gorse is a dense, spiny, evergreen shrub to 5 ft tall, with yellow, pea-like flowers. The stems are highly branched, alternate and terminate with a green spine 1.5 to 2.5 inches long. Juvenile plants have soft, grey-green stems with trifoliate leaves. Mature shrubs appear leafless with simple leaves modified into stiff, curved, awl-like spines 0.25 to 1 inch long. Spines and leaves have a waxy coating and end in a sharp yellow point. Gorse has an extensive, lateral root system that contains nitrogen-fixing root nodules.

Plants begin flowering from 18 months to 3 years of age. Reproduction is by seed which are produced in small, hairy pods 0.5 to 0.75 inches long. Pods become black when mature, and upon drying, disperse seeds by ejecting them several feet from the plant. Seeds can remain viable in the soil for up to 30 years. Large soil seedbanks often accumulate, making long term control difficult. Shrubs may live for up to 30 years.

### NON-CHEMICAL CONTROL

<b>Mechanical</b> (pulling, cutting, disking)	Hand pulling can remove seedlings and small shrubs, but once established this technique is generally not effective.
	Cutting gorse off before it flowers will reduce seed production and deplete the plant's energy reserves. Resprouts are common after treatment. Cutting should be combined with an herbicide treatment or with multiple cuttings over a period of years. Cut shrubs at ground level with power or manual saws.
	Heavy equipment can be effectively used to control gorse in areas where soil disturbance and nonselective species removal are not important considerations. Stumps that remain following such treatment will require herbicide application to prevent regrowth.
<b>Cultural</b>	Repeated grazing by goats and/or sheep can greatly reduce seedling establishment and crown regrowth. In a long-term study, the best control of gorse was achieved by first burning gorse stands, followed by grazing goats or a 2:1 mix of goats and sheep at 10 or more animals/acre. On areas of unburned gorse, sustained goat stocking for 4 to 5 years provided good control in some situations. Once animals are removed, new seedlings must be controlled.

Burning alone does not kill the root system and resprouts are common after treatment. Burning often stimulates a flush of seedling germination after the first rains. Following a burn with herbicide application provides good control.

**Biological**

The gorse seed weevil (*Exapion ulicis*) and spider mite (*Tetranychus lintearius*) are biocontrol agents that have become established in California. The seed weevil reduces seed production but cannot kill established stands. The seed weevil was first introduced to New Zealand in 1931, and was widely established by 1935. It has destroyed approximately 35% of the seed crop annually since then. Heavy mite (*Tetranychus lintearius*) infestations can kill branches and reduce overall plant vigor and are apparent by the dense webbing that covers the foliage.

**CHEMICAL CONTROL**

The following specific use information is based on published papers and reports by researchers and land managers. Other trade names may be available, and other compounds also are labeled for this weed. Directions for use may vary between brands; see label before use. Herbicides are listed by mode of action and then alphabetically. The order of herbicide listing is not reflective of the order of efficacy or preference.

**GROWTH REGULATORS**

**Picloram** **Rate:** Broadcast treatment: 1 to 2 qt product/acre (0.5 to 1 lb a.e./acre). Spot treatment: 0.5% v/v solution and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves.

**Tordon 22K**

**Timing:** Postemergence foliar treatments are best when plants are growing rapidly at or beyond early to full bloom stage.

**Remarks:** High levels of picloram can give long-term soil activity for broadleaves. Picloram is a restricted use herbicide. It is not registered for use in California.

**Triclopyr**

**Garlon 3A, Garlon 4 Ultra, Pathfinder II**

**Rate:** Low volume spot treatment: 0.5 to 2% v/v solution of *Garlon 4 Ultra*, or 0.5 to 2% *Garlon 3A* and water plus 0.25 to 0.5% v/v surfactant to thoroughly wet all leaves. Cut stump treatment: 25% *Garlon 4 Ultra* in 75% oil carrier, or undiluted *Garlon 3A* or 50% *Garlon 3A* in water. Basal bark treatment: 20% *Garlon 4 Ultra* in 80% oil carrier, or undiluted *Pathfinder II* as a ready-to-use formulation. Basal cut stump treatment: 25% *Garlon 4 Ultra* in 75% oil carrier.

**Timing:** Postemergence when plants are growing rapidly. Cut stump, basal cut stump, and basal bark treatments can be applied anytime as long as the ground is not frozen, but are best used in late summer or early fall.

**Remarks:** Triclopyr is a selective herbicide for broadleaf species and will not damage desirable grasses growing nearby. For cut stump treatments, cut stems horizontally at or near ground level, and immediately apply herbicide solution. Suckering from the roots typically occurs after cutting, but the treatment should control most resprouts. Basal bark treatment: spray the lower trunk, including the root collar, to a height of 12 to 15 inches from the ground; the spray should thoroughly wet the lower stem but not to the point of runoff. Plants should not be cut for at least 1 month following basal bark treatment.

**Triclopyr + 2,4-D**

**Crossbow**

**Rate:** Spot treatment: 1 to 1.5% v/v solution of *Crossbow* and water to thoroughly wet all leaves.

**Timing:** Postemergence when plants are growing rapidly.

**Remarks:** *Crossbow* in water forms an emulsion (not a solution), and separation may occur unless the spray mixture is agitated continuously.

**AROMATIC AMINO ACID INHIBITORS**

**Glyphosate**

**Roundup, Accord XRT II, and others**

**Rate:** Spray-to-wet spot treatment: 1.5 to 2% v/v solution of *Roundup ProMax* (or other trade name with similar concentration of glyphosate) in water to thoroughly wet all leaves. Low volume spot treatment: 5 to 10% v/v solution of *Roundup* (or other trade name) in water. Spray coverage should be uniform with at least 50% of the foliage contacted. Cut stump treatment: undiluted product or 50% v/v in water.

**Timing:** Postemergence when plants are growing rapidly. Foliar treatments should be made in late summer or early fall. For cut stump treatment, application in late summer, early fall or dormant season provides best control. Treatment should occur immediately after cutting.

**Remarks:** Nonselective systemic herbicide; gives good control with some resprouts. Plants should not be cut for at least 4 months after foliar treatments. Cut stump applications are as described for triclopyr.

**BRANCHED-CHAIN AMINO ACID INHIBITORS**

**Metsulfuron**      **Rate:** Broadcast foliar treatment: 1 oz product/acre (0.6 oz a.i./acre) plus 0.25% v/v surfactant.

**Escort**            **Timing:** Postemergence foliar treatments are best when plants are growing rapidly at or beyond early to full bloom stage.

**Remarks:** Although metsulfuron has some preemergent activity, best results are generally obtained when applied to the foliage during active growth. Metsulfuron is not registered for use in California.

**RECOMMENDED CITATION:** DiTomaso, J.M., G.B. Kyser et al, 2013. *Weed Control in Natural Areas in the Western United States*. Weed Research and Information Center, University of California, 544 pp.